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Table of Contents

Production Functions in Major League Baseball: A Star Input Method

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ABSTRACT

This is an empirical investigation of the winning function in major league baseball. As more star players are added to a team by signing free agents, the winning percent for that team first increases at an increasing rate but eventually at a decreasing rate. In Rodney Fort's *Sports Economics* textbook, this theoretical production curve is shown graphically for major league baseball but is not estimated with a regression model. This is surprising because a production function is not only important on its own, but it also plays a significant role in supporting the shapes of subsequent cost and profit functions in Fort's text. In this paper I empirically estimate the winning function by identifying and summing the star hitters and pitchers by team, and then correlating these numbers to team win percents. I define a star player as one with a slugging percentage or on-base percentage one standard deviation above the league average for starting players. Star pitchers and relievers will be similarly defined. I aggregate ten years of league cross-sections (2002-11), and investigate several alternative functional forms. The key issue is whether the estimated parameters of a given functional form support the theoretical curvature shown in *Sports Economics.*

INTRODUCTION

Rodney Fort's leading sports economics textbook shows a theoretical production function featuring star players as team inputs and wins as team output (Fort, 2011, p. 100). Using hypothetical data for Major League Baseball, its shape shows increasing returns and then diminishing returns to the number of stars. This underlying production function plays a key role in his development of long run cost curves for professional sports teams. But there is no formal empirical model testing the shape of the production shown in the text. This is surprising because a production function is not only important on its own, but it also plays a significant role in supporting the shapes of subsequent cost and profit functions in Fort's text. In this paper I will estimate the winning function for professional baseball using a unique measure of star players.

BACKGROUND

There will be a distinction drawn between two types of sports production functions. The first is a "team-based" production function because it arises out of a desire to empirically test hypotheses about the role different team-based inputs play in determining team success. These production functions are common in the literature, going back to 1974 (Scully), in which team winning percent (W) is specified as a multivariate

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function W = f(team hitting, team pitching, team standings, end-of-season team contention variables). Building on Scully, several authors use regression models to investigate the marginal revenue product of hitting versus pitching (MacDonald and Reynolds, 1994), the marginal product of batting average versus slugging average (Zech, 1981), the effect of managerial ability on winning (Porter and Scully, 1982), the effect of team racial composition on winning (Hanssen, 1998), and the evidence for Moneyball (Hakes and Sauer, 2006; Farrar and Bruggink, 2011). Winning percent functions based on team inputs have evolved over the years in baseball, including the use of newly created statistics replacing more traditional measures of hitting and pitching. Similar production functions are investigated in basketball (Chatterjee, Campbell, and Wisemen, 1994), football (Hadley, Poitras, and Ruggiero, 2000), soccer (Carmichael, Thomas, and Ward, 2001) and hockey (Leard and Doyle, 2011), to test hypotheses on home field advantage, team efficiency, and the effectiveness of coaching ability.

I call the second type of sports production function the "player-based" production function. This provides the two-dimensional production function found in Fort's sports economics text. It is a special version of the standard production function found in any introductory economics textbook. For sports, however, team output is winning percent, and the number of *star* players is on the horizontal axis. The reason for star players as the labor input rather than simply the number of players is that all teams put nine players on the field, so there is no variation from team to team. In Fort's *Sports Economics* the production curve has the same shape as in the introductory economics texts. Yet other than a pedagogical article (Bruggink, 1993), there is no literature or empirical estimation on the player-based production functions for sports. This player-based production function is the focus of this study, and the theory behind the shape of the curve will be discussed in the next section.

THEORY FOR THE PLAYER-BASED PRODUCTION FUNCTION

The theoretical production function for winning uses star players as its variable input. As more star players are added by signing free agents, total product (winning percentage) increases first at an increasing rate but eventually at a decreasing rate. Why does winning function first increase at an increasing rate? One star player does little to help a horrendous team. The opposing team could always just pitch around him in critical situations. And if the lone star did get a good pitch there frequently are not any teammates on base. A second star adds an incrementally *higher* amount to team winning percentages because when the lineup contains two star hitters, opposing pitchers are less likely to pitch around the first one or walk him intentionally. However, if more and more stars are added and the team's winning percent is already high, the increments to winning diminish. When a team already has star players at every position and the pitching staff has six first-rate starters and several ace relievers, the rules of baseball constrain the marginal contributions of additional stars (they cannot all play at once).

It is a peculiarity of sports that the production function has a long run upper limit. Wins cannot exceed the fixed number of games for a season. As a more practical approach Fort puts the upper limit at 70% wins. This approximates the highest win percent ever attained in modern baseball. The win percents associated with Fort's production function are taken from a table in his textbook (p. 100), and in Table 1 the change in percent wins of each star player is also calculated. In Fort's hypothetical production function, the win percent of a team with no star players is 42%. Each additional star player adds higher amounts to percent wins until the seventh star player. At this point the increases to talent decline. Fort attributes this decline to "Limits to managing more and more stars must be the explanation for diminishing returns." (p.101), although additional reasons are provided below. However this explanation neglects the fact that only nine players are on the field at a given time. This fixed input compromises the assumptions of a long run production function, but works as a better explanation for the diminishing returns than manager inefficiency.

Table 1 Fort's Hypothetical Winning Percent for MLB

stars	win pct	change
0	42	-
1	42.9	0.9
2	44.8	1.9
3	46.6	1.8
4	49	2.4
5	52.8	3.8
6	59.8	7
7	64.6	4.8
8	68	3.4
9	69.5	1.5
10	70	0.5

Fort's win production curve is not technically a long run curve because in sports some inputs remain fixed by the rules of the game: the number of players on the field and on the roster, the number of games in a season, the length of the games, etc. The consequence is a maximum on input and output possibilities, and therefore diminishing returns remains as an outcome in the long run.

The functional form is not specified, but Fort describes the curve as one that "increases at a decreasing rate" after seven stars are on one team (Fort, p. 100). The earlier part of the curve shows increasing at an increasing rate. Theory does not suggest the degree of the polynomial that will best describe the shape of this production function. For this reason the following theoretical shapes will be included for comparison, here $winpct_{it}$ is the winning percent for team i in year t and $tstars_{it}$ is the number of stars on team i in year t:

1. $winpct_{it} = B_0 + B_1\, tstars_{it} + B_2\, tstars_{it}^2 + B_3\, tstars_{it}^3$
2. $winpct_{it} = B_0 + B_1\, tstars_{it} + B_2\, tstars_{it}^2 + B_3\, tstars_{it}^3 + B_4\, tstars_{it}^4$
3. $winpct_{it} = B_0 + B_1\, tstars_{it} + B_2\, tstars_{it}^2 + B_3\, tstars_{it}^3 + B_4\, tstars_{it}^4 + B_5\, tstars_{it}^5$

Each of the above polynomials can provide a curve that is increasing at an increasing rate, and then increasing at a decreasing rate, depending on the magnitudes and signs of the coefficients.

DATA SELECTION PLAYER-BASED PRODUCTION FUNCTION

In the previous section the theoretical production function provided by Fort sets the stage for the rest of this paper. He defends the hypothetical data to generate the curve as

> "…an intuitive snapshot of the relationship between adding stars and winning; it is not the result of any more extensive analysis than you just have read."(p.100)

This study will empirically estimate the production function for baseball by identifying and summing the star hitters and pitchers by team, and then correlating these numbers to team win percents. Star players are not defined by Fort but described as "a cut above the average player" (p. 100). I believe a player with *one standard deviation above average league performance* captures this simple definition of a star. This ensures a limited number of players designated as stars (17% of the rosters), while marking the player as one of statistical distinction. This definition is somewhat unique in that it does not rely on official league designations to identify stars ("All-Stars"), nor does it recognize prior performances or reputation. A discussion on the sample design is next.

First I identify a pool of active players over the years 2002-2011. The stars chosen from this pool will have a minimum number of at-bats (AB) or innings pitched (IP) beyond what it takes to initially qualify for this pool, and will have an important performance statistic that is one deviation from the weighted average in the pool.

Players with a more than trivial participation in a given season form this initial pool. For hitters in this initial pool, this will be at least 100AB in a season, resulting in about half of all hitters listed on *mlb.com* for a given season. For starting pitchers I take players with at least 40 IP and for relievers at least 30 IP. These arbitrary cutoffs again take about half of the starting pitchers and half the relievers listed on mlb.com as having participated in a given season. Players designated as stars, however, must have more participation than just these active players. Star hitters must have at least 300 AB, starting pitchers must have at least 80 IP and relievers must have at least 40 IP to be selected from the initial pool. This second set of cut-offs is also arbitrary.

Players designated as star hitters will be those with an on-base-percentage (OBP) or slugging percentage (SLG) one standard deviation higher than the pool average in their league. Star pitchers will be those with an *opposing* OBP or SLG one standard deviation below the pool average in their league. Both the means and the standard deviations are weighted by either at-bats or innngs pitched. To summarize, for purposes of this paper a star player in a given season is defined by one of the following:

1) a hitter with at least 300 AB and an OBP or SLG one standard deviation above the weighted average for all players in that league with at least 100 AB.

2) a starting pitcher with at least 80 IP and an opposing OBP or SLG one standard deviation below the weighted average for all starting pitchers in that league with at least 40 IP.
3) A relieving pitcher with at least 40 IP and an opposing OBP or SLG one standard deviation below the weighted average for all relievers in that league with at least 30 IP.

The consequences of this definition include:

1) a player considered a star over his career might not be a star every season.
2) a player who performs a key role in his team's success but does not have the sufficient AB or IP will not be acknowledged.
3) a player with an impressive number of runs batted in, home runs, stolen bases, etc., might not be identified as a star.
4) an admirable performance by a player might still miss the one standard deviation cut-off for OBP or SLG.
5) stars with performances two standard deviations above the league average are counted the same as players with just barely over one standard deviation.

Although these consequences are disappointing they are not devastating to my investigation.

Table 2 shows the summary statistics for the total number of stars in the sample, as well as the star players disaggregated by type. Based on the last ten years, the mean stars per team is a little more than four. This breaks down to nearly two hitters, slightly over one starting pitcher, and little over one reliever.

Table 2 Sample Statistics—Stars per Team

Variable	Obs	Mean	Std. Dev.	Min	Max
Star hitters	300	1.89	1.329051	0	7
Star starters	300	1.05	0.9507082	0	5
Star relievers	300	1.33	1.133748	0	6
Total stars	300	4.27	2.246265	0	12

The scatter diagram below (Figure 2) illustrates the data from which the curvature fits will be estimated. Three observations are relevant here. First, there is considerable variation in percent wins for each number of star players per team. This warns of a lack of precision in estimating any functional form. Second, beyond seven stars, the number of observations falls dramatically. This signals particular challenges in using a regression model to verify Fort's hypothetical shape for teams with eight or more stars. This means I will focus on teams with up to seven stars only. Third, there are only six outlying data points in the sample.

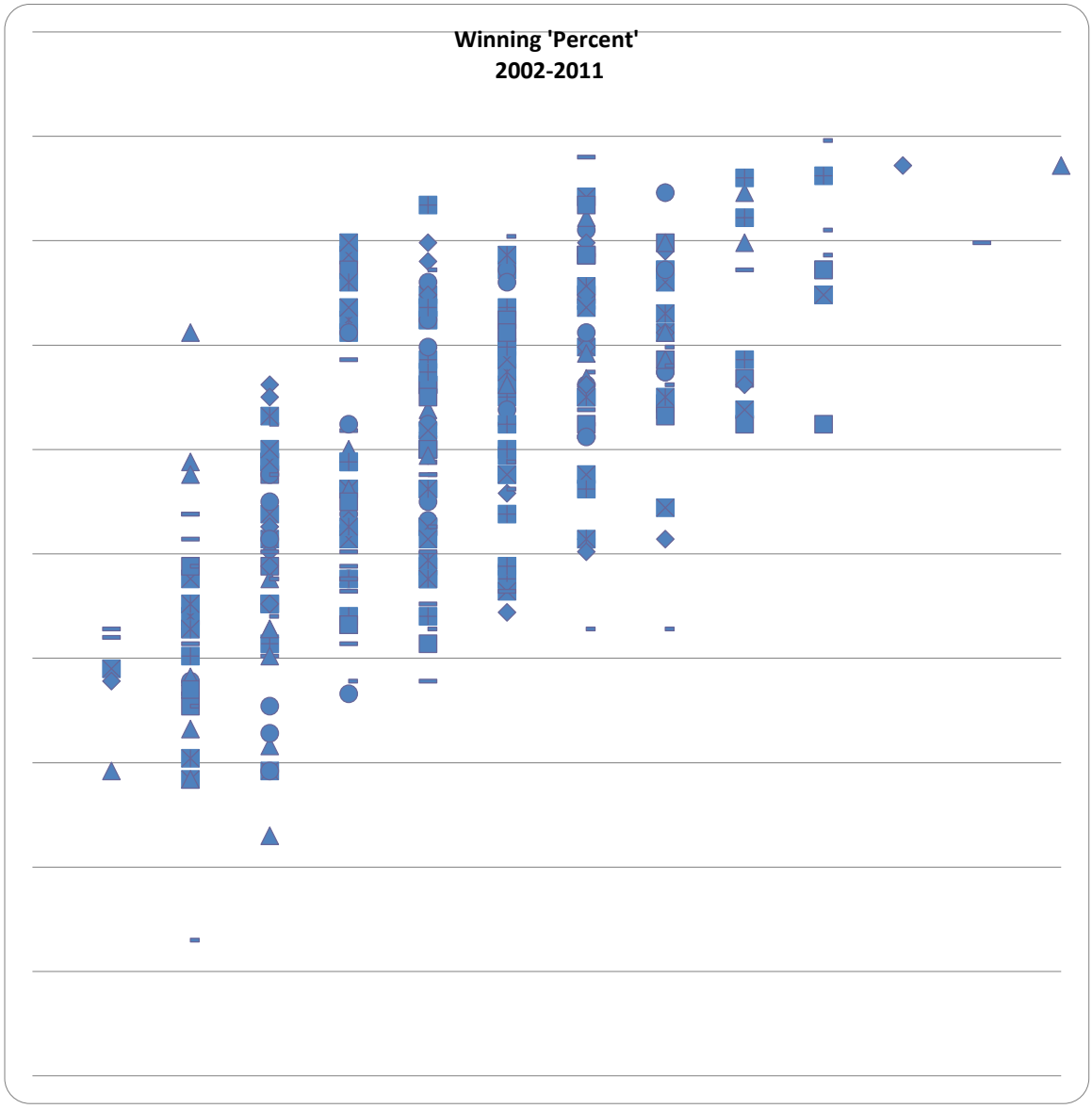
RESULTS FOR THE PLAYER-BASED PRODUCTION FUNCTION

The regression results for the three specifications discussed earlier are shown in Table 3. The variable tstars is the total number of star hitters and star pitchers on each team. The dependent variable pctwin is the team percent wins expressed on a scale from 0 to 1000, where 1000 represents 100 percent

(for example 620 is 62% wins). This is done for convenience and as a concession to the vernacular. Because multicollinearity is an issue with the tstars power terms, I will not rely on the t-coefficients to determine the case for the verification of Fort's production function.

The overall R^2 fit of roughly 50% and the typical error of 51 (5.1 percentage points) reflects the wide variation in wins for each star level seen in the scatter diagram. This sobering result hampers the type of specificity that is the goal of this research. I begin with one overall declaration: all three specifications show diminishing returns of wins with respect to the number of star players, but only the degree five regression supports Fort's particular shape of increasing, then decreasing returns.

Figure 2 Scatter Diagram for 2002-2011



Number of Star Players

Table 3 Regression Results for the Player-Based Winning Function

Variable	Degree 3 Coeffcient	Degree 4 Coefficient	Degree 5 Coefficient
Intercept	374.8	381.4	392.8
tstars	43.2	33.8	6.48
tstars^2	-3.34	0.556	16.8
tstars^3	0.127	-0.416	-4.29
tstars^4		0.0244	0.416
tstars^5			-0.0139
RMSE	51.2	51.3	51.3
R-sq	0.495	0.495	0.497
Adj R-sq	0.490	0.488	0.489

In Figure 3, I plot the degree five regression over a typical range of seven star players. At first one sees growing increases in percent wins, but with the fourth star player, the increases decline. The size of these increases is revealed in Table 4. The first three star players add 1.94%, 3.27 %, and 3.31% increases in percent wins, followed by a 2.72% increase for star player four. Increases begin to sharply fall off with players five to seven (2.0%, 1.49%, and 1.34%, respectively).

The empirical results for the cubic and degree four equations fail to support the particular shape of Fort's textbook production function. Diminishing returns begin immediately. Although these production curves cannot be ruled out as being true winning functions, the conclusions will only discuss the winning function for the degree five equation.

CONCLUSION

There is empirical support for the general shape of Rodney Fort's baseball production function shown in his popular sports economics textbook. One key issue is whether the rate of increase rises at first before falling. In the *Sports Economics* text the rate of increase starts to decline with the addition of the seventh star player. My empirical results shows the rate of increase declines starting with the fourth star player, and the increases fall sharply thereafter. Only the fifth degree polynomial equation supports Fort's shape, but the regression for the cubic and fourth degree regressions have the essentially the same measure of statistical fit. In other words the data does not reveal a superior fit between the degree three, four, or five functional forms.

To my knowledge until now no one has attempted to statistically measure a player-based production function in any sport. I present detailed empirical evidence that support of Fort's hypothetical production function for baseball, although my results suggest some alteration in the shape to more closely align his hypothetical curve with my empirical curve. This has important implications in using these empirical outcomes to predict the benefits of acquiring additional star players and in generating long run cost curves

for teams. Finally, this approach has potential for a new avenue of research in not only baseball but in all competitive sports.

Figure 3 Predicted Winning 'Percent' Winning Function from Degree 5 Regression

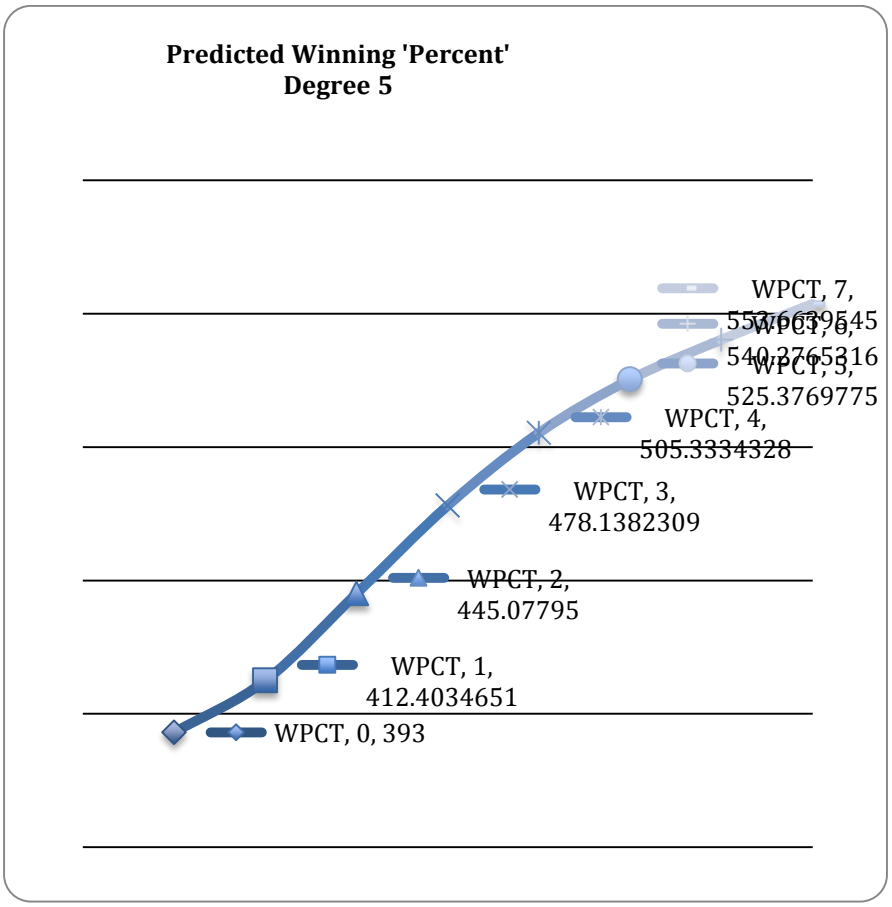


Table 4 Estimated Winning 'Percent' from Degree 5 Regression (divide by 10 for actual winning percent)

stars	'win pct'	change
0	393.0	-
1	412.4	19.4
2	445.1	32.7
3	478.1	33.1
4	505.3	27.2
5	525.4	20.0
6	540.3	14.9
7	553.7	13.4

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Implications of Deposit Rate Deregulation of U.S. to China

Junwei Chen*

ABSTRACT

This paper uses both VAR and VECM to analyze the impacts of deposit rate liberalization in U.S., showing that it would increase mortgage rate and decrease GDP growth rate for some time, but in the long run, there will be a decline in mortgage rate and real house price, and an increasing GDP growth rate. These conclusions and the similarities of reform background between China and U.S. have suggested that it is appropriate for China to follow a similar phased manner, together with the improvement of its supplementary system, such as deposit insurance and strengthening the market and banking supervision.

1 INTRODUCTION

Interest rate liberalization seems to be the inevitable course that every country would take. In July 2013, the Chinese government has announced the deregulation of loan rate, and undoubtedly the corresponding part of deposit rate continues to become an extremely heated topic this year.

In fact, since 1960s the world has already gone through 3 waves of interest rate liberalization. The one in 1960s came as a response to the large-scale capital outflow in some developed economies like Germany and France. The second one in 1970s was triggered by the consistent hyperinflation and capital disintermediation[1] in counties like U.S. and U.K., following the two oil crises. And in 1990s, the top-down interest rate reforms conducted by the government appeared in emerging economies. The experience of these countries illustrates clearly that interest rate liberalization is indeed a double-edged sword. There are many conditions needed to be considered carefully when conducting such a reform. Fortunately, history often exhibits astonishing parallels.

The United States is one of the forerunners that started this reform and completed it successfully in a phased manner. Deposit rate ceiling in U.S. was set by Regulation Q in the Banking Act of 1933 to prevent a recurrence of widespread bank failure and to lower the capital costs of banks, when the federal deposit insurance was also established. However, since 1970s, under the pressure of high inflation, various financial institutions and derivatives were developed in correspondence to investors' needs, such as the Money Market Fund (MMF). These MMFs developed quite rapidly as there was no deposit reserve requirements and no restrictions on their return. And finally, motivated by both the consistent outflow of

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deposits from commercial banks to MMFs, and financial disintermediation, Regulation Q was abolished in 1986.

China is viewed to face a similar situation now, from the comparison of inflation rate and deposit rate between China from 2000 to 2013 and US from 1970 to 1986, which was its reform period. Even though China officially started its deregulation of interest rate market in 1996, it soon came across a deflation afterwards due to the Asian financial crisis. Thus I think it would be better to compare the two rates after China got out of deflation. Here I used Consumer Price Index to calculate the inflation rate and the yield of 3-month treasury bill to represent the deposit rate, which are all in annual terms.

Figure 2.1 Inflation Rate of China & US

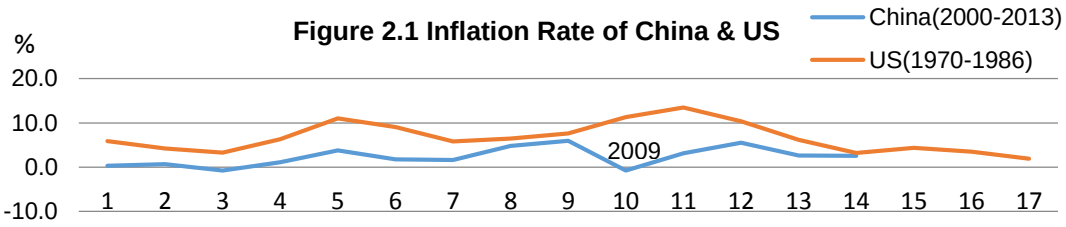
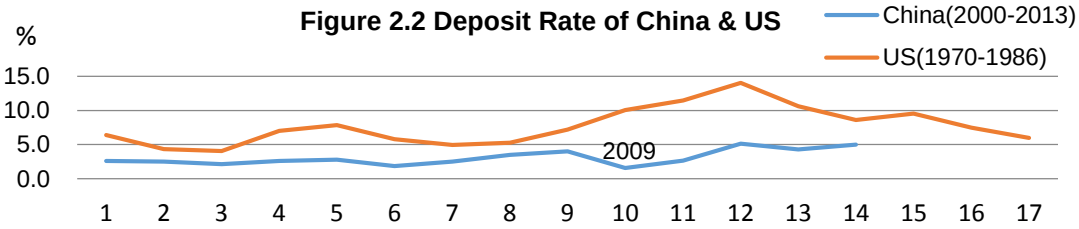


Figure 2.2 Deposit Rate of China & US



From the graphs above, it is apparent that the trends of both inflation rate and deposit rate are basically the same between China and US, only except the abrupt downturn at 2009. If there was no such a severe financial crisis at that time, we would expect a similar increasing path for the two indexes in China. This important macroeconomic background has clearly demonstrated that China has come to the point to make changes as U.S. did in the past.

On the other hand, the boom of the so-called "Baby Legion" represented by Yu'E Bao[2] in China, has also substantially increased the cost of banks to absorb deposits and even caused the movement of capital stock of banks, which is similar to MMFs in US, both resulted from a low level of deposit rate and from the pursuit of investors for higher return. The only thing needed is to change the commercial papers into large deposits of banks, but the logic is still the same. Moreover, the rapid development of Internet Finance in China also began to divert the inflows of banks. All of these non-bank financial products, which are also called shadow banks, are continuously draining stocks of banks, while the competitiveness of banks are still restricted by the deposit rate ceilings.

Driven by both the obstacles in direct financing system and the expansion of shadow banks, China is indeed going through almost the same situation as U.S. faced in 1970s. Therefore, it would be very

meaningful to study the U.S. case and get policy implications to avoid possible problems. In this paper, I will firstly review the related research of U.S., and then combine a VAR model with a VECM to discuss the mutual effects among deposit rate, mortgage loan rate, real wage, GDP growth rate and house price, as well as their policy implications for the Chinese reform.

2 LITERATURE REVIEW

The existing literature has provided lots of discussion about the deregulation of deposit rate in U.S.. The theoretical foundation originated from the theory of financial repressing & financial deepening introduced by Mckinnon and Shaw (1973). They pointed out that the regulation of interest rate would keep it at the level lower than that in equilibrium, harming the efficiency of capital and inhibiting deposits, investment and economic development. Hence they proposed financial liberalization to cure the problems of financial repressing, especially the deregulation of interest rate and exchange rate.

Keeton (1984) combined the analysis with deposit insurance and showed that the removal of deposit rate ceilings would bid up the interest rates on insured deposits, exacerbating the distortion in bank risk-taking behaviors resulted from the moral hazard problem. Meanwhile, Gilbert and Holland (1984) stated that the substantial increase in mortgage loan rate in U.S. since 1970s was not caused by the deregulation of deposit rate, but by the variability of interest rates and economic downturn.

Afterwards, Keeton (1986) continued to testify that by giving rise to availability effects of bank credits, the deposit deregulation would reduce availability effects but not enough to significantly weaken monetary policy. Moreover, Bernanke and Gertler (1995) also found that the balance-sheet effects in the credit channel of monetary policy transmission had not been eliminated in the era of deregulation and innovation, such as the impact of mortgage burden on housing demand.

Considering other countries, Kwan (2002) examines the case of Hong Kong, suggesting that banks earned rents from deposit rate rules and deregulation would lower these rents and hence bank market values. A publication from the Economic Times (2011) predicts that the deregulation of savings bank deposit interest rates announced by the Reserve Bank of India (RBI) are likely to increase the costs both for banks and borrowers and hence push up loan rate. Additionally, a report from RBI (2011) itself claims that there is no evidence of unhealthy competition among bank immediately after the deregulation and a market-based interest rate may be beneficial to savers.

As for China, a working paper from IMF (2009) using case studies and model-based simulations, finds that China already meets several preconditions for deposit rate deregulation and it will likely lead to higher interest rate, improved effectiveness of monetary transmission, and enhance the financial access of underserved sectors. More recently, Song, Storesletten and Zilibotti (2013) explores the effects of capital controls and policies regulating interest rates and exchange rate in a model of economic transition applied

to China, and shows the activist interest rate policy would benefits entrepreneurs during the transition and future works with higher wages.

Overall, as a rapidly developing country, China may also complete such a reform more quickly than some developed economies. But valuable experience tells us an orderly progressive reform with complete supporting system and relatively stable macroeconomic background are particularly crucial.

3 DESCRIPTION OF DATA AND MODELS

The data selected for this model is quarterly data of the United States from 1979 to 2013, covering the period of the world-wide financial crisis. All the data are collected from Federal Reserve Economic Data and Bureau of Labor Statistics. Table 3a below shows the descriptions for the original data I collected.

Table 3a Original Variables Used in Regression

Variable	Description
dr	Deposit interest rate, represented by the second market rate of 3-month treasury bill.
mr	Mortgage rate, represented by 30-year conventional mortgage rate.
w	The median usual weekly earnings of all workers except incorporated self employed, in current dollars, from the Current Population Survey.
gdpr	GDP growth rate of U.S..
hp	All-transactions house price index for the United States with Index 1980 Q1=100.
p	Consumer Price Index for all urban consumers of all items.

Specifically, during the first stage of interest rate liberalization from 1979 to 1981, the deposit rate showed an acceleration of increase, and then began to peak off. After 1982, capital was allocated more efficiently under the guidance of market price, decreasing the deposit rate. Recently, with the extremely weak economy and a threat of deflation, the Federal Reserve lowered short-term interest rate and brought them essentially to zero in December 2008.

Before putting them into the model, I divide the weekly wage by price to get the real wage *"rw",* as the real wage explains more about the workers' welfare than the nominal ones. Similarly, I also transform the house price into the real level of house price *"rhp"*.

3.1 VECTOR AUTOREGRESSION (VAR)

Firstly, the stationarity of each series should be checked by augmented Dickey-Fuller (ADF) unit roots test. Here I applied the ADF test with constant and trend, and found that only the series of GDP growth rate is always stationary. So I continue to test the order of integration on their first differences and find that all the five series are integrated of order one.

After testing the VAR estimation with different lags, according to both AIC (Akaike information criterion) and SIC (Schwarz information criterion), VAR with lag of 4 period is optimal and stationary. So now I can

analyze the results of this VAR estimation step by step. Also note that I am using triangular factorization and the variables are orders as [**dr mr rw gdpr rhp**]**.**

Table 3b: Granger-Causality Tests

	Dependent Variable in Regression				
Regressor	dr	Mr	rw	gdpr	rhp
dr	0.00	0.00	0.50	0.00	0.01
mr	0.39	0.00	0.92	0.21	0.13
rw	0.32	0.11	0.00	0.89	0.43
gdpr	0.00	0.02	0.45	0.00	0.80
rhp	0.95	0.54	0.06	0.18	0.00

The results of Granger-Causality test show that the deposit rate can help predict mortgage loan rate, GDP growth rate and real house price at the 1% significance level. But the test does not provide any evidence that deposit rate granger-causes real wage. On the other hand, GDP growth rate is the only one that can help predict deposit rate at 1% significance level and real house price can granger-cause real wage by at a 10% significance level. Moreover, GDP growth rate granger-causes mortgage loan rate at 5% significance level.

The impulse responses, with a horizon of 50 quarters, show clearly the direction and magnitude of changes in variables to a shock on deposit rate, such as an announcement of the relaxation in regulations. In response to a 1% increase in deposit rate, the mortgage loan rate first increases for 8 quarters and then gradually declines. Meanwhile, real wage reacts negatively to the increase in deposit rate, and its absolute magnitude starts to decrease after 7 quarters. GDP growth rate originally responds positively but immediately drops sharply to negative, and oscillates around 0. Until 11 quarters later, it returns to stay positive. Besides, the magnitude of negative impulse response of real house price keeps growing and does not fall until 15 quarters later.

Last but not least, the results of variance decomposition confirmed the relationship suggested by Granger-Causality tests. Interestingly, real wage takes the largest percentage in explaining all the other variables almost all along the 50 horizons, and deposit rate next. About half of the variance of mortgage loan rate is originally explained by deposit rate and itself, but only for 2 quarters, real wage becomes dominant. GDP growth rate has a very similar variance decomposition with mortgage rate. However, the case of real house price is a little different. As horizon extends, the part explained by itself first increases and then declines, while at least 80% is still explained by real wage and the contribution of deposit rate finally reaches about 6.5%. On the other hand, deposit rate is the only one that may have some influence on the variance of real wage, although 99% is still explained by itself.

3.2 VECTOR ERROR-CORRECTION MODEL (VECM)

After examining the mutual effects among these variables, it is also important to check whether there exists a long-run equilibrium relationship. As the variables in VECM are the first difference of original ones, the optimal lag selection should be 3. Before that, I used the Johansen tests to verify the existence of cointegration and the results indicate that the five variables are cointegrated and the rank is 1. So that I can derive the following VECM and part of the estimation output is shown below.

$$Z_t = A' y_t$$

$\triangle y_t = \delta_0 + \delta_1 \triangle y_{t-1} + \delta_2 \triangle y_{t-2} + \ldots + \delta_{p-1} \triangle y_{t-p+1} - BZ_{t-1} + \mu_t$, where Z_t is a stationary 1×1 vector

$y'_{t-i} = [\mathbf{dr}_{t-i}\ \mathbf{mr}_{t-i}\ \mathbf{rw}_{t-i}\ \mathbf{gdpr}_{t-i}\ \mathbf{rhp}_{t-i}]$, i=1,...,p-1

Table 3c: Estimation Result of VECM (Selected Part)

Variables	dr	mr	rw	gdpr	rhp
L._ce1	0.0402001*** (3.87)	0.0253783*** (3.84)	-0.0009732 (-1.55)	-0.0269485** (-2.81)	0.0002356 (0.97)
LD.dr	0.0772634 (0.437)	0.1799935** (2.84)	-0.0008939 (-0.15)	0.2096301* (2.28)	-0.0050553* (-2.18)
L2D.dr	-0.5239565*** (-5.11)	-0.1327983* (-2.04)	-0.0052615 (-0.85)	-0.3160056*** (-3.34)	0.0021099 (0.88)

Note: t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

In summary, there are five variables and rank(1) specified to estimate one equilibrium relationship. The speed of adjustment in the first equations is about 0.04, implying the speed of deposit rate at which it adjusts to the error correction term. And other speeds work in the same way. The long-run equilibrium relationship is

$$\mathbf{dr} - \mathbf{2.536456mr} + \mathbf{19.95425rw} + \mathbf{13.93706gdpr} - \mathbf{3.771821rhp} - \mathbf{63.57376}$$

This suggests that variables are all linked to deposit rate with the expected signs. But only the coefficients of mortgage rate and GDP growth rate are statistically significant at 99% confidence level. As showed above, the short-run adjustment parameter of deposit rate with lag one is 0.077 and that with lag two is -0.524, but only the latter is statistically significant. This result demonstrates that even though deposit rate adjusts most quickly among the five variables, it will still go through some oscillation before it reaches the long-run equilibrium, but not simply in a monotone adjustment path.

4 DISCUSSION OF RESULTS AND POLICY IMPLICATIONS

After going through the two models, their results are basically in accordance with the economic theory and the previous expectations. Next I will discuss their policy implications in detail.

4.1 DEPOSIT RATE & MORTGAGE LOAN RATE

The results above, especially the result that GDP growth rate granger-causes mortgage rate also confirms the conclusions of Gilbert and Holland (1984) that the increase of mortgage rate in 1970s was indeed caused by the variability of interest rates and economic downturn. On the other hand, it also verifies that the deregulation would increase the risk-taking behaviors of banks by providing more long-term credits and more mortgage lending, which can be concluded from economic theory in either a competitive national market or a market where each depository institution has some power.

Therefore, timing of deposit rate liberalization matters and it is important to keep monitoring the market fluctuations. Generally speaking, it would be more appropriate to deregulate deposit rate in an easy monetary environment with relatively high liquidity. It also reminds policymakers that a phased manner is more appropriate as it will give the government enough time to adjust other supplementary policies. Otherwise, an activist deregulation may lead to sharp swings or even a crisis.

Nevertheless, this conclusion is really important for China whose potential economic growth is still at medium or high speed and economic activities remain sensitive to interest rate changes. Moreover, experiences of many developing countries have proved that there are large sum of mid- and low-end customers in great demand of different kinds of financial services in rural areas. But the cost of providing such services is much higher than that to key accounts. Thus the fact that a deregulation of deposit rate would finally lead to a decline in mortgage loan rate will provide more advantages for development of rural finance, which has become the vein of contemporary economy in China.

4.2 DEPOSIT RATE, REAL WAGE & REAL HOUSE PRICE

Real wage seems to be uncorrelated with the other four variables. Although the long-run equilibrium relationship and the impulse response suggests that it would experience a little decline for some time, the coefficient still lacks enough significance. But it may be due to the problem of the data. It could be more meaningful if separating the labor force by occupation and check the effects of deposit rate liberalization on the real wage of each groups.

The results of the real house price is definitely a good news for Chinese government who has tried several ways to control the continuous increase and possible bubbles in housing market in China, such as house purchase quota policy. And in my model, the decrease of real house price would in turn strengthen the public purchasing power in the housing market.

Therefore, even though the results in this paper cannot clarify the effects of deposit rate liberalization on real wage, it still confirms that there will be real effects on people's benefits, helping improve some aspects of their living standards.

4.3 Deposit Rate & GDP Growth Rate

China once kept an astonishing GDP growth rate for over ten years, which recently goes down to 7.4%. The number sounds fine, but the growth rate of final demands sharply declined to only 7.0% for the first quarter in 2014. The macroeconomic statistics in August also hit a new low boundary.

Even though strong stimulations to keep steady growth such as lowering interest rate would be only temporarily effective and may lead to larger problems in the future, under such a falling economic growth rate and the boom of shadow banks, people may say deregulation of deposit rate should be postponed. However, this deregulation is not equal to an increase in deposit rate. Especially for China, where the influence of high interest rate has already been partly released due to shadow banks and other non-bank financial products, it would not necessarily deteriorate the financing environment for many enterprises and further the economic growth.

As showed above, GDP growth rate is the only one that can help predict deposit rate. From this perspective, GDP growth rate would not only become a valid index to check the achievements of interest rate liberalization, but also a good market detector signaling possible problems in the interest rate market.

5 CONCLUSION

This paper uses both VAR and VECM to examine the effects of deposit rate liberalization on mortgage loan rate, real wage, GDP growth rate and house price, showing that the deregulation of deposit rate would increase mortgage rate and decrease GDP growth rate for some time, but in the long run, it will lead to a decline in mortgage rate and house price, and also take GDP growth rate to an increasing path. But this paper cannot verify the relationship between deposit rate and real wage.

These conclusions and the similarities of reform background between China and the United States have provided much confidence in the Chinese version of deposit rate liberalization. It is appropriate for China to follow a similar phased manner with US as "long-term first, short-term later; large-scale first, small-scale later". For instance, it may be beneficial to first allow banks to increase the current floating ceilings on deposit rate from 10% to 30% or even 50%. More importantly, however, is the improvement of short boards in the supplementary system, especially when China is facing the dual pressure from the declining economic growth rate and competition with shadow banks. Deposit insurance is one of the most contributive elements in the success of U.S.. Besides, strengthening the market and banking supervision, including adjusting the balance sheet structure of commercial banks also matters, in order to avoid ruinous competition among banks and possible financial turbulence. Meanwhile, reforms of state-owned enterprises should be pushed forward to separate government power from the financing process, and the exit mechanism of financial institutions should be further improved to protect investors better and avoid the possibility of moral hazard and vicious bank runs.

In a word, deposit rate liberalization is like stepping stones, but not just simply removing its ceiling, but should be a natural accomplishment resulting from improvements of the comprehensive economic, political and operational systems. After all, practice is the only way to test the truth.

ENDNOTES

1. Disintermediation is the removal of intermediaries from a process, supply chain or market. In capital market, a common example is that by selling securities, a borrower can borrow directly from investors, by-passing banks.
2. An online investment fund which became popular in China since 2013 by offering investors better liquidity and higher rates of return.

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Portfolio Risk Reduction and Skewness Effects

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ABSTRACT

Numerous studies have suggested that more investors nowadays are incorporating skewness as a factor in the selection of equity portfolios and the composition of the optimal portfolio can be significantly affected by this factor. After comprehensive literature review on the debate of this topic and the methods in trying to incorporate skewness in portfolio optimization, the paper uses empirical data first on two-asset portfolios, then on multi-asset portfolios selected based on various criteria such as industry sectors, correlation coefficient, random pick etc., to test on the effect of skewness to the risk of the portfolio. From the experiment results generated by two-asset portfolios, we find that negative skewness is the weakest in risk reduction. Then using this discovery, the paper runs regressions on the portfolio skewness to the risk reduction of the portfolio and discovered the opposite result, the two variables are actually negatively related. This means that the more positive skewed stocks are chosen in a portfolio, the smaller the portfolio risk is reduced.

INTRODUCTION

In the past few decades, a lot of papers have been published focusing on the skewness of stock returns and a lot of them have reached to the conclusion that the distributions for the returns of individual stocks are not perfectly normal but are skewed. Before this assertion, the return distribution has always been assumed to be normal and all moments higher than two are considered irrelevant to investor's decisions under uncertainty (such as Samuelson, 1970; Rubinstein, 1973; Tobin, 1958). Later empirical studies revealed that the rate of return on equities does not yield to a symmetric probability distribution (Ibbotson, 1975; Prakash et al., 2001). Also in papers by Kraus and Litzenberger, 1976; Prakash and Bear, 1986; Stephens and Proffitt, 1991, skewness, which is the third moment, has all been identified as present in the distribution of stock returns. Later on, three papers had been written in explaining the asset skewness theoretically (Grossman, Zhou 1996; Constantinides, 1997; Bates, 1996). Hence it has been proved rigorously that higher moments such as skewness on return distributions cannot be neglected. These studies point out the importance of skewness in modern finance, as the unrealistic assumption of normal distribution is wrong.

This rising debate on skewness in stock returns has also apparently drawn attention on equity portfolio selection since individual stocks are the major elements in a portfolio. H. Markowitz made a speech in

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Baruch College when he earned the Nobel Prize in 1990 for introducing the modern portfolio theory. During the speech, he admitted that if one can overcome computational difficulties, there is "more to be done" in incorporating higher moments (i.e. third and fourth moments such as skewness and kurtosis) into portfolio modeling[1]. In his modern portfolio theory, Markowitz adopts the use of mean-variance evaluation to trade off risk and return. However, a recent study by DeMiguel, Garlappi, and Uppal (2009) shows that nowadays a lot of mean-variance (MV) portfolio models designed to reduce the effect of estimation error cannot efficiently increase return or decrease risk than any other simpler portfolios. On the other hand, some like Roman, Darby-Dowman, and Mitra (2007) try to ameliorate the MV model by introducing more risk factors. Unsatisfied at all the formal approaches, some start to look at higher moments to include into the MV model. And based on the papers discussing individual stock returns, many believed that including skewness in the MV model might make a better portfolio.

Skew, or skewness can be mathematically defined as the averaged cubed deviation from the mean divided by the standard deviation cubed. The formula is expressed as the following:

$$\text{Skewness} = \frac{\sum(x_i - \bar{x})^3}{(n-1)\sigma^3}$$

If the result of the computation is greater than zero, the distribution is positively skewed. If it's less than zero, it's negatively skewed. If the result is equal to zero then it means that the distribution it's symmetric. For interpretation and analysis, skewness is always used to focus on downside risk. Negatively skewed distributions have a long left tail, which for investors can mean a greater chance of extremely negative outcomes. Positive skew would mean frequent small negative outcomes, and extremely bad scenarios are not as likely.

Study by Arditti in 1967 shows that investors prefer positive skewness rather than negative since positive skewness means a fat tail to the right and even though this means more frequent small negative returns, it greatly decreases possibilities of extreme negative returns. On behavioral finance side, stocks with a positive skewness return distributions seem more preferable especially to risk averse investors as the distribution skew to the right and extremely negative values will rarely occur. Choosing positively skewed stocks hence may significantly decrease the risk of the portfolio. However, this assumption is yet lack of empirical support and the exact effect of skewness to portfolio return and risk is still under discussion. It is still not clear if one should include as many positively skewed stocks as possible or if there should be a combination of both positive and negative in order to optimize the portfolio. The discoveries of the effect of skewed stocks in a portfolio shed lights to those who want to improve the original portfolio theory by including higher moments. It inspired the mean-variance-skewness model seekers by optimizing the skewness to an either positive of moderate level. Many methods have incorporated this optimization concept in their model.

This paper will first look at different methods used in formulating a mean-variance-skewness model on portfolios and then use empirical data to study the behavior of portfolio skewness on portfolio risk reduction.

COUNTER ARGUMENTS ON SKEWNESS PERSISTENCY OVER TIME

Many recent studies show that the market return distribution is constantly positively skewed. However, the studiy shown by J. Clay Singleton and John Wingender (1986) indicates that the skewness of individual stocks and portfolios of stocks does not persist across different time periods. Positively- skewed equity portfolios in one period are not likely to be positively skewed in the next time period. Past positively skewed returns do not predict future positively skewed returns. The most important finding in this paper is that while skewness occurs with almost constant frequency in cross sections, neither individual securities nor portfolios remain skewed over time. These results actually dispute previous evidence and are inconsistent with investment policies that encourage aggressive investors to concentrate in skewed equities.

In fact, Beedles and Simkowitz[2] (1980) have done a research on the persistency on skewness by comparing the frequency of securities with skewed returns in different cross sections. They concluded that, “regardless of how skewness is measured, securities have displayed a persistent propensity to positive asymmetry during the last three decades." However, the study by J. Clay Singleton and John Wingender shows that even thought skewness is persistent in cross section data, it is not when using time series. The paper uses time series of data from 1960 to 1980 and analyzed the skewness level of all the consistent stocks each year.

The table above indicates that skewness was less persistent for five-stock portfolios than it was for individual securities. It also noted, as did Simkowitz and Beedles, that positive skewness was much less frequent in the portfolio returns. Only 23 of the 108 twenty-stock portfolio returns were right skewed, and the skewness was almost never persistent.

This paper, assuming to be valid, gives us a warning that the attempts to select stocks based on skewness may fail, as the skewness level may not persist over time. According to this paper, in order to minimize the time series effect, we decided to focus our data on only one year (the year of 2011).

DATA SET DESCRIPTION

Before going into details, we hereby clarify the data selection of this paper and to create reference for future chapters. Our data pool is gathered from prominent research institution on the monthly return of all the US market trading stock in one year, the year of 2011. Note that we only picked the data on one year, the year of 2011. The reason is that according to the literature we studied in chapter two (section 2.3), some scholars argue that skewness does not tend to last or stay at the same level overtime. To build on this argument, this paper thus presumes that the assertions in the literature are valid and that time series data is not efficient or may be misleading in skewness study. The literature by J. Clay Singleton and John

Wingender shows that even though skewness is persistent in cross section data, it is not when using time series. Therefore, in this paper we adopt portfolios that are within a year with monthly returns.

The reason for us to pick the year 2011 specifically is because the year 2011 is the closest to today that has complete monthly data available to public. Even though studying the most recent data is always proven to be challenging, the effort may provide valuable insight towards the current market and aid current investors in their portfolio selection. This is why we did not randomly pick a year in the further past because the study result, due to uncertainties and hundreds of factors affecting the market at that year, may not have any value to portfolio investment on skewness today.

The entire pool of equities is on over 7000 stocks. We then screened off the companies that does not have continuous data or have incomplete information of the year. This helps us come up with 5680 companies within over seventy industry sectors[3]. Then we ran the descriptive on this data set of how many companies consist of each industry sector. And we selected the industries that contain more than 40 companies. This gives us a total of 5007 companies and this is our final data pool. The descriptive is as following:

		频率	百分比	有效百分比	累积百分比
有效	10	84	1.7	1.7	1.7
	13	163	3.3	3.3	4.9
	20	81	1.6	1.6	6.6
	27	45	.9	.9	7.4
	28	308	6.2	6.2	13.6
	33	52	1.0	1.0	14.6
	35	173	3.5	3.5	18.1
	36	312	6.2	6.2	24.3
	37	73	1.5	1.5	25.8
	38	203	4.1	4.1	29.8
	44	42	.8	.8	30.7
	48	124	2.5	2.5	33.2
	49	129	2.6	2.6	35.7
	50	68	1.4	1.4	37.1
	51	46	.9	.9	38.0
	58	48	1.0	1.0	39.0
	59	49	1.0	1.0	39.9
	60	421	8.4	8.4	48.4
	62	69	1.4	1.4	49.7
	63	124	2.5	2.5	52.2
	67	1710	34.2	34.2	86.4
	73	353	7.1	7.1	93.4
	80	53	1.1	1.1	94.5
	87	94	1.9	1.9	96.3
	99	183	3.7	3.7	100.0
	合计	5007	100.0	100.0	

3.1.1

The first column on the left are the SIC codes of different industries and the second column next to it shows the number of companies in that industry. The third column gives a sense of how many percent of the entire pool does in each industry construct. All the empirical evaluations are based on the data selected

from the above data pool. The data pool contains a total of 5007 companies and each has 12 entries representing the monthly return of each stock[4].

SKEWNESS ANALYSIS ON TWO-ASSET PORTFOLIOS

After reading all the empirical studies on how the individual stocks' skewness level affect the portfolio return and risk, we decide to use a different method to also try to empirically test the effect of skewness on portfolio risk and return and try to grasp some sense in stock selections based on skewness.

According to Markowitz's modern portfolio theory, all portfolio valuations should start from the basic. This means that in order to look at the performance of a complicated multi-asset portfolio, we should first instead look at a simplified version with only two assets. This chapter will construct studies on two asset portfolios by incorporating skewness into modern portfolio theories and determine the effect of skewness on the efficient frontier and the optimal point on the frontier. We will first randomly select pairs of stocks and calculate the correlation coefficient, portfolio skewness and then calculate minimum variance points for each of the two asset portfolios. Among all the portfolios we construct, we will observe the differences of the efficient frontier between portfolios with the same correlation coefficient while different individual asset skewness level. The question we are interested in is: with the same correlation coefficient, does different skewness combinations shift or change the shape of the efficient frontier, and thereby shift the minimum variance, and if yes, how?

According to the literatures we gathered, when incorporating skewness in portfolio optimization, most models choose to try, under certain constraints, maximizing the skewness level in a portfolio. Many scholars as we mentioned in chapter two such as Arditti (1967) argued that theoretically, positive skewness is more preferred for not having extremely negative values. From all these previous evidences, this experiment is also trying to support previous studies from another facet. Therefore, before we go into the details, our assumption is that positive skewness should have a bigger impact on risk reduction and on the opposite, negative skewness should have a smaller impact or negative impact on risk reduction of the two-asset portfolio.

Adopting the Markowitz mean-variance model, we construct the mean variance model of two-asset portfolios. Suppose we have two risky assets and we know the means are $\overline{R1}$ and $\overline{R2}$, variances $\sigma_1^2$and σ_2^2, and a correlation ρ between the two. The weights of the two portfolios are w and (1-w), for $w \in [0,1]$.

Then the portfolio mean of this asset is:

$\overline{R_p} = w * \overline{R_1} + (1-w) * \overline{R_2}$.

The portfolio variance is:

$\sigma_p^2 = w * \sigma_1^2 + (1-w)^2 * \sigma_2^2 + 2\rho * \sigma_1\sigma_2 * w(1-w)$

As the weight w changes, we trace out a curve for this two-asset portfolio with the standard deviation σ on the x-axis and the mean return of the portfolio $\overline{R_p}$ on the y-axis. In our selected data set,

which contains more than five thousand stocks with their monthly return on the year of 2011, we screened out the stocks that have significant skewness level and also the ones with skewness that is very close to 0. To quantify this criteria, we set the screening limits to stocks that have skewness level of 0, or greater than 1 or less than -1. The reason for us to not include moderate skewness levels (i.e (0,1) or (-1,0)) in this experiment is that we believe significant values may have more effects to the two-asset portfolio, which will be easier to observe. In addition, we assume that moderate skewness levels have the same direction of effect as its extreme cases. For example, we assume that holding all other constant, A_1 and A_2 are two stocks with the same return and standard deviation but A_1 has -1.2 skewness and A_2 is -0.3. A_1 and A_2 have the same correlation coefficient to B respectively. We then assume that A_1 and A_2 will have the same direction of effect on the two-asset portfolio and A_1's effect will be more significant. This selection does not deny that moderate skewness will have no effect or little effect to the portfolio, but only to help us observe the effect easier. This assumption works when the two assets have the same sign of skewness, i.e. they have both positive skewness levels or they both have negative skewness. This experiment does also include the possibility when the two stocks have the opposite sign, where one has positive skewness and the other has negative skewness. Intuitively, the result of this combination is ambiguous as one positive skewed and one negative skewed asset may shift the portfolio skewness somewhere between these two polar and through this test, we will try to discover the behavior of this combination as well.

From these selected stocks, we used SPSS to calculate a correlation matrix that describes the correlation between every two of the stocks[5]. We then selected the stock pairs that have correlation coefficient from 0.6 to 0.8 and -0.6 to -0.8. These stock pairs each form a two-asset portfolio we discussed early in this chapter. In order to see the effect of individual skewness on the risk and return of its two-asset portfolio, we control for the level of correlation coefficient, which due to heavy calculation and organization effort, is set as a specific interval rather than being categorized to different levels and analyzed respectively. In short, we will only pick the stock pairs that have quite significant correlation coefficient that is 0.6 and 0.8.

We then categorize these selected stock pairs into four different groups by the combination of its individual stock skewness. To make it clear, suppose we have 1000 stock pairs, which are also known as our two-asset portfolios and two individual stocks, A and B, form each of these portfolios. A and B both has a unique skewness level. Depending on the skewness combination of A and B, we constructed four categories:

i. Skewness of A and B are both greater than 1, denoted Pos & Pos

   The two-asset portfolios in this group are built by two stocks that both have skewness greater than 1.

ii. Skewness of A and B are both less than -1, denoted Neg & Neg

   The two-asset portfolios in this group are built by two stocks that both have skewness less

than -1.

iii. Skewness of A and B are both 0, denoted Zero & Zero

The two-asset portfolios in this group are built by two stocks that both have skewness equal or very close to 0.

iv. Skewness of A and B are larger than +1 and less than -1 respectively, denoted Pos & Neg

Hence, we sort all the stock pairs we selected into two big categories (+0.6 to +0.8 and -0.6 to -0.8) and each category contains the four groups we stated above. For each portfolio in these groups, we calculate out the optimal point of the portfolio using minimum variance portfolio theory. "A portfolio of individually risky assets that, when taken together, result in the lowest possible risk level for the rate of expected return. Such a portfolio hedges each investment with an offsetting investment; the individual investor's choice on how much to offset investments depends on the level of risk and expected return he/she is willing to accept.[6] The investments in a minimum variance portfolio are individually riskier than the portfolio as a whole. The name of the term comes from how it is mathematically expressed in Markowitz Portfolio Theory we introduced in the previous chapter, in which volatility is used as a replacement for risk, and in which less variance in volatility correlates to less risk in an investment. Just as the name, minimum variance portfolio aims to calculate the optimal weight that can achieve the smallest portfolio variance. To minimize the risk is exactly what this paper is aiming to do so we adopted this portfolio construction method in doing two-asset portfolio analysis.

After massive computation, for each group we have 10 portfolios with their minimum variance optimized. Then for each of these portfolios, we calculated the risk reduction level in terms of percentage. The risk reduction rate is quantified by comparing the optimized portfolio's standard deviation to the smaller standard deviation of the two assets, which can be noted as the following:

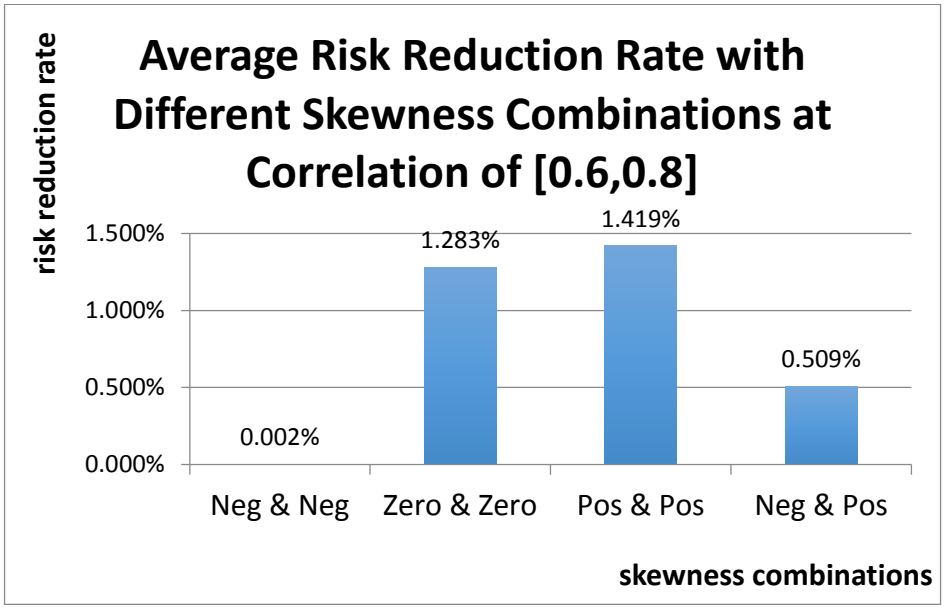
Risk Reduction Rate= $[S_p - \text{Min}(S_1, S_2)]/ \text{Min}(S_1, S_2)$

In the above equation, S_p is the minimum variance portfolio's standard deviation and S_1, S_2 are the standard deviation of the two assets. The risk reduction rate can give us a sense of how much the standard deviation is reduced in each case when forming a portfolio and help us compare which skewness combination on average has the highest risk reduction rate. For correlation coefficient at 0.6 to 0.8, we have four groups and also for correlation coefficient at -0.6 to -0.8, we have the same four groups. Each group as we have picked has more than ten two-asset portfolios and we finally calculated the arithmetic mean of the risk reduction rate for each group. The result is as following:

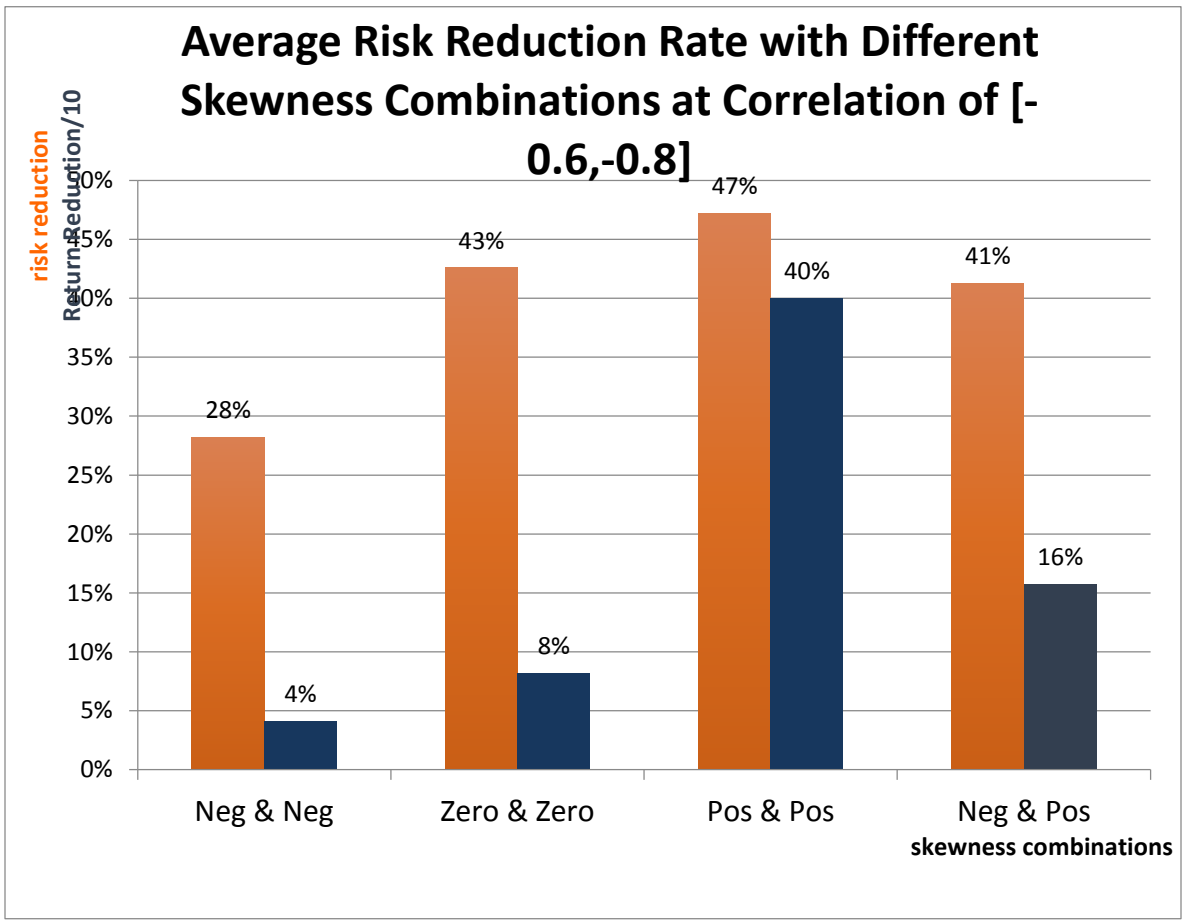
Average Risk Reduction Rate				
Groups	Neg & Neg	Zero & Zero	Pos & Pos	Neg & Pos
Correlation [-0.6, -0.8]	28%	43%	47%	41%
Correlation [0.6, 0.8]	0.002%	1.283%	1.419%	0.509%

4.1.2

As we can see in the above graph, we also calculated the return reduction rate when the correlation coefficient is negative. When correlation coefficient is positive and especially at a high level of larger than 0.6, we know that the portfolio is very hard to diversify as the two assets in this kind of portfolio are highly correlated. Normally since the goal is to diversify risk, we do not consider involving too many highly correlated assets. Thus the study of the positive correlation coefficient is just to see if the result is consistent with the result from the negative correlation coefficient and see if there are any similar observations. This is the reason we focus more on negative correlation coefficient possibilities rather than positive.



4.1.3



4.1.4

The first and the most important observation is that no matter the correlation coefficient is negative or positive, the combination of two negative skewed assets (group Neg & Neg) has the lowest risk reduction rate. When the two assets are positively correlated, there is almost no risk reduction for two negative skewed assets. Although as we discussed that positively correlated equities almost do not reduce any risk when put into a portfolio together, we still find that there is some risk reduction at 1% in some group we constructed. Comparing to this, the risk reduction rate of group Neg & Neg in [0.6, 0.8] is only at 0.005%, which is almost zero. This shows us the probability that when both assets are negatively skewed, the risk reduction is probably low. Luckily, we find the same result in the category where correlation coefficient is [-0.6, -0.8]. From the graph above we can see that the average risk reduction rate for negatively correlated portfolios that consist two negatively skewed stocks is 28%, a percentage more than 30% lower than the second lowest reduction rate, which is at 41%. This supports our assumption that the combination with two negatively skewed assets has the lowest risk reduction rate.

On the opposite, the best combination is hard to be decided as the risk reduction rate for groups Zero & Zero, Pos & Pos and Neg & Pos at both negative and positive correlation coefficient are all clustered in

the same range (Positive correlation is at 1.283%, 1.419% and 0.509% respectively and negative correlation groups are at 43%, 47% and 41%), which can only be distinguished from the reduction performance of the Neg & Neg group, which has significant lower performances. From only this sample report, we can see that no matter the correlation is positive or negative, the none-skewed group and the group with both positive skewness has the highest risk reduction rate.

Another exciting observation is that we found the rank of the risk reduction rate is exactly the same for the two categories when the correlation is positive or negative. The group that has the highest risk reduction rate in both cases is Pos & Pos, where the portfolios in that group are contained by two positive skewed equities, then Zero & Zero follows and then comes the Neg & Pos group and at last is the group Neg & Neg.

On the level of two-asset portfolios, we confirm previous studies on skewness preference based on our empirical experiment and we find that negative skewness is not conducive in reducing the risk level of portfolio and thus negatively skewed assets are less preferable in the selection of two-asset portfolios. Two-asset portfolios that contain two negatively skewed assets have the smallest effect in reducing risk and the risk reduction rate for portfolios that consist one negatively skewed asset is also lower than those that do not have any negatively skewed asset.

SKEWNESS ON RISK REDUCTION RATE IN MULTI-ASSET PORTFOLIOS

From our study on portfolio selection, one of the most classic methods is the traditional selection method. According to Markowitz's modern portfolio theories, in order to diversify the portfolio risk, one should pick elements that are less correlated. He suggested a positive relation between risk and portfolio correlation, which indicates that the higher correlation between the selected equities is, the higher risk this portfolio will have. Hence the traditional selection corresponds to investor's most common sense that in order to diversify portfolio risk, one should select stocks that are less correlated so that one does not "put all the eggs in one basket." And the "baskets" on the basic level of understanding is obviously industry sectors. Before the emergence of more advanced portfolio selection methods, portfolio risk diversification is always equivalent to choosing stocks that are in different industry sectors. Many at first believed that different industries, intuitively, should have their individual behavior, and hence have different performances. This makes many scholars believe that between most industries the correlation coefficient is low. Despite the fact that some industries are actually moving in the same direction or sometimes highly correlated, choosing stocks in different industries is always considered to be the easiest and the fastest way to diversify risk. Note that this method is not the best portfolio selection method as we have pointed out that certain industries are highly correlated and selecting stocks that are in different industries does not mean that these stocks are less correlated. For example, if we picked stocks in the oil industry and also stocks in transportation industry such as airline companies or car companies, we will most likely not to be

able to diversify too much risk because even though they are in different industries, one industry solely relies on the other since oil is the primary power for transportation and any change in the oil industry will definitely affect the transportation industry as well. No matter what, to first have a look at the possible relation between skewness and portfolio risk, this section will adopt this method and select stocks from all the twenty-five different industries of the data set introduced in chapter three.

According to our dataset description (see table 3.1.1), we neglected industries that have less than 40 companies and it returns to us 25 different industries and a total of more than five thousand companies. From each of these industries, we randomly select one stock and as a result we will have a portfolio that contains twenty-five stocks. We then repeat this selection procedure and finally construct 40 portfolios using this method.

For each portfolio, using their monthly returns on the year of 2011, we calculate the variables we need for our regression using equal weight (each company in the portfolio takes 1/25 of the portfolio). There are a total of six variables generated from the data. The variable names and descriptions are as the following:

	Variable Abbreviation	Variable Name
Dependent Variable	riskreducrt	Risk Reduction Rate
Independent Variable	portskw	Portfolio Skewness
Control Variables	portreturn	Portfolio Return
	avrcorr	Average Correlation
	negskw	Number of negatively skewed asset in %
	posskw	Number of positively skewed asset in %

5.1.1

Riskreducrt = (average standard deviation – portfolio standard deviation) / average standard deviation

Using the data we gathered and import them into STATA, we first run an OLS using the simple regression function trying to have a brief glance at our data and possible problems we are facing. The following is our simple regression results of portfolio skewness on portfolio reduction rate with all the control variables we select:

```
. reg riskreducrt portskw portreturn avrcorr negskw posskw
```

Source	SS	df	MS		
Model	.068129307	5	.013625861	Number of obs =	40
Residual	.035654209	34	.001048653	F(5, 34) =	12.99
				Prob > F =	0.0000
				R-squared =	0.6565
				Adj R-squared =	0.6059
Total	.103783517	39	.002661116	Root MSE =	.03238

riskreducrt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
portskw	-.0315055	.012136	-2.60	0.014	-.0561689	-.0068422
portreturn	.0567247	.7161016	0.08	0.937	-1.398569	1.512018
avrcorr	-.5626669	.0895122	-6.29	0.000	-.7445776	-.3807562
negskw	.0565572	.1098867	0.51	0.610	-.1667594	.2798737
posskw	.044399	.0887605	0.50	0.620	-.135984	.2247819
_cons	.5751221	.0839774	6.85	0.000	.4044594	.7457847

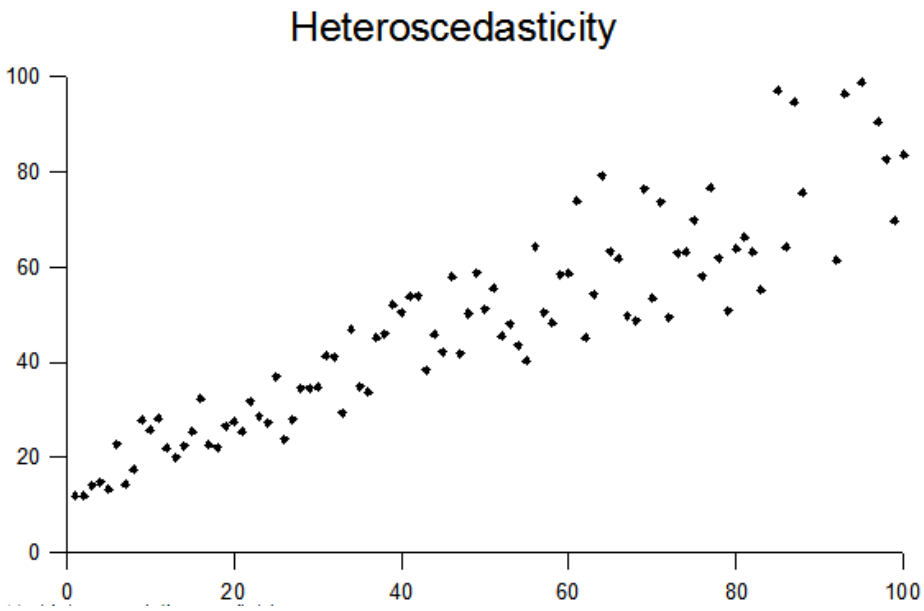
5.1.3

From the above result we can see that the p-value for our independent variable is 0.014, which is smaller than the critical value 0.05. This means that the test result is significant at this point.

We now move one to test for multicolinearity in the data. We adopted the test of variance inflation factor for multicollinearity (VIF) to check if any of the variables we used are highly correlated. Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others. If this is the case the estimates of the coefficient may change erratically in response to small changes in the model or the data. However "multicollinearity does not reduce the predictive power or reliability of the model as a whole, at least within the sample data themselves; it only affects calculations regarding individual predictors."8 This means that a multiple regression model with correlated predictors can indicate how well the entire bundle of predictors predicts the targeting variable but it may not give valid results about any individual predictor, or about which predictors are redundant with respect to others.

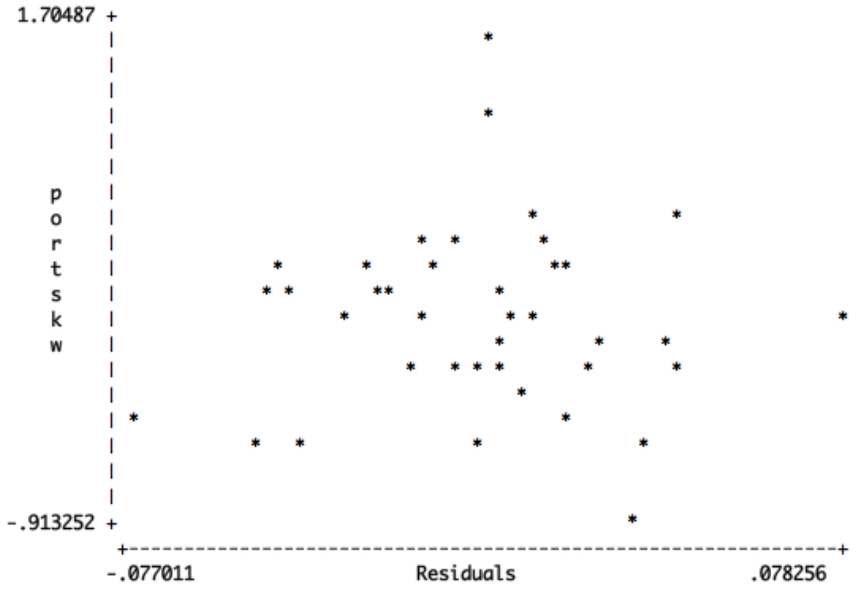
Thereis no variable that has a VIF value even over 5. This means that there is no problem of multicolinearity in this regression model.

Now since we have data of all different portfolios, we are actually dealing with cross section data. Cross-sectional data refers to data collected by observing many subjects (such as individuals, firms or countries/ regions) at the same point of time, or without regard to differences in time. Analysis of cross-sectional data usually consists of comparing the differences among the subjects. Our data set fits this profile as we are comparing the differences among the 40 portfolios. The most common problem we face in cross-section data is heteroskedasticity. The basic idea is that if the data set is heteroskedstic, it means that the error of the dependent variable does not have a constant variance. A most common example is as the following:



5.1.5

From this we can see that a typical case of heteroscedasticity has the following distribution of error, where the variance of the error is not stable. We need to test our sample to see if there is any significant level of heteroskedasticity. Therefore, we plot out the relation of our independent variable and our error term. The graph is as following:



5.1.6

From this graph we do not see a very obvious trace of heteroskedasticity as the trend of the error is vague. Thus instead, we use Cook & Weisberg's test on heteroskedasticity to see if there is any alternate

result that can be clearer. The Prob> Chi^2 is not very significant. This tells us that this data set is mostly homoscedastic.

For the relation between portfolio skewness and the risk reduction, the research result in fairly interesting. We can see that the p-value for this independent variable is also close to zero. This tells us that in our data set, the level of portfolio skewness does affect the portfolio risk level and hence as Mr. Markowitz and other scholars predicted, higher movements should indeed be taken into account. However, what astounded us the most is that the coefficient of the independent variable is actually negative. This result is exactly the opposite of our assumption that we made from the findings in two-asset portfolios. We assumed that the relation between the portfolio skewness and portfolio risk reduction rate should be positive, meaning that the more positive the portfolio's skewness is, the higher rate of risk reduction one should have. However, we have to say that in this year of 2011 and under the traditional portfolio selection method, the relation between portfolio skewness and portfolio risk reduction rate is negative.

CONCLUSION

Even though as many scholars have agreed that positive skewness is always preferred, the empirical testing result generated in this paper proves that this stock selection criteria needs more consideration. The result shows us counter examples in which negative skewness is actually preferred in risk reduction. Both selection methods indicate that an increase in either portfolio skewness or number of positively skewed assets in the portfolio will actually decrease the risk reduction rate and hence give us a less optimized portfolio. These findings rejected the previous study results that positive skewness is always preferred for investor who seeks to lower their portfolio risk. We should certainly not generalize such assertion since we only focused on one specific year of the stock market and we only adopted two stock selection methods. However, this study still has its significant implication that when using portfolio optimization it is not always the case that positive skewness should be desired. Sometimes, negative skewness may result in a better improvement in portfolio risk reduction. This discovery rings a bell to the current investors that when including skewness in portfolio optimization, one should at first run tests on the stock market and see its behavior in at least the previous year in order to have a better understanding of whether positive or negative skewness is preferred in the portfolio risk reduction at the moment. And then, after a short study, the investor can optimize his portfolio using his model and findings on the skewness effects. Therefore, the paper concludes that it is not always true that positive skewness is preferred in risk minimization. Sometimes, as our experiment result tells us, more negative skewness can actually decrease the portfolio risk. Investors' discretions are highly advised when trying to incorporate skewness into portfolio optimization, as the effect of skewness is not always positive.

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3. A complete description of the data is available from the author
4. Sample data is available from the author
5. Sample chart is available from the authors.
6. Jason Hsu (2011) " Quantitative Asset Management Notes on Minimum Variance Portfolios"
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Does Reducing Product Liability Affect Market Value?

Gayle L. DeLong*[1,2]

ABSTRACT

I investigate whether shielding manufacturers from product liability affects their market values. Using the vaccine industry as an example, I examine events surrounding the introduction of the U.S. National Childhood Vaccine Injury Act (NCVIA), legislation that protected vaccine firms from product liability. The market reacted negatively when courts enforced liability. Examining 133 new vaccine approvals, I find the market awarded the licensing of a new vaccine in the United States 1.3% higher after NCVIA compared with before the legislation, when the market was indifferent to the announcement of a new vaccine. Results suggest that preempting product liability litigation can contribute to transforming a low-profit business into an attractive product line.

INTRODUCTION

"The ['vaccines court'] …buffers…makers of childhood-disease vaccines from much of the litigation risk that dogs traditional pill manufacturers and is an important reason why the vaccine business has been transformed from a risky, low-profit venture in the 1970s to one of the pharmaceutical industry's most attractive product lines today" (Wall Street Journal, 2009).

Scholars have long regarded regulation and litigation as complements (Kolstad, Ulen and Johnson, 1990). Ex ante regulation sets a minimum standard of care, while ex post litigation forces companies to make costly changes to address unforeseen problems with their products. Although several examples of preempting regulation (deregulation) exist – including telecommunications, transportation, and banking – we know very little about the preempting of litigation or "delitigation." Theoretically, if a firm is able to preempt litigation, the firm's market value could either remain constant or increase. Market value would not change if the regulator takes over the role of litigation by enforcing more oversight ex post, because no major change would occur in the manufacturing process. Regulators would force firms to continue to monitor and to address unforeseen problems. Market value would also not change if the producer passes savings in litigation costs onto the consumer by lowering prices. Conversely, if the regulator does not increase ex post oversight to the ex ante level and the firm does not lower its prices, the market value of the firm should increase. The market would react positively to delitigation both at the time of announcement

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as well as subsequent announcements of new products, since the firm could manufacture the new products more cheaply.

We can view the passage of the U.S. National Childhood Vaccine Injury Act (NCVIA) in 1986 as a social experiment to examine the effect of delitigation on firm value. The Act established the Vaccine Injury Compensation Program (VICP), a U.S. government program that shields vaccine manufacturers from most product liability litigation. If a vaccine injures a person, he or she can file a claim under VICP to receive compensation. Funding for the Program comes from an excise tax on the sale of each vaccine. Examining market responses to events before and after the passage of the legislation provides insights into the effects of delitigation.

To evaluate the influence of delitigation, I examine changes to vaccine manufacturers' equity values around events associated with the introduction and implementation of product liability preemption. I find that vaccine manufacturers in the United States experienced negative returns when a U.S. court found a firm liable for vaccine injury. I also find the licensing of a vaccine in the United States is more valuable to a firm after the passage of limited liability than before. Prior to the legislation, the announcement effect of the licensing of a new vaccine was, on average, zero; after delitigation, pharmaceutical companies earned on average a statistically significant 1.1% when they announced a new vaccine. Taken together the results suggest delitigation has helped to transform vaccines into attractive products.

POLICY IMPLICATIONS OF DELITIGATION

The findings of this study have implications in several areas of public policy. Governments are often major purchasers of vaccines, and reducing litigation costs could reduce the prices of vaccines. Manning (1994) investigated the influence of changes in tort law on the prices of vaccines. He found that under a regime of strict product liability to the vaccine manufacturer 96 per cent of the price of the DPT vaccine went toward litigation costs. Reducing litigation costs could reduce the cost of producing goods. Firms could lower the prices of vaccines, allowing governments and other consumers to reduce spending. Indeed, when Manning (1997) investigated price differences between prescription drugs sold in Canada versus the United States, he found that half of the difference in price comes from the litigation risk that drug makers experience in the United States that Canadian sellers do not experience.

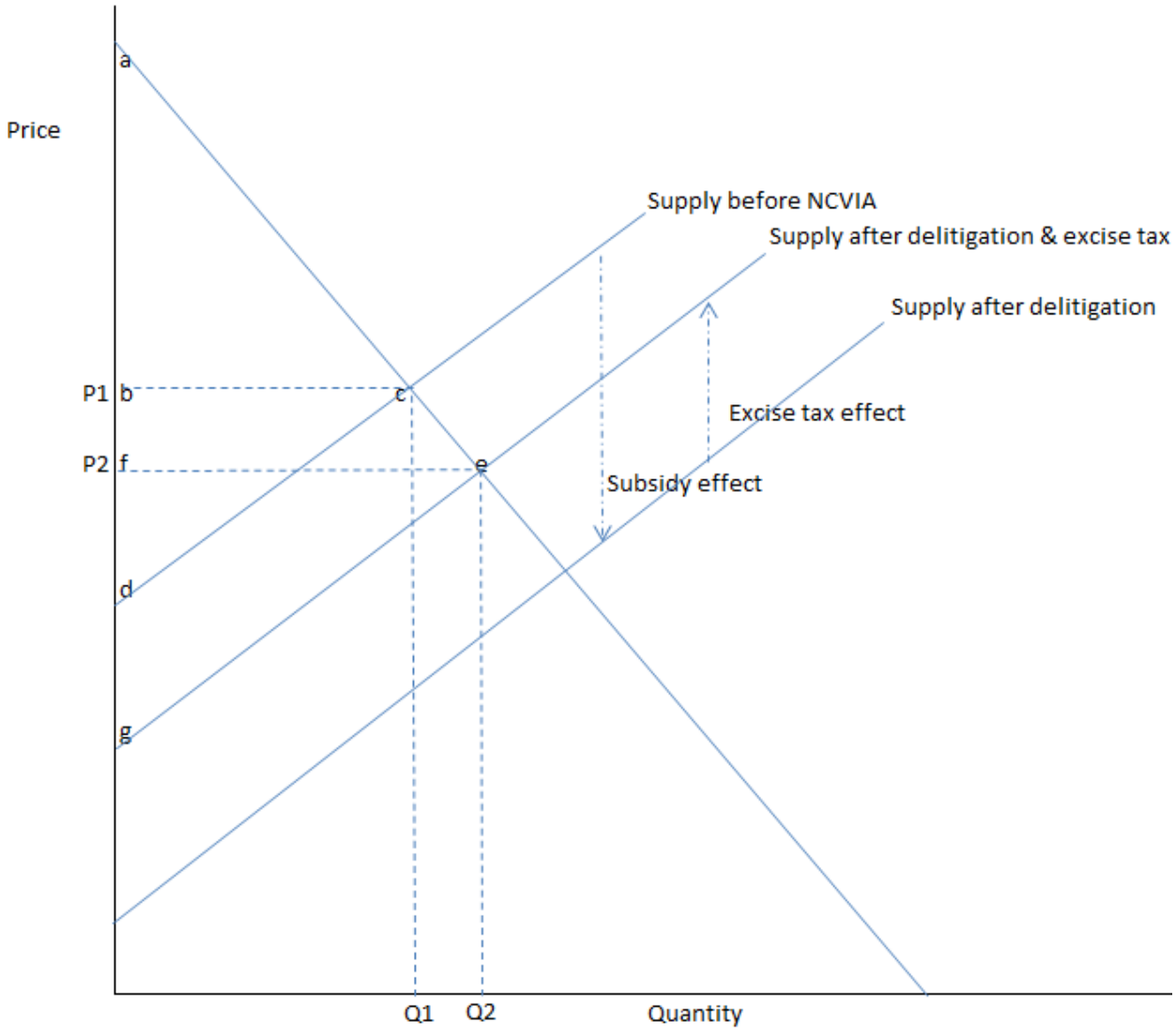
A second issue is the influence of litigation costs on product innovation. Viscusi and Moore (1993) show how large litigation costs can stifle innovation and the development of new products. Although VICP does not address this issue, enhancing product development could be a by-product of lowering litigation costs.

A third important policy issue is the acceptance of childhood vaccines. Public trust is essential for a successful immunization program, yet trust in vaccines is falling (Opel, et al., 2013). Almost half of all parents surveyed expressed concern that the profit motivation biased pharmaceutical companies, thereby

making vaccine information unreliable (ASTHO, 2010). If this research shows no change after delitigation – that vaccines were not and are not particularly profitable – parents might be more trusting of the information they receive about vaccines and be more willing to participate in childhood vaccine programs.

A fourth policy implication involves the influence of NCVIA on economic distortions. By lowering producers' costs of litigation and compensation, NCVIA essentially subsidizes the manufacture of vaccines. However, it uses an excise tax on consumers to defray the costs of the compensation. The following graph shows the net effect of NCVIA on producer and consumer surpluses:

Figure 1: Supply and demand for vaccines before and after NCVIA



The original supply curve ("Supply before NCVIA") intersects the demand curve at point C, suggesting the following free-market equilibrium conditions: price P1, quantity Q1, consumer surplus *abc* and producer surplus *bcd*. VICP addresses two costs to producers, litigation and compensation. The legislation drives the litigation costs close to zero – in effect a subsidy – while shifting the compensation cost of injury to consumers through an excise tax. The curve "Supply after delitigation" depicts the subsidy effect of VICP. "Supply after delitigation & excise tax" shows the effect of the excise tax that compensates injury. The result is a new equilibrium price of P2, lower than the original price, and a greater quantity Q2. As long as prices fall, consumer surplus increases to *afe*. Producer surplus would be *feg*, which is greater than *bcd* as long as the "Supply after delitigation & excise tax" does not return to the original "Supply before VICP." A shift back to the original supply curve would occur only if the excise tax covered all the costs of product injury. However, the excise tax covers only the costs associated with injuries, and not litigation costs. Producer surplus, therefore, also increases.

The preceding analysis suggests testable hypotheses concerning the benefits of VICP to producers and consumers that I explore in this paper. Before presenting the hypotheses, I provide background into product liability and the NCVIA.

WHY PRODUCT LIABILITY IS EXPENSIVE

Product liability is expensive: Firms incur both direct litigation costs as well as indirect costs when a consumer files a product injury case. Bhagat, Bizjak and Coles (1998) find firms lose an average of almost 1.5% of market value upon the filing of product liability lawsuit against them and posit that reputational costs are extremely high for defendants of product liability cases. Viscusi and Hersch (1990) find that product liability litigation influence market returns more than actions by regulators. Firms expressed concerns that additional consumers would file lawsuits or regulators would force the firms to stop a particular line of business or both. Prince and Rubin (2002) find that events leading up to the verdicts can be detrimental to the automotive and pharmaceutical firms they examine. They find a firm loses value upon the filing of product liability lawsuit or upon the announcement of news that could lead to a lawsuit. The loss in market value often exceeds the direct costs of the fines, providing support for Viscusi and Hersch's finding that firms may incur costs beyond the actual lawsuit. The threat of litigation can also curtail some possible business ventures, since the net present value of a project must include estimated legal costs of product liability. If expected litigation costs are high, a product may not be profitable.

DELITIGATION OF THE VACCINE INDUSTRY IN THE UNITED STATES

In 1976, vaccine makers for the first time experienced delitigation. Prior to that year, firms selling vaccines in the United States bought liability insurance for injuries associated with their products from private companies. In the wake of a potential swine flu epidemic in 1976, the U.S. government wanted to

implement a mass vaccination program against the disease. Private insurance companies refused to cover vaccine manufacturers for the flu shot, because the insurers were concerned that the vaccine makers had rushed through the development process. Although the U.S. Food and Drug Administration (FDA) had approved and licensed the swine flu vaccine, private insurers stated the risks from product liability were unknowable (New York Times, 1976b). Vaccine manufacturers warned that they would not be able to provide the vaccine unless they could obtain liability insurance against injuries associated with their product (Wall Street Journal, 1976). In August 1976, the U.S. Congress passed the National Swine Influenza Immunization Program Act (the "Swine Flu Act"), which directed anyone injured by the flu shot to file a lawsuit against the U.S. government and not the vaccine manufacturer or the person administering the shot. The government could then sue any party that it felt had caused the injury (New York Times, 1976a). The legislation did not include any special procedure for evaluating cases of injury from the swine flu vaccine, and people who claimed to be victims of vaccine injury had to try their cases in regular court. The U.S. government became involved in expensive litigation and paid out over $90 million (Grey, 2011).

Vaccine manufacturers lobbied the U.S. Congress to create a no-fault compensation program similar to the Swine Flu Act for victims of injury from all childhood vaccines (Finkelstein, 2004). The manufacturers argued that increasing litigation was making their business climate uncertain and they needed protection from lawsuits to provide a steady supply of vaccines. Grey (2011) reports that Congress wanted to protect the vaccine industry and provide for a speedy resolution for victims of vaccine injury, but did not want to repeat the expensive litigation that resulted from the National Swine Flu Program.

The National Childhood Vaccine Injury Act (NCVIA), which Congress passed in 1986, decreed that consumers could not hold a vaccine manufacturer liable if its product caused damage as long as the manufacturer used FDA-approved procedures. Consumers could still sue if the company did not warn of dangers or did not follow FDA procedures, but such cases are very difficult to prove. The legislation includes the Vaccine Injury Compensation Program (VICP), which directs a person who believes that a vaccine injured him or his dependent to file a petition in the U.S. Court of Federal Claims. A Special Master adjudicates the claim rather than a judge, and – in an effort to speed the process – the legislation suspends the Federal Rules of Civil Procedure and the Federal Rules of Evidence. The Special Master can request documents, but no one else is entitled to discovery.

HYPOTHESES

In my first test, I seek to establish whether product liability is expensive to vaccine makers. I examine the effect of product liability litigation on the market value of vaccine manufacturers for three events. On February 8, 1972, a Texas jury awarded $200,000 to the father of Anita Reyes, a toddler who became paralyzed after receiving a vaccination against polio manufactured by Wyeth. On July 31, 1974, the Fifth Circuit Court of Appeals upheld the jury decision. On April 30, 1984, an Idaho jury found Lederle liable for

an injury and awarded $1.1 million to the parents of an infant who became paralyzed after receiving Lederle's pertussis shot. To gauge the effect on the vaccine industry, I include not only the defendants in the lawsuits, but also all other vaccine firms for which I am able to find data. My first test is therefore whether product liability litigation is associated with a change in market values for vaccine manufacturers.

Next, I explore whether the NCVIA influenced the market value of vaccine manufacturers. I measure market reaction to the licensing of vaccines before and after legislation that reduced product liability. Although the Act allows vaccine manufacturers to enjoy drastically lower liability, the firms also face increased regulatory burdens. The legislation requires federal agencies to maintain the Vaccine Adverse Event Reporting System (VAERS), where health care providers are to report a suspected vaccine injury. Additionally, the excise tax that compensates people injured by vaccines raises the costs of those vaccines. The costs of the increased regulation may offset the benefits of the lowered liability. I therefore test whether legislation that reduces product liability affects market values of vaccine manufacturers.

Finally, reducing liability costs allows firms to charge less. I therefore examine vaccine prices over time to determine whether they fell.

EMPIRICAL RESULTS

To determine whether vaccine manufacturers in general experienced a change in value when courts found Wyeth Laboratories in the early 1970s and Lederle in the mid-1980s liable for vaccine injuries, I examine the market reactions to the legal decisions. Specifically, I first determine firm *i*'s stock return, $R_{it} = \log(1+(P_{it} - P_{i,t-1})/P_{i,t-1})$, where P_{it} is firm i's stock price at time t, as well as the return to the market, $R_{Mt} = \log(1+(P_{Mt} - P_{M,t-1})/P_{M,t-1})$, where P_{Mt} is the market's index time t. I then determine the relationship between R_{it} and R_{Mt}:

(1) $R_{it} = \alpha_i + \beta_i * R_{Mt} + \varepsilon$.

To estimate α_i and β_i, I use daily stock data from 250 to 30 days before the courts announced the decisions. The expected return for stock *i* on day *t* is $a_i + b_i * R_{Mt}$ where a_i and b_i are the estimates of α_i and β_i from equation (1). Any difference between that expected return and the actual return on day *t* is the abnormal return. I then add together the daily abnormal returns to create the cumulative abnormal returns (CAR_i) for each vaccine manufacturer for the 7-day period (t=-5,1) surrounding the announcement of the legal decision:

(2) $CAR_i = \sum_{t=-5}^{1} R_{it} - (a_i + b_i * R_{Mt})$.

Daily stock prices for firms listed on a U.S. exchange as well as the value-weighted market index come from CRSP. I include all publicly traded firms that sold vaccines in the United States for which I could find stock market data from CRSP. I obtain the names of vaccine license holders in the United States from the *Children's Vaccine Initiative,* which reported that in 1972, 18 entities – including 14 commercial firms, three

public health departments, and one university – held licenses to sell vaccines in the United States. By 1984, the number of commercial firms selling vaccines for the U.S. market had fallen to eight. Of the commercial firms, I was able to find stock market information for nine firms in 1972 and five firms in 1984. Firms for which I could not find data were foreign firms for which CRSP did not provide data. Datastream, a database that reports stock prices for non-U.S. firms, did not have data going back far enough for my analysis.

Reaction to litigation was positive on average in the early 1970s, but turned negative by the mid-1970s. I can provide the chart that details individual firm's reaction to litigation upon request. Highlights are as follows: Investors in most vaccine manufacturers found the jury verdict against Wyeth on February 8, 1972 a positive event. The only firm to experience negative reactions was Lederle (-2.4%), which also produced the oral polio vaccine. However, another producer of the oral polio vaccine, Pfizer, experienced a 2.3% gain. The result suggests that investors expected competitors to gain from Wyeth's troubles, perhaps because only Wyeth (and perhaps Lederle) appeared to have quality control issues. Prince and Rubin (2002) also found that when a consumer sued a drug company for product liability, competitors gained market value. However, investors reacted differently on July 31, 1974 to the upholding of the decision by the 5th Circuit Appellate Court. On average, the manufacturers experienced an abnormal return loss of 7.0%, a total of $1.2 billion ($5.3 billion in 2010 dollars). By this point, investors may have begun to suspect industry-wide liability issues. Similar to Bhagat, Bizjak and Coles (1998), who find that the market value loss to defendants far exceeds the amount of any fine, the market value that the firms lost far exceeded the $200,000 fine that Wyeth had to pay. The same negative reaction occurred ten years later. Investors in all but two vaccine manufacturers greeted the jury decision on April 30, 1984 to award plaintiffs $1.1 million for a vaccine injury as bad news. Firms listed on the U.S. market lost an average of 4.3%, which is economically and statistically significant. Perhaps investors in vaccine manufacturers did not continue to follow the pattern found by Prince and Rubin (2002), because the liability of one vaccine began to raise questions of liability risk in all vaccines.

To determine whether firms experienced abnormal returns associated with legislation that reduced product liability, I look at market reaction to the licensing of new vaccines both before and after delitigation. I examine market reaction to the announcements of the U.S. Food and Drug Administration (FDA) licensing new vaccines. Specifically, I examine market reactions to vaccine licenses before the passage of legislation that preempted product liability and compare them to market reactions after the U.S. Congress passed the legislation. I calculate abnormal returns of stocks using the methodology and data described at the beginning of the Empirical Results section. I find the dates of vaccine approvals from several sources. The FDA (2012) website provides a list of vaccines currently approved in the United States. The supporting documents to this website provide the dates of initial approvals. If the supporting documents did not specify the initial approval date, I searched Factiva for news reports of the vaccine's approval. For dates of historic vaccine approvals, I use Appendix H, "Historical Record of Vaccine Product License Holders in the United

States," of a report by the Institute of Medicine (1993). If a firm receives more than one license on a single day, I include that firm and that date only once. I include only the initial licensing of a particular vaccine and not subsequent uses of the same vaccine. For example, the FDA first licensed Connaught Laboratories' diphtheria and tetanus toxoids acellular pertussis (DTaP) vaccine, Tripedia, for children aged 15 months to seven years on August 28, 1992; on July 31, 1996, the FDA licensed Tripedia for infants at least six weeks of age. I include only the initial license date, since the product did not change. I do include combination vaccines. For example, Merck's measles, mumps, rubella, varicella (MMRV) vaccine, ProQuad, is the combination of its previously approved MMR and varicella vaccines, but the combination is a new product so I include its initial approval. Returns for vaccine manufacturers listed on a U.S. exchange as well as the value-weighted market returns come from CRSP. For firms not listed on a U.S. exchange, return data come from Datastream. The final dataset includes 75 vaccine dates before the legislation and 58 vaccine dates after the legislation.

The results, which I report in Table 1 below, suggest that vaccine manufacturers earned an average of 0.4% overall: a statistically insignificant -0.2% (p=0.6547) before the legislation, and a statistically significant 1.1% (p=0.0241) after the passage of the legislation on November 14, 1986. The 1.3% more that firms earn upon the licensing of a vaccine after the U.S. Congress passed legislation suspending product liability is statically significant (p=0.0368).

Table 1: Market reaction to announcement of new vaccine

Variable	Total sample	Before legislation	After legislation	Difference (After-Before)
CAR	0.004	-0.0016	0.0113**	0.0129**
s.e.	0.003	0.0036	0.0049	0.0061
t-stat	1.3605	-0.4491	2.3175	2.138
p-value	0.176	0.6547	0.0241	0.0368
N	133	75	58	

** Statistically signficant at the 5% level.

Although the legislation mandated increased regulatory costs, firms still enjoyed higher returns. The added costs and increased regulatory burdens might have been small for several reasons. Since U.S. state governments mandate vaccines, the demand for the product is inelastic, so increased prices from the excise tax could be passed on to the consumer or the consumer's health insurance company. Although VAERS establishes an injury reporting system that might hurt the reputation of firms, the system is passive and therefore may greatly underreport actual adverse events. Although the legislation mandates health care providers to report adverse effects, no enforcement mechanism exists to ensure that they do. The Centers for Disease Control and Prevention, which monitors VAERS, do not routinely investigate reports of injuries, so post-licensure monitoring is not enforced. In an effort to enhance the reporting system, Hinrichsen et al.

(2007) created a process to track patients with potential vaccine injuries. The research group found 20.5 events per 1,000 doses of vaccines administered. During the same time period, the number of vaccine adverse effects registered in VAERS was 0.12 per 1,000 doses, suggesting that providers report only one in 170 (= 20.5/0.12) adverse events. The passive VAERS system, therefore, probably does little harm to the reputation of vaccine manufacturers.

Finally, I examine whether vaccine prices decreased so that consumer surplus increased. The only two vaccines for which data are available from 1986 through 2014 are the inactivated polio vaccine (IPV) and the MMR. Private-sector IPV price increased over 600% from $3.80 to $27.44 per dose, and MMR increased 271% from $15.15 to $56.14. These increased exceeded the increase of the consumer price index over the period, 216%. Manning (1994) noted that prices of vaccines did not fall after the legislation; he conjectured that some uncertainty regarding liability still existed. The Supreme Court resolved the uncertainty in 2011 with its Bruesewitz v. Wyeth decision that effectively barred consumers from suing vaccine makers in civil court. See Kesselheim (2011) for more detail. If Manning's speculation was correct, prices should have fallen after 2011. However, between 2011 and 2014, the average price of vaccines increased by 10% when inflation was 5%. I can provide details upon request.

CONCLUSION

The National Childhood Vaccine Injury Act of 1986 (NCVIA) appears to be very positive for vaccine manufacturers. Before the legislation, producers faced two costs related to product liability – litigation and compensation. These costs greatly affect the market values of vaccine firms: After an appellate court upheld product liability for one firm in 1974, all vaccine manufacturers lost an average 7% of market value. The NCVIA allowed vaccine makers to vastly reduce litigation costs and to transfer the cost of compensation to consumers in the form of an excise tax. The legislation appears to have affected the market value of vaccine firms positively: After the legislation, the market rewarded the introduction of a new vaccine 1.3% higher than before. Consumers, however, do not appear to have benefited from the legislation: Producers did not lower prices, so consumer surplus did not rise.

Generalizing these results to other industries is difficult. Delitigation may only be valuable to firms that sell products, such as vaccines, that the government mandates. Otherwise, consumers may not purchase a product if they have no legal recourse after the sale.

ENDNOTES

1. I thank Jeff Wagner for very helpful and insightful suggestions on this manuscript. Participants of the 2014 New York State Economics Association Annual Conference, Loundonville, NY, also provided helpful suggestions.

2. Disclosure: I filed a claim under the U.S. National Vaccine Injury Compensation Program for my daughter. The Office of Special Masters in the U.S. Court of Federal Claims dismissed the claim on the basis of untimely filing.

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Turkey's Rising Imports from BRICS: A Gravity Model Approach

Gönül Dinçer*

ABSTRACT

The share of BRICS countries in the world trade is significantly rising for more than a decade and it was approximately 3 % in 1980, 6 % in 2000 and 16 % in 2013 in the total world imports. The same rising pattern of BRICS is also being seen in Turkey's trade since early 2000s. In this study, the imports of Turkey from BRICS are analyzed using an augmented gravity model over the period 2002-2012. The results indicate that the basic gravity variables are consistent with the theory. Furthermore, R&D expenditures in Turkey is negatively correlated with Turkey's imports from BRICS countries whereas R&D expenditures in BRICS countries are positively correlated.

Key Words: International Trade, the Gravity Model, Panel Data Analysis, BRICS, Turkey

Jel Classification: F10, F14, C33

1. INTRODUCTION

Since 2000, the emergence of Brazil, China, India, Russian Federation and South Africa in the world economy is a well-known fact. This phenomenon can also be seen in the world trade statistics. Table 1 and Table 2 shows the shares of BRICS countries in the world trade over the period 2000-2013.

Table 1: Shares of BRICS Countries and Turkey in the Total World Exports (%)

	Brazil	China	India	Russian F.	S. Africa	Turkey
2000	0.81	3.50	0.76	1.43	0.46	0.67
2005	1.03	6.44	1.24	2.07	0.52	0.81
2010	1.22	9.14	1.97	2.34	0.54	0.81
2013	1.20	10.36	1.98	2.52	0.46	0.90

Source: World Bank, World Development Indicators Database.

The share of Brazil in total world exports was 0.81 % in 2000. In 2013, it accounted for the 1.20 % of the world exports. The share of China tripled from 3.5 % in 2000 to 10.4 % in 2013. India more than doubled from 0.76 to approximately 2 %. Russian Federation's share has also increased and reached the level 2.5 % in 2013. On the other hand, South Africa's share in total world exports slowly increased and decreased during the period thus South Africa kept its share at approximately 0.50 % level (Table 1).

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Table 2: Shares of BRICS Countries and Turkey in the Total World Imports (%)

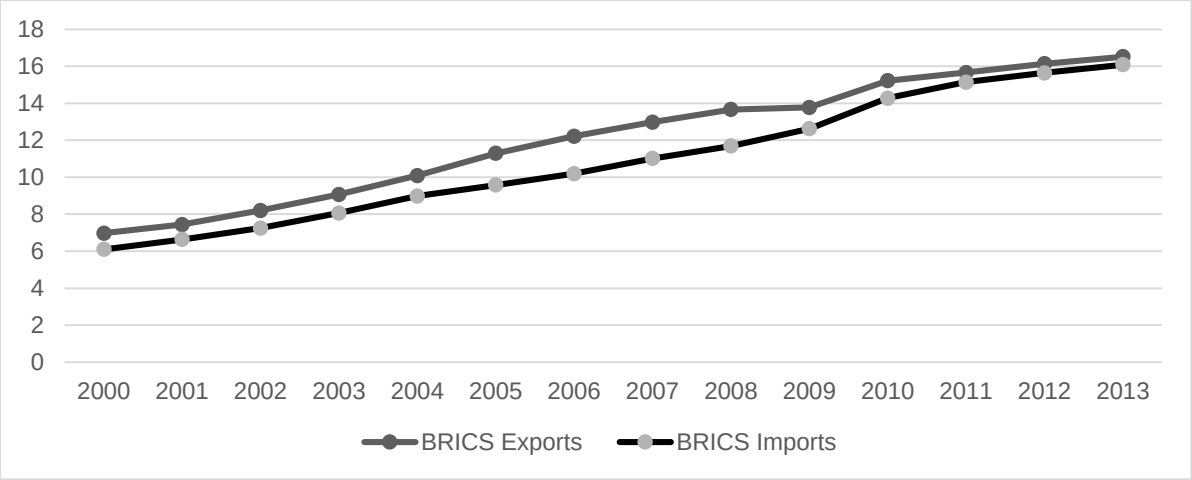
	Brazil	China	India	Russian F.	S. Africa	Turkey
2000	0.95	3.14	0.82	0.78	0.41	0.77
2005	0.79	5.54	1.43	1.28	0.54	0.95
2010	1.37	8.19	2.42	1.74	0.55	1.05
2013	1.48	9.67	2.34	2.07	0.52	1.16

Source: World Bank, World Development Indicators Database.

The shares of BRICS countries in total world imports are increasing too. The share of Brazil in world imports was 0.95 % in 2000. In 2013, it accounted for the 1.5 % of the world imports. The share of China more than tripled from 3.14 % in 2000 to 9.67 % in 2013. India more than doubled from 0.82 to approximately 2.3 %. Russian Federation's share has also increased and reached the level 2.07 % in 2013. South Africa's share in total world imports slowly increased and it accounted for the 0.52 % of the world imports (Table 2).

Figure 1 shows the share of BRICS in total world exports and imports over the period 2000-2013:

Figure 1: Share of BRICS in the Total World Trade (%)



Source: World Bank, World Development Indicators.

In 2000, the total share of BRICS in world exports was approximately 7 %, and the total share of BRICS in world imports was approximately 6 %. By 2013, both shares reached significantly high levels. The share of BRICS accounted for 16.5 % of the total world exports and 16 % of the total world imports.

In Table 1 and Table 2, it is also seen that Turkey's shares in the world trade are rising, but they are rising slowly. On the other hand, the share of BRICS in Turkey's trade is rising rapidly. Table 3 shows that

BRICS shares of Turkey's exports and imports were 3 % and 11 % in 2000. By 2013, exports share of BRICS was approximately 8 % and imports share of BRICS climbed up to 23.5 %.

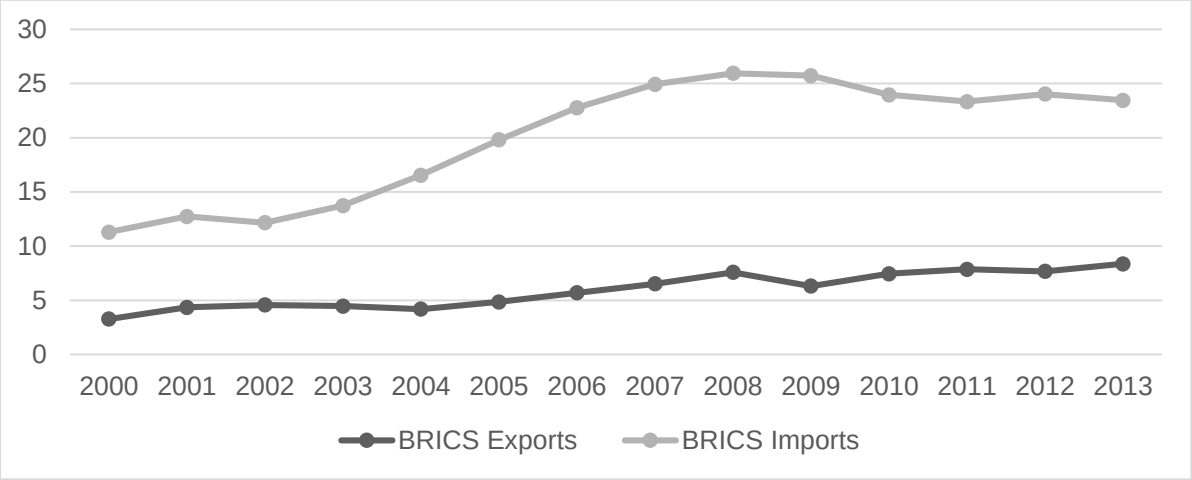
Table 3: Shares of BRICS in Turkey's Exports and Imports (%)

	Exports	Imports
2000	3.3	11.3
2005	4.9	19.8
2010	7.5	23.9
2013	8.4	23.5

Source: Turkish Statistical Institute, Foreign Trade Statistics Database.

Figure 2 shows the rising pattern of BRICS in Turkey's trade. The obvious fact here is that the imports share of BRICS is almost three times greater than the exports share and it was rising faster than the exports share until 2010.

Figure 2: Share of BRICS in Turkey's Exports and Imports (%)



Source: Turkish Statistical Institute, Foreign Trade Statistics Database.

An important point here is that Turkey's share in total world imports increased only 0.39 points, the share of BRICS countries in Turkey's exports increased approximately 5 points but the share of BRICS in Turkey's imports increased 12.2 points during the period. The exports and imports shares of BRICS increased in similar ratios in the world trade. However, the imports share of BRICS in Turkey's trade increased faster than the exports share, it almost tripled the exports share and reached a much more significant level.

This study aims to analyze the imports of Turkey from BRICS using a gravity model. The equation is specified for testing the effects of incomes of the trading countries, R&D expenditures of them and the effect of geographic distance on the imports of Turkey from BRICS.

2. RELATED LITERATURE

A joint study of the World Trade Organization and the United Nations Conference on Trade and Development (2012) declares the gravity model the work-horse of international trade analysis.

The gravity model of international trade has an intense history. Bergeijk and Brakman (2010) state that there are a number of 'fathers' of gravity who got very close to formulate the model such as Isard and Peck, and Ravenstein who used a similar logic to the gravity model of international trade in his migration studies. But Jan Tinbergen was the first to publish a mathematical formulation and an empirical application of the gravity model in international trade.

The basic gravity equation which was introduced in "Shaping the World Economy: Suggestions for an International Economic Policy" by Tinbergen (1962) is as follows:

$$E_{ij} = \alpha_0 \frac{Y_i^{\alpha_1} Y_J^{\alpha_2}}{D_{ij}^{\alpha_3}}$$

Where;

E_{ij} = exports of country i to country j

$Y_i^{\alpha 1}$ = GNP of country i

$Y_j^{\alpha 2}$ = GNP of country j

$D_{ij}^{\alpha 3}$ = distance between country i and country j and α_0 is the constant.

Tinbergen (1962) stated that the main factors determining the size of the trade flows between any pair of countries are the economic size of the exporting country, the economic size of the importing country and the distance between them. He explains their relevance as follows:

i) the amount of exports a country is able to supply depends on its economic size

ii) the amount that can be sold to a particular country varies with the size of that country's market

iii) the volume of trade depends on transportation costs (these correspond with the geographic distance between the two countries)

After Tinbergen's pioneer work, a wide range of studies are published in regard to the model. Linnemann (1966), Anderson (1979, 2003, 2010), Bergstrand (1985, 1989), Helpman (1987), Deardorff (1995), Smarzynska (2001), Evenett and Keller (2002), Greenaway and Milner (2002), Head (2003) and Feenstra (2004) investigated the theoretical foundations of the gravity model.

Matyas (1997, 1998), Egger (2000, 2002) and Baltagi, Egger and Pfaffermayr (2014) contributed to the econometric specifications of the model.

Since the gravity model became so popular, more research has been invested on it and a vast literature has grown. It should be emphasized that augmented gravity equations with additional variables are applied rather than the basic model in the majority of the studies. Also, the gravity model is now the work-horse of many other topics such as foreign direct investment flows, migration and economic integrations.

Pöyhönen (1963), Eichengreen and Irwin (1998), Wall (1999), Feenstra, Markusen and Rose (2001), Egger (2002), Filippini and Molini (2003), Anderson and Wincoop (2003), Batra (2004), Kimura and Lee (2006), Walsh (2006), Helpman, Melitz and Rubinstein (2008), Mayer (2009), Baldwin and Taglioni (2011), Greene (2013) are some of the main studies of the gravity model which analyze bilateral trade flows between countries.

Aitken (1973), McCallum (1995), Bayoumi and Eichengreen (1997), Olarreaga, Soloaga and Winters (1999), Sharma and Chua (2000), Hassan (2001), Sapir (2001), Nilsson (2002), Zarzoso and Lehmann (2003), Antonucci and Manzocchi (2006), Caliendo and Parro (2009) are some of the prominent studies of the gravity model which analyze trade between and within economic integrations.

Christie (2003), Buch, Kokta and Piazolo (2003), Egger and Pfaffermayr (2004), Ledyaeva and Linden (2006), Bénassy-Quéré, Coupet and Mayer (2007), Bergstrand and Egger (2007), Kleinert and Toubal (2010) are some of the studies of the gravity model which analyze foreign direct investment flows between countries and blocs.

Gould (1994), Head and Ries (1998), Karamera, Oguledo and Davis (2000), Girma and Yu (2002), Piperakis, Milner and Wright (2003), Leblang, Fitzgerald and Teets (2014), Lewer and Berg (2008), Ramos and Surinach (2013) are some of the studies of the gravity model which analyze migration flows between countries.

In this study, an augmented gravity model is used to analyze the imports of Turkey from BRICS countries over the period 2002-2012.

3. MODEL AND DATA

The dependent variable used in this paper is the natural log of imports of Turkey from BRICS countries over the period 2002-2012 and the gravity equation of the model is as follows:

$$\ln(imports_{ijt}) = \alpha_i + \beta_1 \ln(GDP_i) + \beta_2 \ln(GDP_j) + \beta_3 \ln(dist) + \beta_4 \ln(texports_i) + \beta_5 (RD_i) + \beta_6 (RD_j) + u_{it}$$

All non-ratio variables are in logs where;

- $imports_{ijt}$ is the imports of Turkey from BRICS countries
- GDP_i is the GDP of Turkey
- GDP_j is the GDP of BRICS
- Dist is the geographic distance between the capital cities of the country pairs
- $texports_i$ is the total exports of Turkey
- RD_i is the GDP share of research and development expenditures in Turkey

- RD_j is the GDP share of research and development expenditures in BRICS
- u_{it} is the error term
- α_i is the constant which denotes unobservable individual effects (cross-sectional effects)
- β_1, β_2, β_3, β_4, β_5 and β_6 are the coefficients of the independent variables.

The sources and the units of the data used in the analysis are described in Table 4.

Table 4: Data Sources

Variables	Source	Unit
Turkey's imports from BRICS	Turkish Statistical Institute	Current, US $
GDP	World Bank, WDI	Current, US $
Distance	CEPII	Km
R&D expenditures	World Bank, WDI	% of GDP
Turkey's exports	Turkish Statistical Institute	Current, US $

4. ESTIMATION RESULTS

The most commonly used methods for estimating a gravity model with panel data includes simple ordinary least squares (OLS), the fixed-effect models (FEM), and the random-effect models (REM). Since the regressions include individual effects it is essential to determine if they are either random or fixed. The literature suggests that a random-effect estimations is better when estimating trade flows between a randomly selected group of trading partners taken from a larger population. The literature also suggests that fixed-effect estimations are preferable when estimating trade flows between ex-ante predetermined groups of trading nations (Greene, 2013).

In this study, an ex-ante predetermined group of trading nations are selected which are Turkey and BRICS countries. Hence, fixed-effects estimation is applied. In order to verify the preference, The Hausman specification test is also applied and the fixed-effects estimation is approved. The estimation results of the augmented gravity equation is presented in Table 5:

According to the results, the estimated coefficient for Turkey's GDP has the expected positive sign and is statistically significant. Also, the estimated coefficient for the exporting countries' (BRICS) GDPs has the expected positive sign and is statistically significant too. A higher GDP of Turkey suggests that an increase in GDP will increase its purchasing power and the capacity to absorb imports whereas an increase in the income of the BRICS countries translates into a higher production capacity and an increased ability to exports.

Geographic distance has a negative and statistically significant estimated coefficient that is consistent with the gravity model's theoretical assumptions. Distance, a proxy for transportation costs, mirrors the costs associated with physically shipping a product from its production location to its export destination.

Geographic distance is the most significant determinant of Turkey's imports from BRICS and a coefficient of -1.59 implies that a 1 percent increase in the distance will cause Turkey's imports from BRICS to decline by 1.59 percent.

The estimated coefficient for Turkey's R&D expenditures has a negative sign and is statistically significant whereas the estimated coefficient for the R&D expenditures in BRICS countries has a positive sign.

Table 5: Gravity Model Estimation for Turkey's Imports from BRICS Countries, 2002-2012

				Number of obs = 58
				F(9, 48) = 678.13
				Prob > F = 0.0000
				R-squared = 0.9788
				Root MSE = .22319
	Coef.	Std. Err.	T	P>|t|
lGDP$_j$	.5076845	.1942987	2.61	0.012*
lGDP$_i$	.8790192	.3076715	2.86	0.006*
Ldist	-1.59029	.0426223	-37.31	0.000*
ltexports$_i$	.4374979	.2092301	2.09	0.042*
RD$_j$	.8105331	.1981664	4.09	0.000*
RD$_i$	-1.289699	.4772122	-2.70	0.009*
Cons	-10.43835	3.727547	-2.80	0.007*
Hausman specification test				0.0000
Pesaran's test of cross sectional independence				1.4985
Modified Wald test for groupwise heteroskedasticity				0.0000
Wooldridge test for autocorrelation				0.0571
Shapiro-Wilk W test for normal data				0.0627

Note: All non-ratio variables are in logs, and *represents statistical significance at 5% level.
Source: Author's own estimates.

Finally, the estimated coefficient for Turkey's total exports has a positive sign and is statistically significant. This means that Turkey's exports and imports are moving together which may also imply that Turkey's exports are dependent on imports.

5. CONCLUSION

The objective of this paper is to employ an augmented gravity model of international trade to empirically analyze the imports of Turkey from BRICS during the years 2002-2012. The period started from 2002 due to the availability of the R&D data. The gravity equation included basic gravity variables plus other variables designed to capture the rise of the imports from BRICS. The results are based on the study of five trading partners over an eleven year period. Regression analysis was performed on panel data fixed-effects model.

The results of the analysis indicate that Turkey's imports from BRICS are positively correlated with Turkey's GDP and GDPs of BRICS countries. Turkey's GDP determines its capacity of imports and BRICS countries incomes determine their capacity of production and exports. These findings of the GDP variables are consistent with the gravity model's main assumption: The larger the countries, the stronger the economic interaction between them.

Turkey's imports are also positively correlated with R&D expenditures in BRICS. On the other hand, Turkey's imports from BRICS are negatively correlated with Turkey's R&D expenditures. These results may suggest that the technological progress of BRICS countries is an important reason of Turkey's rising imports from BRICS.

Geographic distance is also negatively correlated with Turkey's imports from BRICS. Geographic distances are fairly high between Turkey and BRICS countries. Due to this fact, distance is the most significant determinant of Turkey's imports from BRICS. This finding supports gravity model's assumption regarding distance and transportation costs.

Furthermore, Turkey's imports from BRICS are positively correlated with Turkey's total exports. This fact may suggest that Turkey's exports are depending on imports. This is an important problem for Turkish economy because higher levels of exports require even higher levels of imports therefore export revenues cannot be realized. Turkey's imports majorly consist of intermediate goods. BRICS countries are important intermediate goods exporters. Hence the findings about the total exports variable in the analysis point to the import dependence of exports problem of Turkey.

The results altogether indicate that Turkey's imports from BRICS countries can mostly be explained by the gravity model. Distance is an important determinant of foreign trade. The economic growth of BRICS and Turkey reflects on the trade between them. The rise of the R&D expenditures of BRICS positively effects Turkey's imports whereas the rise of the R&D expenditures of Turkey negatively effects it.

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Macroeconomic Policies and their Impact on Access to Healthcare Services in Sierra Leone

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ABSTRACT

The objective of this study is to examine how macroeconomic policies have shaped health outcomes in Sierra Leone, particularly with regard to access to healthcare services. The study also examines how these health outcomes vary by income and geographical location.The introduction of Poverty Reduction Strategy Papers in Sierra Leone after the civil war in 2005 has witnessed a major shift in macroeconomic policies, which has had a negative impact on the population's access to healthcare services. Additionally, government social sector cuts, escalating costs of healthcare services, corruption and mismanagement have all contributed to dwindling access to healthcare services in Sierra Leone. The foregoing impact is captured in the results of countrywide demographic and health surveys conducted in 2008 and 2013. These surveys highlight a series of grim statistics relative to several social indicators in Sierra Leone. For instance, Sierra Leone ranks among the highest in the world in infant and maternal mortality rates. Moreover, a life expectancy of 45 years qualifies Sierra Leone as the country with the lowest life expectancy rate in the world. This study found that variations in income, education and geographical location all have an impact on access to healthcare services in Sierra Leone. As far as income is concerned, the study found a positive relationship between income and access to healthcare services. And the less educated an individual is, the less he or she has access to healthcare services. Further, generally, urban residents tend to have more access to healthcare services than their counterparts in rural areas.

INTRODUCTION

The objective of this study is to examine the impact of macroeconomic policies in the form of the well known Poverty Reduction Strategy Papers (PRSPs) framework on access to health care services in Sierra Leone. To achieve this objective, the study will rely heavily on data in both the 2008 and 2013 Sierra Leone Demographic and Health Surveys.

Macroeconomic policies in the form of Poverty Reduction Strategy Papers (PRSPs) have their origins in the Structural Adjustment Programs (SAPs) of the 1980s. SAPs embodied a series of policy interventions designed mainly by the World Bank and the International Monetary Fund. These policy interventions came in the form of loans to support the balance of payments in developing countries.

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But apart from loans to support the balance of payments in developing countries, SAPs were also a combination of monetary, fiscal, institutional and regulatory policy instruments. As monetary instruments, they dealt with inflation and foreign debt issues. As fiscal instruments, they dealt with issues related to government expenditures. As institutional instruments they dealt with issues related to decentralization and as regulatory instruments they dealt with issues related to price controls.

However, in 1999, the World Bank and the IMF decided to adopt a more country-driven approach to the issues of promoting growth and reducing poverty in developing countries. This marked the birth of the Poverty Reduction Strategy Papers (PRSPs) framework.

With PRSPs, developing countries are required to produce a Poverty Reduction Strategy Paper if they are to apply for debt relief through the Heavily Indebted Poor Countries (HIPC) initiative and other monetary aid. PRSPs detail a country's plan to reduce poverty and promote growth through the implementation over a period of three or more years of specific economic, social and structural policies. PRSPs are also designed as conduits for recipient countries to meet the Millennium Development Goals (MDGs).

PRSPs were introduced in Sierra Leone in 2005 to help address the many developmental challenges facing the country. Coming out of a brutal civil war, Sierra Leone needed to achieve accelerated and broad-based economic growth in both rural and urban areas, reduce poverty, improve health care services, provide essential social and economic services and infrastructure for the poor, create job opportunities and improve governance.

Although noticeable progress was achieved during the implementation of the first PRSP, reducing poverty and improving health care services for a population of 6 million people remained daunting tasks. This paved the way for the introduction and implementation of the second PRSP which covered the period 2009 -2012.

Before the introduction of second PRSP, the Government of Sierra Leone (GOSL) reported that progress during the implementation of the first PRSP (2005-2007) had been mixed. Accordingly, Sierra Leone had maintained a stable macroeconomic environment with strong economic growth and achieved a moderate level of inflation. However, serious challenges remained especially in the healthcare sector. For example, in 2008, infant and child mortality rates ranked among the highest in the world. There were 89 deaths per 1,000 live births while the under-five mortality rate was 140 deaths per 1,000 live births.

Also, the neonatal mortality rate was 36 deaths per 1,000 live births while the post-neonatal mortality rate was 53 deaths per 1,000 live births. Mortality rates for children under one year old also stood at 56 deaths per 1,000 children.

Faced with the foregoing grim statistics, the GOSL decided to not only reduce the infant and child mortality rates but also maternal mortality rates by introducing the Free Healthcare Initiative (FHCI) in 2010. The FHCI allowed pregnant women, lactating mothers and children under five to receive free healthcare services.

But as good as the FHCI has been, it has actually increased the demand for healthcare services thereby severely constraining an understaffed healthcare system. Additionally, there are also serious problems of accountability in the healthcare sector.

It follows that access to healthcare is not only about user fees. Adequate health personnel, infrastructural development and other vital issues remain very serious problems. In short, Sierra Leone's healthcare system lacks both the medical and administrative capacity to produce quality care.

The ineffectiveness of the country's health care system was especially exposed when the Ebola Virus Disease (EVD) struck in May of this year. Many hospitals and clinics have closed as staff and patients have fled out of fear that they would be infected by the virus. But even before the outbreak, it was reported that it was common for family members of patients to be asked to supply basic equipment like gloves for doctors, syringes and over-the-counter pain killers.

The rest of the paper is divided as follows: Section II will present the methodology, section III, the review of literature, section IV, the Poverty Reduction Strategy Papers framework, section V, Sierra Leone's health status in general, section VI, access to health care and section VII, the conclusion and recommendations.

METHODOLOGY

The objective of this study is to examine how changes in macroeconomic policies have shaped outcomes with respect to access to healthcare services in Sierra Leone.

To achieve the above objective, two major methods of data analysis are employed. Health literature covering the specific areas in health investigated is reviewed. And to understand the impact of the PRSP on health, the study utilizes data from the 2008 and the 2013 Sierra Leone Demographic and Health Surveys (SLDHS). Demographic and Health Surveys are internationally acknowledged surveys that are conducted to obtain information on health issues that affect the management and development of a country's population.

Funded by the Government of Sierra Leone and various international organizations and agencies, the SLDHS contains detailed information relative to the demographic, health and social indicators of Sierra Leone. The 2008 SLDHS is a nationally representative sample of of 7,374 women aged 15-49 and 3, 280 men aged 15-59.

The 2013 SLDHS on the other hand, was generated from a nationally representative sample of 12,629 households in Sierra Leone. Interviewers from Statistics Sierra Leone (SSL) successfully interviewed 16,658 women between the ages of 15 and 49 and 7,262 men between the ages of 15 and 59. Both survey samples provide estimates of rural and urban areas in Sierra Leone and also carry vital data for the four regions and the fourteen administrative districts of Sierra Leone.

The SLDHS investigated issues relative to health, poverty status, geographical location, gender and other social aspects of life. The timeliness of the surveys, particularly for the subject under discussion cannot be overemphasized as each was conducted just at the end of each PRSP thereby filling the information gap of the literature review.

Moreover, the surveys are critical to evaluating the achievement of the goals and targets established within the PRSPs. Thus, notwithstanding the fact that the SLDHS addresses the aspects of selected health indicators that are the subject of this study, the data and results presented in the SLDHS represent a valuable tool to assess progress that Sierra Leone has made in the last few years, particularly in the healthcare sector.

REVIEW OF LITERATURE

Macroeconomic policies in the form of Structural Adjustment Programs (SAPs) and Poverty Reduction Strategy Papers (PRSPs) can seriously impact health systems and access to healthcare services. Access to healthcare services refers to the ease with which a population can obtain needed medical services. It allows a people to command healthcare resources in order to preserve or improve their health.

Access to healthcare varies across countries. And just as access to healthcare varies across countries, so does it vary across groups and individuals within a country. These variations in turn, are largely influenced by social and economic conditions as well as a country's health policies. (Gulliford, et al. 2002).

Like SAPs before them, PRSPs are designed to encourage the structural adjustment of the economies of the developing countries implementing them. In this vein, these countries are expected to follow a neoliberal economic agenda recommended by the World Bank and International Monetary. Such a liberal agenda would, for example, include curtailing government spending and promoting market competition. In this case, the free market is given priority while the state assumes a secondary role. And with the entrenchment of freedom in the marketplace, individuals are left to account for their actions. This principle can be extended to education, welfare and healthcare.

However, PRSPs have been criticized for their impact on the social sector. Critics have argued that by insisting on cuts in health spending, PRSPs affect the supply of health services. And by reducing household income, PRSPs affect the demand for health services (WHO).

It follows that PRSPs while having a direct impact on health can also have indirect influences. For example, cuts in government revenues can directly lead to cuts in healthcare services. Such cuts can also lead to decreased employment, increased prices of commodities, decreased government services and decreased spending on infrastructure which can all in turn potentially lead to an increase in morbidity and mortality thereby affecting health status indirectly (Brunelli, 2007).

Correspondingly, studies have shown that macroeconomic adjustment programs have had a deleterious effect on the health status of people in countries implementing them. In a study of Structural Adjustment Programs in Pakistan, Bhutta (2001) found that IMF conditionalities in the 1980s led a dramatic rise in the proportion of national budget devoted to debt services. Bhutta also found that poverty increased in Pakistan, which in turn led to increased rates of malnutrition, especially childhood malnutrition. When household income decreases, food intake also decreases.

In many developing countries, in addition to the austerity conditions that PRSPs can impose on the social sector, income, social and cultural barriers can also inhibit a population's access to healthcare. In these cases, a population's utilization of healthcare is not only dependent on the adequacy of supply but also on affordability and physical accessibility. This imposes a two mechanism of effects – a supply side and a demand side.

On the supply side, Heddad, etal (2001) argue that health policies relative to regulation, organization and financing of health systems can have an impact on healthcare availability, price and quality. On the demand side, these writers maintain that a community's economic climate affecting employment, resource availability, and consumption as well as health inputs such as nutrition, education, and risk exposure "are expected to modify health needs, ability to pay, perception of the price, of accessibility and of quality of health services." Therefore, ultimately, simultaneous changes in both supply and demand affect the utilization of health services.

PRSPs are advocated to remedy the effects of a crisis and since they involve both short-run stabilization and long-run adjustment measures, one would expect that in the stabilization stages of the economy, access to health care especially for the poor will worsen (Haddad, et al, 2001). But as the economy adjusts to the measures of PRSPs, conditions would start to improve.

It is also important to note that studies have established that over a billion people in low- and middle-income countries have no access to needed health services as they are unaffordable. Even in a country like South Africa where access to healthcare is constitutionally guaranteed, Harris, et. al (2011) have argue that "considerable inequities remain, largely due to distortions in resource allocation." Additionally, vast distances and high travel costs between rural areas and urban areas and high user fees for care have also militated against access to healthcare in many developing countries.

All African countries fall within the broad category of developing countries. Accordingly, Sierra Leone's health characteristics mirror those of a developing country. The country has a decentralized healthcare system where a mixture of private, government and non-governmental organizations provide medical care. Generally, all medical care in the country carries a user-fee. The Ministry of Health and Sanitation is responsible for organizing healthcare and therefore oversees all healthcare delivery in the country.

Sierra Leone's decentralized healthcare system features 13 health districts with each district having a health management team and an average of 50 peripheral health units (PHUs) and over 100 technical staff.

The PHUs, which are the primary healthcare delivery points are of three types: the Maternal and Child Health centers, the Community health posts and the community health centers. The Maternal and Child Health posts are located in smaller towns with populations between 500 and 2000. They serve as the first level of contact on the ground. The Community health centers in turn, are responsible for health prevention measures, cures and health promotion activities. They also oversee the other PHUs in the area. The Community health posts perform functions that are similar to community health centers. However, they have fewer facilities.

In April 2010, concerned with the dwindling access to healthcare services especially among women and children, and the rising maternal and infant mortality rates, the government of Sierra Leone launched the "Free Health Care Insurance" (FHCI) initiative. The initiative declared free medical care for pregnant women, breast –feeding women and children under the age of five. Below, we present healthcare expenditure as a percent of GDP for five West African countries between 2009 and 2012.

Table 1: Health expenditure, total (% of GDP): Sierra Leone and 4 other West African countries

	2009	2010	2011	2012
Sierra Leone	16.9	15.4	16.3	15.1
Liberia	14.4	13.1	15.6	15.5
Guinea	6.3	6.2	6.0	6.3
Ghana	5.1	5.3	5.3	5.2
Senegal	4.8	4.8	5.0	5.0

Source: Compiled from World Bank Data

Table 1 shows that as a % of GDP, health care expenditure in Sierra Leone has been higher between 2009 and 2012 than Liberia, Guinea, Ghana, Senegal. Reports from Sierra Leone's Ministry of Health and Sanitation (MoHS) have stated that spending on healthcare has been beneficial to the country. According to the MoHS, a year after the launching of FHCI, 39,100 more women delivered their babies at health facilities while 12,000 more maternity complications were dealt with at the country's health facilities. Moreover, there was a substantial increase in the number of women seeking post-natal care as compared to the pre-FHCI period (Sierra Leone, MoHs 2011).

But while the foregoing represents good news, a 2011 Amnesty International interview of Sierra Leonean women and girls revealed serious problems with the new health care initiative. According to Amnesty International, many women and girls who had tried to access the healthcare system after the FHCI were unable to access drugs or care. The situation was that either the healthcare facilities did not have the drugs and other essential medical supplies or patients were charged for medicines and care that were supposed to be provided for free. There were also cases where pregnant women were referred to pharmacies where medicines were available for a price (Amnesty International, 2011).

Another bad news was that since FHCI had increased the demand for healthcare, the initiative had put an understaffed healthcare system under serious pressure. And to make matters worse, like in many other

developing countries, there were problems associated with long travelling distances between rural and urban areas and accountability issues in the very healthcare system itself. All these have made it apparent that access to healthcare is not only about user fees.

Additionally, Sierra Leone's healthcare system also suffers from weak institutional capacity, inequities in access to proven interventions, inadequate statistical health data, and weak monitoring and evaluation capacity. And like other African countries, there are also problems associated with internal resources. Moreover, Sierra Leone still faces challenges associated with insufficiency of external resources needed to achieve the Millennium Development Goals (MDGs). The MDGs were adopted in 2000 by United Nations member states as initiatives to address poverty and drastically reduce it by 2015.

POVERTY REDUCTION STRATEGY PAPERS (2005-2012)

Since the end of the civil in 2002, Sierra Leone has had two Poverty Reduction Strategy Papers (PRSPs). PRSP I covered the periods 2005-2007 and PRSP II covered the periods 2009 -2012. PRSPs are documents that describe a country's macroeconomic, structural and social policies and programs over a three year period or longer.

PRSPs are prepared by member countries of the World Bank and the International Monetary Fund in collaboration with these institutions (World Bank and IMF) and other important stakeholders with the objective of promoting broad-based growth and reducing poverty.

While PRSPs aim to provide the crucial nexus between national public actions, donor support, and the development outcomes needed to meet the United Nation's Millennium Development Goals (MDGs), PRSPs also highlight a country's financing needs and major sources of financing.

According to the IMF, five core principles must underlie PRSPs.

- First, they must be country-driven and must promote national ownership of strategies through the broad-based participation of civil society.
- Second, they must be result-oriented and focused on producing results that benefit the poor.
- Third, they must be comprehensive in that they must recognize the multinational nature of poverty.
- Fourth, they must be partnership-oriented in that they must involve a coordinated participation of development partners (government, domestic stakeholders, and external donors).
- Fifth, they must have a long-term perspective for poverty reduction.

At the time of the launching of PRSP-II, the government of Sierra Leone acknowledged that progress during the implementation of PRSP-I had been mixed. For example, the country's macroeconomic environment had been stable with strong economic growth. Additionally, inflation had been moderate and there had been declining current and fiscal imbalances. However, serious challenges remained especially in the healthcare sector.

For PRSP-II, the government presented a comprehensive medium –term strategy that focused on four strategic priorities:

- The enhancement of the National power supply through improvements in the management and regulation of the energy sector. Work was still ongoing on the Bumbuna Hydroelectric Project. Once this project was completed, electricity supply would be enhanced in all cities in the country.
- Increasing Agricultural and fisheries productivity. This sector was also to be made competitive. Since the agriculture and fisheries sector engaged the services of the majority of Sierra Leoneans, developing this sector was critical to economic growth and development. And in developing this sector the government wanted to focus more on rural poor smallholders who constituted the poorest segment of society.
- Significantly improving the national transportation network. By developing this sector, the movement of goods and services and of people would be greatly enhanced. This would also lead to increased investment and economic activity.
- Promoting sustainable human development through decentralized service delivery. Government would focus on improving education and raising the completion rate, especially of primary and junior secondary schools. This strategy will also focus on reducing mortality rates, especially for infants and pregnant women, making available minimum maternal and neonatal health care systems, scaling up immunization, promoting early and exclusive breast feeding and promoting hygienic practices all over the country.

According to the government, the foregoing priorities were to be underpinned by good governance, macroeconomic stability, private sector development, financial sector reform, and natural resource management.

Government also outlined the financing options for achieving the aforementioned objectives. These were to include the intensification of domestic revenue mobilization, which will see an improvement of the efficiency of tax and non-tax collection. Additionally, government was also determined to convince its development partners to increase donor support. Moreover, government will solicit support from the Millennium Challenge Corporation with its commitment to fight poverty.

Furthermore, government would explore the private sector for partnership especially in the infrastructural development while at the same time exploring the concept of Diaspora bonds, which will involve the issuing of bonds to Sierra Leoneans in the Diaspora.

HEALTH STATUS IN GENERAL

There are too many deaths of mothers, babies and children in Sierra Leone from preventable conditions. Maternal and child health indicators are among the worst in the world. Also, poverty levels

are high and so are illiteracy, fertility, and teenage child bearing rates. And to make matters worse, a life expectancy of 45 years is the worst in the world.

Table 2: Life expectancy at birth, total (years): Sierra Leone and 4 other West African countries.

	2009	2010	2011	2012
Sierra Leone	45	45	45	45
Liberia	59	59	60	60
Guinea	55	55	56	56
Ghana	60	61	61	61
Senegal	63	63	63	63

Source: Compiled from World Bank Data

Table 3: Maternal mortality ratio (modeled estimate, per 100,000 live births): Sierra Leone and 4 other West African countries.

	2010	2013
Sierra Leone	1,200	1,100
Liberia	680	640
Guinea	690	650
Ghana	410	380
Senegal	360	320

Source: Compiled from World Bank Data

A maternal mortality ratio of 1,100 per 100,000 live births in 2013 makes Sierra Leone one of the worst places in the world for a mother to give birth. This rate is easily the worst among the four other West African countries with which comparisons are made in the table above.

In addition to the foregoing, Sierra Leone's infant mortality rates per 1,000 births of 117 in 2009, 114 in 2010, 112 in 2011, 110 in 2012 and 107 in 2013 are far worse than Liberia, Guinea, Ghana, and Senegal for the same period of time (World Bank). Furthermore, the country has one of the worst under-5 mortality rates in the world.

Sierra Leone's healthcare system ranks among the worst in the world. This can partly be attributed to the fact that much of the country's health infrastructure was destroyed during the civil war. But notwithstanding this, corruption and mismanagement are rife in the health sector. Additionally, currently, there is an acute shortage of healthcare workers for a population of 6 million people. Many nurses and doctors fled the country during the civil war and healthcare workers continue to leave due to uniformly low wages and escalating workloads.

The country's healthcare is highly subsidized by foreign aid and supplemented by healthcare non-governmental organizations. In fact it is estimated that foreign non-governmental organizations supply 60% of the budget of Sierra Leone's Ministry of Health and Sanitation (BBC Newsnight, 2007).

Sierra Leone's healthcare system generally operates on a user-fee basis. This makes healthcare to become an unaffordable luxury for 70% of the population living below the poverty line. This has

contributed immensely to the country's high mortality rates. The under-five mortality for the period 2009-2013 was 156 deaths per 1,000 births with most of the early childhood mortality occurring in the first year of life. Infant mortality, which ranks among the highest in world, was 92 deaths per 1,000 births between 2009 and 2013 (2013 SLDHS).

The 2013 SLDHS estimates the following five child mortality rates:

i) Neonatal mortality (NN): the probability of a child dying within the first month of life.

ii) Post neonatal mortality (PNN): the difference between infant and neonatal mortality.

iii) Infant mortality: the probability of a child dying before the first birthday.

iv) Child mortality: the probability of a child dying between the first and fifth birthday.

v) Under-5 mortality: the probability of a child dying between birth and the fifth birthday.

Table 4: Early Childhood Mortality Rates: Neonatal, Postnatal, Infant, Child, and Under-five mortality rates for five-year periods preceding the 2013 survey

Years Preceding the survey	Neonatal Mortality (NN)	Post-Neonatal Mortality (PNN)	Infant Mortality	Child Mortality	Under-five Mortality
0-4	39	54	92	70	156
5-9	46	81	127	77	194
10-14	48	104	152	89	227

Source: SLDHS 2013

Although high in absolute terms, a downward trend can be observed in infant mortality rates as these rates decreased from 152 deaths per 1,000 births between 1999 and 2003 to 127 between 2004 and 2008 and 92 between 2009 and 2013. This contrasts with neighboring Liberia where in the five years immediately preceding 2013 (2008-2013), infant mortality was only 54 deaths per 1,000 live births.

Currently, child mortality in Liberia is estimated at 42 deaths per 1,000 children surviving to 12 months of age, while the overall under-5 mortality rate between 2008 and 2013 was 94 deaths per 1,000 births (LDHS 2013).

In Nigeria, the level of under-5 mortality for the period 2009-2013 was 128 deaths per 1,000 live births. The infant mortality rate was estimated at 69 per 1,000 live births. Thus, Sierra Leone trails Liberia and Nigeria in the categories that have been compared (NDHS 2013).

Maternal mortality in Sierra Leone also ranks among the highest in the world. In fact it has been suggested in several studies that getting pregnant in Sierra Leone is a very risky exercise as one in every 21 women in the country is at risk of death in child birth.

As for child mortality, its main causes are malaria, diarrhea, and pneumonia. But malnutrition also plays an important role as sixteen percent of all children are underweight with 6 percent being severely underweight. 18 percent of all male children are underweight while 15 percent of females are underweight.

There are also geographical disparities in children that are underweight with more underweight children (18 percent) found in rural areas than in urban areas (12 percent) (SLDHS 2013).

Also, the highest proportion of underweight children (18 percent) is found in the northern region of the country while the lowest (10 percent) is found in the country's western region. Moreover, a higher proportion of underweight children (17 percent) are born to uneducated women compared with 14 percent of underweight children who are born to women with secondary school education (SLDHS 2013).

And anemia has also posed a serious threat to health in Sierra Leone. Anemia is especially common among children and women. In fact 80 percent of all children between the ages of 6 and 59 months are afflicted by anemia (SLDHS 2013).

Malaria is also a serious threat to life in Sierra Leone. Like other countries in the developing world, Sierra Leone suffers from a crisis of malaria. Malaria is the most common cause of illness and death in Sierra Leone. This disease easily dwarfs all other outpatient visits in Sierra Leone as it accounts for 50% of all outpatient visits. It also accounts for 38% of admissions. The most vulnerable groups to malaria in Sierra Leone are children aged under 5 years and pregnant women (WHO)

ACCESS TO HEALTHCARE SERVICES

Access to healthcare services is critical to efforts aimed at reducing mortality rates in Sierra Leone. Unfortunately, many Sierra Leoneans find it difficult to access quality medical care for a host of reasons. Some of the more serious reasons are: getting money for treatment; distance to health facility; concern no drugs are available.

Problems in accessing healthcare

Table 5: Percentage of women age 15- 49 reporting serious problems in accessing healthcare when sick, by type of problem, 2008

Background characteristics	Getting money for treatment	Distance to health facility	Concern no drugs available	At least one problem accessing healthcare	Number of women
Age					
15-19	76.8	49.2	47.6	86.3	1,198
20-34	80.0	54.0	49.1	89.4	3,873
35-49	81.8	53.1	48.7	89.7	2,303

Source: Compiled from 2008 SLDHS

But accessing healthcare also varies according to region, education, and wealth quintile. According to the 2008 SLDHS, women in the Eastern and Northern regions had more problems with getting money to access healthcare than their counterparts in the Southern and Western regions. Also, nationally, less educated women had more problems with getting money traveling to health facilities or other problems in accessing healthcare.

Further, women in the fourth and highest wealth quintiles have lesser problems in accessing healthcare than their counterparts in the middle, second and lowest wealth quintiles.

A 2009 Amnesty International study found that thousands of Sierra Leonean women and girls die every year as a result of treatable complications of pregnancy and childbirth. According to this study, while most of these people die in homes, some do not survive the journey to the hospital, dying in taxis, on motorbikes or on foot. For those that are fortunate to reach a healthcare facility, many are denied the necessary treatment to save their lives.

Thus, three critical delays can be associated with maternal mortality. These are the delays in seeking medical care, delays in getting to a clinic or hospital, and delays in treatment at the clinic or hospital. These delays in turn are driven by costs of healthcare, traveling distance to healthcare facilities, poor infrastructure, policy of healthcare officials requesting payment before administering treatment, lack of medical supplies at clinics and hospitals, and unavailability of trained staff.

Although a high percentage of Sierra Leonean women now receive some type of antenatal care, many continue to give birth outside a health facility without a medical official or midwife in attendance. This can be dangerous when complications arise. Studies have established that while many women have died as a result of bleeding after giving birth, others have suffered hours or days of obstructed labor.

The maternal indicators show that the percentage of mothers that delivered by a skilled provider varied by age, residence, region and wealth quintile. Based on the 2013 SLDHS, teenage pregnant women were more likely to deliver by a skilled provider than their older counterparts. Thus, while 64.6% of teenage pregnant women delivered by a skilled provider, 59.9 % of pregnant women between the ages of 20-34 delivered by a skilled health provider and 52.5% of women 35 and older delivered by a skilled provider.

Also, a higher percentage of pregnant women in urban areas were delivered by a skilled provider than rural pregnant women. Moreover, a higher percentage of pregnant women in the Eastern, Southern and Western regions had access to a skilled provider than women in the Northern region. This may have to do with the fact that of the four regions in the country, the northern region has the least number of health care facilities.

Access to a skilled provider also varies on the basis of wealth quintile, with the richest wealth quintile having more access and the poorer and poorest having the least access to a skilled provider.

Like many other countries, Sierra Leone has adopted the World Health Organization guidelines for childhood immunizations. According to these guidelines, all children should receive vaccinations against tuberculosis, polio, measles and other diseases during the first year of life. Based on information collected during the 2013 SLDHS, two-thirds (72.6) of children within the age range 12-23 months had received all vaccinations.

Table 6: Percentage of women age 15-49 reporting serious problems in accessing healthcare when sick, by type of problem, 2008

Background characteristics	Getting money	Distance to health facility	Concern no drugs available	At least one problem accessing healthcare	Number of women
Region					
Eastern	83.8	58.4	59.0	92.2	1,325
Northern	88.0	59.7	47.6	94.2	3,001
Southern	79.9	51.8	61.1	92.8	1,542
Western	60.9	35.7	29.2	71.8	1,506
Education					
No education	85.5	59.5	51.4	93.2	4,860
Primary	80.1	44.9	44.9	88.5	960
Secondary or higher	62.6	37.3	42.6	76.0	1,554
Wealth quintile					
Lowest	89.5	68.0	56.3	96.2	1,382
Second	87.5	61.1	51.2	95.4	1,368
Middle	87.0	59.6	52.3	95.0	1,428
Fourth	80.7	46.8	48.1	89.9	1,472
Highest	60.1	34.1	38.1	72.3	1,723

Source: Compiled from 2008 SLDHS

Variations in immunization also exist between rural areas and urban areas on the one hand, and educational levels of mothers, on the other. Accordingly, 69 percent of rural area children received all vaccinations compared with 66 percent of urban children. Also, a higher percentage of children with mothers with secondary or higher education received all vaccinations compared with children of mothers with no education or only primary school education.

Studies have established that acute respiratory infection, fever, and dehydration from diarrhea are major causes of childhood morbidity and mortality in Sub-Saharan Africa. Therefore, treating children with symptoms of these illnesses is critical in reducing child deaths. According to the 2013 SLDHS, 72 percent of children with acute respiratory infection, 66 percent with fever, and 65 percent with diarrhea sought treatment from a health facility.

Also of importance is that in Sierra Leone as in many Sub-Saharan African countries, traditional medicine for the treatment of both communicable and non-communicable diseases is relied on by many. The problem here is not that traditional medicine does not have many positive aspects. Studies have established that many techniques used in traditional medicine, especially those that involve the use of herbs and roots have been proven scientifically to have clinical success. However, relying on traditional medical care as the primary source of medical care can be problematic especially when complications arise in the process of treating a patient.

Table 7: Maternal care indicators

Background characteristics	Percentage with antenatal care from a skilled provider	Number of women	Percentage delivered by a skilled provider	Percentage delivered in a health facility	Number of births
Mother's age at birth					
<20	98.6	1,609	64.6	57.4	2,293
20-34	97.1	5,566	59.9	54.5	8,075
35+	95.4	1,473	52.5	49.9	1,830
Residence					
Urban	98.2	2,387	78.9	68.1	3,112
Rural	96.7	6,260	53.2	49.7	9,087
Region					
Eastern	98.3	2,054	77.0	72.8	2,958
Northern	95.5	3,385	41.5	37.1	4,749
Southern	98.2	1,982	64.0	60.4	2,892
Western	97.7	1,226	74.2	60.7	1,600
Mother's education					
No education	96.3	5,768	54.2	49.4	8,394
Primary	98.0	1,203	63.0	57.5	1,725
Secondary or higher	99.2	1,676	79.3	71.7	2,079
Wealth index quintile					
Poorest	96.0	1,901	50.9	48.4	2,858
Poorer	96.7	1,809	52.0	49.8	2,616
Middle	96.7	1,797	53.2	49.2	2,573
Richer	98.1	1,694	67.4	60.0	2,300
Richest	98.3	1,447	83.7	70.1	1,851
Source: Compiled from SLDHS 2013					

Table 8: Child vaccinations

Background characteristics	All basic vaccinations	No vaccinations	Percentage with a vaccination card	Number of children
Sex				
Male	68.3	3.8	71.0	1,040
Female	67.8	3.2	75.4	1,129
Residence				
Urban	65.6	4.2	65.0	561
Rural	68.9	3.2	76.2	1,608
Education				
No education	66.9	4.7	73.2	1,423
Primary	65.2	1.2	78.1	313
Secondary or higher	73.8	1.1	70.2	432
Wealth quintile				
Lowest	73.1	4.0	72.1	521
Second	66.3	4.5	77.3	463
Middle	66.8	2.3	77.8	464
Fourth	69.4	2.4	76.7	402
Highest	62.3	4.5	58.8	319

Source: Compiled from 2013 SLDHS

It is important to note that problems associated with accessing healthcare in Sierra Leone are related to poverty and inequality. When PRSPs are implemented, the macroeconomic changes that follow immediately impact people living in the structurally adjusted country. The most common effect is a dramatic increase in poverty and the income gap between the rich and the poor.

Despite recent growth, Sierra Leone remains a poor country. GDP per capita in Sierra Leone still lags behind the sub-Saharan average. This makes Sierra Leoneans some of the poorest people in the world, thereby affecting their consumption of healthcare.

Table 9: GDP Per capita (current US $)

Year	Sierra Leone	Sub-Saharan Africa
2011	374	1,445
2010	326	1,309
2009	324	1,144
2008	348	1,242
2007	304	1,112
2006	267	983
2005	241	863
2004	221	758
2003	210	623

Source: Compiled from: World Bank: A Poverty Profile for Sierra Leone, June 2013

GDP per capita for the period 2003-2011 as measured in current USD, increased from $210 to $374 in Sierra Leone. The average increase over this same period for sub-Saharan Africa was 132 percent, from $623 to $1,445.

Despite the low per capita income, the overall incidence of poverty in Sierra Leone declined from 66.4 percent in 2003 to 52.9 percent in 2011. The poor were individuals in households with per adult equivalent consumption between 1,625,568 Leones (371.39 USD) per year in 2011. In 2003, this was equivalent to 750,326 Leones (173 USD) per adult equivalent year. With these poverty lines, the rural poverty rate was substantially higher than the urban poverty rate. While rural poverty rate in 2011 was 66.1 percent compared with 78.7 percent in 2003, urban poverty in 2011 was 31.2 percent compared with 78.7 percent in 2003 (The World Bank, 2013).

There were also regional disparities in poverty rates. While these rates declined in the Northern, Eastern, and Southern regions, they increased in the Western region.

The statistics for income inequality were just as bad. Income inequality is measured by the Gini index, which uses a scale of 0 to 100, where zero represents perfect equality and 100, perfect inequality. In reality, neither extreme occurs anywhere. However, an inequality above 50 percent is considered to be high and could undermine a society's sense of unity and common purpose (The World Bank, 2013).

Inequality adversely affects human development. Although growth has been buoyant in much of sub-Saharan Africa in the last decade, there is a general consensus that this growth has not trickled down to the majority of the population is terms of better living standards. There are also concerns that not only is

growth in sub-Saharan Africa accompanied by rising income inequalities but that the existing growth model is itself driving increasing income inequality. In Sierra Leone, overall, national inequality decreased from 0.39 in 2003 to 0.32 in 2011.

There were also variations in inequality across districts, with Bombali district in the North registering the highest value of 0.42 and Tonkolili, also in the North registering the lowest value of 0.21. The rural areas experienced a decrease in the Gini coefficient from 0.32 to 0.29. Additionally, a decrease occurred in Freetown, the capital, from 0.31 to 0.27. However, other urban areas registered an increase from 0.29 to 0.31 (The World Bank, 2013).

CONCLUSION

Over the last decade, macroeconomic policies in Sierra Leone have tended to shape health outcomes especially with regard to access to health care services. The introduction of Poverty Reduction Strategy Papers, a set of macroeconomic policies starting in the early 2000s have tended to have a negative impact on access to healthcare services as they have resulted in a net reduction of government expenditure in the country's social sector, which includes the healthcare institutions.

The results of the demographic and health surveys of the 2008 and 2013 highlight a series of grim statistics relative to mortality rates in Sierra Leone. A life expectancy of 45 years is the lowest in the world. And infant and maternal mortality are skyrocketing. Thus, Sierra Leone's health status is by any measure very poor.

This study found that access to healthcare services in Sierra Leone varies by income, education and geographical location. It found that there is a positive relationship between income levels and access to healthcare services. Also, the more educated a Sierra Leonean is, the more access he could have to healthcare services. Furthermore, urban area residents tend to have more access to healthcare services than rural area residents. This may have to do with the fact that there are more healthcare services available in urban areas than in rural areas.

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Cost of Loans and Group Affiliation

A. Melih Küllü *

ABSTRACT

The paper examines the impact of business group affiliation on cost of loans in an emerging market setting. Bank loans are dominant source of corporate funding, specifically in emerging markets, in which business groups exist as leading economic entities. The impact of belonging to a group on the firm's cost of capital is important to understand. Overall, findings suggest that cost of borrowing advantages/disadvantages exist for business groups and their affiliated firms.† Business groups may create borrowing cost advantages by their implemented policies and the selection of their loan applicant firms at the time of their borrowing.

INTRODUCTION

Is there an advantage/disadvantage in business group affiliation when seeking capital? Does affiliation level of the borrowers affect the assessment of the lenders? How about group strategies, structure or implemented policies? Altogether, what is the impact of business group affiliation on cost of borrowing? This study aims to provide more insight to address these economically important questions for business group affiliated firms.

Business groups are important economic actors in many markets around the world (La Porta et al., 1999). These entities are associations of legally independent firms, which are bound together with formal or informal ties, and act in coordination (Khanna and Rivkin, 2001). The economic, social, and regulatory characteristics of countries play a role in the formation of these entities in each market setting; nevertheless, these groups play a significant role in their respective economies and control a substantial part of their country's productive assets (Weinstein and Yafeh, 1995; Khanna and Yafeh, 2007). They essentially serve as an important powerful form of an economic organization, specifically in emerging market economies (e.g., South Korean *chaebols*, Indian *business houses* and Turkish *holdings).* These groups are one of the major drivers behind the increased role of emerging economies within the global economy.

Bank loans are the most important source of corporate financing as shown in existing research on loan financing, financial contract terms, and cost of debt (e.g. Chava et al., 2009; Graham et al., 2008). Especially in emerging markets, banks are the foremost credit suppliers and outside monitors (Demirguc-Kunt and Levine, 2001; Love et al., 2007), leveraging decisions of group-affiliated firms are significantly different from those of non-affiliated firms such as these groups enjoy exceptional access to government and foreign

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† For further details of the results and tables, see Küllü et al. (2014a).

loans (Manos et al., 2007), and single countries are considered the best settings to understand financial contracting terms regarding hard-to-compare small and private firms (Qian and Strahan, 2007).

Building on the extant literature on group affiliation, this paper examines the impact of group affiliation on the respective members' cost of debt. It specifically brings organizational structure (group affiliation extent, foreign and government ownership, being a financial firm, foreign group affiliation), operational strategy (having a group bank, being diversified or focused), and internationalization (cross-listing) policies into the picture to provide a more thorough perspective to analyze the group affiliation impact on cost of debt. It uses bank loans as the metric and Turkish groups (holdings) and the market as the setting. It concentrates on firms' cost of loans as captured by the spread given that default risk is the foremost determinant of loan pricing (Guner, 2006), and is significantly impacted by corporate governance practices (Freixas and Rochet, 1997). Effective corporate governance is expected to decrease the risks that are associated with information asymmetries. Easley and O'Hara (2004) argue that disclosure of information lowers the informational risk, and therefore decreases the cost of capital. Strahan (1999) shows that the cost of loans is related to the riskiness of the borrowers, and non-price loan terms are related to pricing. For non-price loan terms, I examine maturity and deal amount, and for price term, I examine spread.

In examining the impact of group affiliation on the firm's cost of bank loans I seek answers to the following questions: (a) What is the impact of business group affiliation on affiliated firm's cost of loans, and does the extent of group affiliation matter? (b) What is the impact of having a group bank, or being a financial firm on the cost of loans? (c) What is the impact of being focused or diversified on the cost of loans? (d) Does foreign or government ownership, foreign group affiliation, or cross-listing matter?

LITERATURE REVIEW

A majority of business groups are highly diversified entities with pyramidal or complex ownership structures. Corporate finance theory suggests that corporations need to focus in order to minimize possible agency problems and utilize management expertise (Jensen, 1986; Denis et al., 1997). Lang & Stulz (1994) and Berger & Ofek (1995) find that membership in diversified conglomerates destroys value. Many other diversification studies have also found that focus leads to better performance compared to diversifying (Meyer et al., 1992; De Long, 2001; Laeven and Levine, 2007). On the other hand, Khanna and Palepu (2000b) show that diversification may not destroy value in emerging market settings. Since, these groups are highly diversified, but controlled by dominant/founder shareholders, major lines of these studies focus on corporate control motivations of dominant/founder shareholders and some potential governance concerns around agency problems. Unlike widely-held US conglomerates, emerging market business groups tend to have concentrated corporate control (La Porta et al., 1998). They can be private family firms, or public but governed with a very limited number of major shareholders.

Dominant/founder shareholders create corporate control via differentiating cash-flow/control rights (La Porta et al., 1999), cross-holdings (Claessenset al., 2000) and pyramid ownership structures (Bebchuk et al., 1999; Almeida and Wolfenzon, 2006). With established control rights, the dominant shareholders of these groups create a joint standing against minority shareholders, creditors, regulatory agencies and any other third parties.

Corporate finance theory suggests that diversified corporations underperform, -possibly due to potential agency problems and inefficiencies in management (Jensen, 1986; Berger and Ofek, 1995; Denis et al. 1997)-, group affiliation enables some positive perceptions such as co-insurance/risk sharing effect (Ferris et al., 2003; Khanna and Yafeh, 2007; Francis et al., 2014), use of funds to provide support to distressed group firms - propping (Bae et al., 2002), monitoring ability of large controlling shareholders (Shleifer and Vishny, 1986; McConnell & Servaes, 1990; Weinstein & Yafeh, 1995), existence of internal markets and group financial support (Hoshi et al., 1991; Lincoln et al., 1996; Bianco and Nicodano, 2006; Gopalan et al., 2007; Masulis et al., 2011), importance of group reputation/track record as a substitute for underdeveloped investor protection regulations (Khanna and Palepu, 2000a; Gomes, 2000), debt renegotiation power of large controlling shareholders against creditors (Davydenko and Strebulaev, 2007), increased competitiveness and ease in investment implementation and technology transfers (Guillen, 2000).

On the other hand, the possibility of controlling shareholders' expropriation of resources - tunneling (Bae et al., 2002; Bertrand et al., 2002), increased controlling rights against the interest of minority shareholders (Claessens et al., 2002; La Porta et al., 2002), hard to monitor internal group activities by outsiders (Lin et al., 2011), inefficiency in allocation of resources through internal capital markets (Rajan et al., 2000; Scharfstein and Stein, 2000), and inefficiencies and value loss from diversification discount perspective (Berger and Ofek, 1995; Lang & Stulz, 1994) are considered as major potential problems that are associated with business groups.

At large, positive and negative sides of business group's corporate control have been at the center of the studies from structural and performance perspectives. Performance impact of group affiliation (Khanna and Rivkin, 2001), the groups' role of circumventing market inefficiencies (Chang and Hong, 2002; Fisman and Khanna, 1998; Fisman, 2001, Amsden and Hikino, 1994) and comparisons of affiliated and unaffiliated firms (Khanna and Palepu, 2000a; Manos et al., 2007) has been some related subjects of study.

Business groups have been studied in various emerging market settings such as Chili (Khanna and Palepu, 2000b), Thailand (Bertrand et al., 2008), Korea (Chang and Choi, 1988; Bae and Jeong, 2007; Bae et al., 2002), India (Khanna and Palepu, 2000a; Bertrand et al., 2002; Gopalan et al., 2007), Russia (Chernykh, 2008; Shumilov, 2008), and cross-country studies (Guillen, 2000; Khanna and Rivkin, 2001; Khanna and Yafeh, 2005; Claessens et al., 2000) among others. However, despite the importance of these

groups in the economic development of significant number of countries, one area of importance that has not been examined in detail is the impact of group affiliation on its members' cost of loans.

Information asymmetry between borrowers and lenders is highly important in the lending process (Sufi, 2007). Banks have access to proprietary information, and they are more effective monitors than equity and bond holders (Diamond, 1984; Fama, 1985). Since, some business groups have group banks within their group structure, and group firms tend to act in coordination, financing capabilities of affiliated firms may differ from unaffiliated firms at the time of their borrowing. It would be interesting to examine if having a group bank has an impact on group firms' cost of debt. Existing theoretical literature shows that corporate governance and debt policies are highly related (Williamson, 1988; Diamond, 2004). Empirical studies show that both firm-level governance characteristics (Sufi, 2007; Francis et al., 2008; Chava et al., 2009), and country-level regulatory environment and business firm characteristics are highly important factors regarding bank loans and loan contract terms (Qian and Strahan, 2007; Bae and Goyal, 2009). Firm-level corporate governance has been found to have an impact on bank loan contracting (Francis et al., 2009). The ability of controlling shareholders to expropriate from minority shareholders and creditors is a major concern (Claessens et al., 2000), and a main source of corporate credit risk is strategic actions of self-interested dominant shareholders (Aslan and Kumar, 2012). Hence, this study focuses on the loan market and single emerging economy to better understand the relationship among firms' cost of debt, group affiliation, firm structure, corporate strategies, and policies.

TURKISH BUSINESS GROUPS

The importance of emerging markets within the global economy has increased steadily over the past two decades. Emerging markets differ from developed markets in many respects. Though there are many other relevant characteristics, important differences are their rapid growth rates, abundant resources, increasing population, and dynamic internal demand. Similar to other emerging markets' business groups, Turkish holdings play a dominant role within the economy and around the neighboring regions. Turkey presents an appropriate setting to examine business groups. It is highly integrated with European and Asian markets with a rapid growth in the last decade (fastest-growing European economy). The Turkish economy is the fifteenth largest in the world, and the sixth largest in Europe based on World Bank gross domestic product (GDP) rankings. Its economy has been steadily growing despite several crises it has faced in the last decade. It experienced an average growth rate of 6.8% from 2002 to 2007. After the 2008 global crisis, growth reached 9.2 % in 2010, and 8.5 % in 2011. Ownership data and group affiliation information is available and tightly monitored by regulatory agencies. Beyond Turkey, Turkish holdings are specifically active in neighboring regions: Eastern Europe, Central Asia, the Middle East, and Northern Africa. These groups are highly diversified, and group firms are tightly controlled. Both family and non-family business groups exist. Turkey is not a transition economy, liberalization policies has been implemented since 1950s

with an escalated trend after 1980s. Additionally, Turkish business groups have been studied at a lesser level compared to other emerging economy business groups.

MAIN RESULTS

Using bank loan data from Dealscan and firm-specific data from Worldscope and the Istanbul Stock Exchange over the 1991–2011 time-period, I find that group affiliation extent increases cost of loans (lower maturity, higher spread), government ownership increases cost of loans (lower maturity, higher spread, lower deal amount). Moreover, having a group bank is advantageous in terms of cost of loans (higher maturity, lower spread), and foreign ownership is beneficial in terms of pricing (lower spread), however being affiliated with a foreign group is not beneficial (lower maturity). Additionally, diversification strategy is not beneficial in terms of cost of loans (lower maturity and deal amount). Several studies show that emerging market firms that are diversified, have foreign ownership, or are cross-listed have a lower cost of bank loans. The results have important implications for understanding the relationship among an affiliated firm's strategy, structure, and its cost of debt and also for the development and growth of emerging markets. Overall, these findings suggest that there is a cost of borrowing advantage in having a group bank, having foreign ownership and being focused in terms of their decreasing impact on borrower firms' cost of loans.

CONCLUSION

The empirical evidence considered in this study shows that the extent of group affiliation matters. I find that group affiliation extent increases cost of loans (lower maturity, higher spread), government ownership increases cost of loans (lower maturity, higher spread, lower deal amount). Moreover, having a group bank is advantageous in terms of cost of loans (higher maturity, lower spread), and foreign ownership is beneficial in terms of pricing (lower spread), however being affiliated with a foreign group is not beneficial (lower maturity). Additionally, diversification strategy is not beneficial in terms of cost of loans (lower maturity and deal amount).

Overall, these findings suggest that there is a cost of borrowing advantage in having a group bank, having foreign ownership and being focused in terms of their decreasing impact on borrower firms' cost of loans. On the other hand, the extent of group ownership in a borrower group firm is perceived to be highly important from the point of lenders, and the choice of borrower group firm have an impact on the cost of debt. This analysis may have important implications for both business groups and lending institutions in terms of loan contracts.

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The Effect of Income on Diabetes after Hurricane Katrina

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ABSTRACT

There is a large literature that documents a positive correlation between income and a variety of measures of good health. This correlation may reflect causality in both directions and may also reflect omitted "third variables" that are positively related to income and health. In my research, I employ an exogenous negative shock to income due to a natural disaster to estimate the true causal impact of income on health, focusing on diabetes. The shock I will use is Hurricane Katrina, which severely damaged counties in Alabama, Mississippi, and Louisiana in August 2005. I use these treatment counties and a variety of alternative sets of control counties in a difference-in-differences (DD) research design. From the Behavioral Risk Factor Surveillance System I obtain measures of income and health for residents of these counties before and after the date on which the hurricane struck. I estimate DD regressions in which income or health is the dependent variable to obtain the impact of the hurricane on each outcome in the treated counties net of other factors. I then use the interaction between an indicator for residents of the treatment counties and an indicator for the period after the hurricane struck as an instrument for income in a two-stage least squares regression of diabetes on income.

INTRODUCTION

The aim of this research is to explain the relationship between income and health, focusing on diabetes, in the presence of a natural disaster, specifically Hurricane Katrina in 2005. There is a large literature to explain the correlation between income and health status, between income inequality and mortality, or health inequality. However, as Fuchs indicates, due to the complicated characteristics of the socioeconomic correlates of health, the significance magnitude and even the sign of the correlation between income and health could vary from study to study (Fuchs, 2004). He also states that the relationship between income and health is more complicated than that between other socioeconomic factors of interest as determinants of health.

There are different approaches to the relationship between income and health. Based on much empirical evidence, income is the most important determinant of health. Higher income leads to better health because higher income individuals or households make large investments in their health. That is why more preventive medication and higher quality healthcare services to maintain good health are available to the high income individuals and households (Grossman 1972). The design of this research is based on the demand for health theory introduced by Grossman (Grossman, 1972). Individuals demand health. The demand for health increases as health is depreciated and approaches the threshold of one's

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health status with respect to his or her socioeconomic status (SES) such as age and gender. The demand for health also implies income can increase health. Following the theory of demand for health, the importance of income for achieving good health is because good health requires spending money. Many papers discuss the income effect on health. In this research, I design an empirical model based on the correlation between income and health and other research on self-rated health outcomes.

This research intends to add to the empirical evidence of the correlation between income and health in the presence of a natural disaster using instrumental variables, assuming Hurricane Katrina affected health only through income. In addition, this research discusses the income effect on health with a possible explanation of the causality issue. The effect of a natural disaster on the relationship between income and health was rarely discussed in previous research.

Hurricane Katrina in 2005 was one of largest natural disasters in U.S. history. It was not suspected to be that devastating until landfall was made. The impact of Hurricane Katrina was so severe that there are still rehabilitation works in progress around the Hurricane Katrina damage areas. From the case of Hurricane Katrina (2005), the experience of natural disasters, in the existence of public relief or support for individual health, assuming no direct disaster effect on health, is negatively correlated with better health status for individuals through individual income status, and it also confirms that higher income status is positively correlated with better health status in the presence of the natural disaster effect.

HURRICANE KATRINA

Hurricane Katrina made landfall in west Louisiana early on Monday, August 29th, 2005. It reached category 5 with wind speeds over 140 miles per hour just before landfall. When it hit the New Orleans area, Katrina was a category 4 hurricane with wind speeds over 100 miles per hour and heavy rainfall. East Louisiana regions, such as the New Orleans area, were severely hit as the hurricane made landfall in the northern area of the Gulf of Mexico. Even though the first landfall was made in Florida, Hurricane Katrina's damage in Florida was not severe in the state since it was only a category 1. Katrina's severity developed because, after it had passed through the Gulf of Mexico, it encountered warm sea temperatures and moisture. The effect of the hurricane was vast: it reached from the Gulf of Mexico to the South all the way to the Northeast and Midwest.

TARGETING HURRICANE KATRINA'S EFFECT

It is difficult to draw the line between Katrina's damage area and the non-damage area in the southern and Midwest regions. Many states were directly affected.* The most severe damage occurred on August 29th - 30th, 2005. Hurricane Katrina became a lower category hurricane when it passed through the inland

* Hurricane Katrina affected Alabama, Mississippi, Louisiana, and Florida.

area on the first day after landfall. The maximum wind speed fell below 50 miles per hour and rainfall dropped on Tuesday, August 30th, 2005.

To examine Hurricane Katrina's effect, I define the treatment region of the residents affected by Hurricane Katrina. One possible method is to designate the most severely damaged area as the regional target area. According to the summary report on the aftermath of Hurricane Katrina by the Bureau of Labor Statistics (BLS) (Dolfman et al. 2007), the estimated damage in the New Orleans area accounts for over 50 percent of total damages. Over 80 percent of the city was flooded. The estimated dollar amount of damage to the area was over $200 billion. Dolfman et al. specify that the over-the-year job loss in the city economy averaged 95,000 jobs during the first 10 months after the hurricane according to the Quarterly Census of Employment and Wages (QCEW) of the BLS. It means one out of three refugees lost their jobs. The estimated wage loss during the 10 months after the hurricane was about $ 2.9 billion or 76 percent of total wages in the New Orleans area. The damage in the New Orleans area is sufficient to identify the New Orleans area as the target area of the hurricane's effect. The economy of the area has been called Greater New Orleans (GNO) which distinguishes it from Metropolitan New Orleans. GNO is composed of 10 parishes: St. James, St. John the Baptist, St. Charles, Jefferson, Orleans, St. Bernard, Plaquemines, Tangipahoa, Washington, and St. Tammany (Figure 1).

Next, the effect of Hurricane Katrina can be quantified by using counties hit by the hurricane and calculating the distance between the geographical coordinates of Hurricane Katrina's landfall and the population centroid of the county. According to NOAA, Hurricane Katrina made its final landfall at 7 am on Monday, August 29th, 2005. The coordinates of the landfall were latitude (°N) 26.8000 and longitude (°W) 91.7000 (Knabb et al. 2005). Using geographical coordinates in terms of latitude and longitude of the counties from Centers of Population for Census 2000, I measure the geographic distance from the landfall of Hurricane Katrina to the population centroid of the county. (Figure 2).

I use these treatment counties and a variety of alternative sets of control counties in a difference-in-differences (DD) research design. From the Behavioral Risk Factor Surveillance System, I obtain measures of income and health for residents of these counties before and after the date the hurricane struck. I estimate DD regressions in which income or health is the dependent variable to obtain the impact of the hurricane on each outcome in the treated counties net of other factors. I then use the interaction between two indicators, one for residents of the treatment counties and the other for the period after the hurricane struck as an instrument for income in a two-stage least squares regression of health on income.

EMPIRICAL MODEL

The base model, using the model in Wooldridge, 2002, is

$$y_{it}^{*} = \gamma \cdot k + R' \cdot \Omega + \delta \cdot w_{it} + X' \cdot \mathrm{A} + Z' \cdot \mathrm{B} + \varepsilon_{it}$$

where, by definition of linear projection error, $E(\varepsilon) = 0$ and $cov(X, \varepsilon) = 0$. k is a time indicator variable, R is a vector of indicators of the Katrina target region, X is a vector of control variables including a constant term, Z is a vector of fixed dummies, and w_{it} is an endogenous covariate. The latent dependent variable for health, y_{it}^{*}, is primarily from diabetes status, which is self-reported in the Behavioral Risk Factor Surveillance System (BRFSS) data from the Centers for Disease Control and Prevention (CDC). Overall general health status, 'Have you ever been told by a doctor that you have diabetes?,' originally places each health response in four categories: Yes, I have diabetes (1), Yes, but only during pregnancy (2), No, I do not have diabetes (3), No, but I am pre- diabetes or borderline diabetes (4). For clear and easy use of diabetes status, I converted the dependent variable into binary dependent variables, which are defined as "Good or positive health status" equals one and 0 otherwise, to clearly estimate the effect of the disaster and the effect of income on the dependent variables for health. I generated binary variables for diabetes. The purpose of this is to clarify the interpretation of the marginal effect of the natural disaster, Hurricane Katrina, on the dependent variables for health.

Health Outcome: Diabetes

Diabetes is referred as "*A group of diseases marked by high levels of blood glucose resulting from defects in insulin production, insulin action, or both. Diabetes can lead to serious complications and premature death, but people with diabetes can take steps to control the disease and lower the risk of complication,"* according to National Diabetes Education program, CDC.

According to the "Economic Costs of Diabetes in the U.S. in 2012" by American Diabetes Association, total cost of diagnosed diabetes in the United States in 2012 is $245 billion and $176 billion for direct medical costs for hospital and emergency care, office visit, and medications. It was the seventh cause of death, on 234,051 certificates, in the U.S. in 2010.

Diabetes has distinguishable types. Diabetes is conventionally defined as type 1, type 2, or gestational type (diabetes during pregnancy). Diabetes is recorded in the questions as "Have you ever been told you have diabetes by medical personnel?" in the BRFSS data. The response of the individual can be either diagnosed as diabetes or diagnosed as borderline diabetes or female diabetes during pregnancy. Since I include either female diabetes during pregnancy or borderline diabetes symptoms, there are four different categories indicating diabetes.

"No Diabetes A1" indicates individuals who have never been told they have diabetes by medical personnel (I do not include either female diabetes during pregnancy or borderline diabetes here). "No Diabetes A2" indicates those who have never been told they have diabetes by medical personnel (I include borderline diabetes symptoms but not female diabetes during pregnancy). "No Diabetes B1" indicates those who have never been told they have diabetes by medical personnel (I include female diabetes during pregnancy but not borderline diabetes symptoms). "No Diabetes B2" indicates that the individuals have

never been told they have diabetes by medical personnel (I include both female diabetes during pregnancy and borderline diabetes symptoms).

Since BRFSS is self-rated, the health status data in BRFSS is subjective: each individual's response does not necessarily correspond to the individual's actual health. For example, the response could reflect the physiological response to the person's particular circumstances and/or his or her feelings about this. Hence it is important to apply other health status measurements that are more objective including assessment by health professionals.

Time indicator

The time indicator variable, k, is a dummy variable indicating the time period after Hurricane Katrina made landfall on August 29, 2005. BRFSS provides the survey date for each observation (day of the month and year). Each of the 50 states and D.C. has its survey on a different day of the month. This paper keeps the original survey date format in applying the time fixed effect to each day of the month in each year.

INDICATOR FOR TARGET TREATMENT REGION OF HURRICANE KATRINA

A vector of indicators for the target treatment region, R, provides indicators for the Katrina damage area. The Hurricane Katrina effect is described in two methods that differ with respect to geography. First, the 10 parishes of Greater New Orleans (GNO) are more specific locations of severe damages (Figure 2). The hurricane damage of the GNO area accounts for over 50 percent of the total damage (summary report from BLS, Dolfman et al. 2007). The model also estimates Katrina's effect by using the 10 parishes of the GNO area as a target treatment region of Hurricane Katrina.

The second category of the treatment region is defined as the geographic distance from the population centroid of the county and parish to the landfall of Hurricane Katrina at 7:00 A.M. on August 29th, 2005. The population centroid distance to the landfall of Hurricane Katrina indicates the residents of the treatment region, affected by Hurricane Katrina, with respect to the geographic distance to the hurricane. The first treatment region by the population centroid distances of the counties and parishes to the landfall of Hurricane Katrina is defined as those that are less than or equal to 21 km (Distance (1)).

Endogenous Covariate

The endogenous covariate, w_{it}, indicates observed annual household income of each observation. BRFSS uses eight income categories, surveyed at the annual income level, ranging from (1) less than $10,000 to (8) $75,000 or more. To convert the observed income level into a continuous variable, each income level is converted to the midpoint value of the interval and I also apply two thirds of the lowest income value to the lowest income level and one and a half times the highest value indicated in the income level to the highest income level. Due to inflation in recorded annual income of households, this paper deflates the annual household incomes by the national annual CPI-U from the Bureau of Labor Statistics (BLS). Additionally, in creating the dependent variables for health, deflated annual household income is

converted into binary form (one if equal to or greater than $17,000 and otherwise 0.) For a family of four, the poverty threshold is $17,650 in 48 states and DC (2001) and $14,630 for a family of three. This threshold is referred to as the federal poverty level. The poverty threshold of this binary variable is taken from the poverty guidelines, which are referred to as "federal poverty level", of the Department of Health and Human Services (HHS) in 2001 (HHS 2001). It is derived from the Federal Poverty Measure of annual income provided by the Census Bureau.

Control variables

A vector of control variables, X, includes socio-economic variables and a constant term. The vector is composed of age, age-squared, sex, marital status, race, and education. Age ranges from 18 years to 65 years and older. Age-squared is also included to restore the linearity of the age effect in the regression. For the sex variable, female equals 1 and male equals 0. For marital status, married equals 1 and other statuses 0. Race indicators consist of White only, Black only, Hispanic only, and others. Education is recorded as a categorical variable ranging from (1) "never attended school or only kindergarten" to (6) "college graduate."

DIFFERENCE IN DIFFERENCES: HURRICANE KATRINA

Hurricane Katrina's effect on income and diabetes status in the damage area is estimated by comparing income and health status before and after Katrina made landfall on August 29th, 2005. Hurricane Katrina, hereafter D, indicates the interaction term of the time indicator, k, and the indicator of the target treatment region of Hurricane Katrina, R (i.e. FEMA's disaster- designated areas or the regions distinguished by the population centroid distance). D provides the difference in differences (DD) estimation of the hurricane's effect. The coefficient estimates of D present the effect of Hurricane Katrina in the target regions of the residents after landfall.

The effect of income on diabetes health status is estimated by using instrumental variable estimation with the instrumental variable D for the endogenous covariate income status. The linear projection of income status on control variables and instrumental variables is presented below. The reduced form (1) equation for the endogenous explanatory variable, w_{it}, of the base model is

$$w_{it} = \eta \cdot k + R' \cdot \Theta + D' \cdot \Phi + X' \cdot \mathrm{I} + Z' \cdot \Lambda + e_{it}$$

where $$cov(D, e) = 0,\ E(e) = 0$$

Considering D as a vector of instrumental variables, $D = k \cdot R$, and using the base model above

$$\because\ cov(w, D) \neq 0, \qquad cov(D, \varepsilon) = 0$$
$$,\forall\ E[w \mid \varepsilon] \neq 0, \qquad E[D \mid \varepsilon] = 0$$

The reduced form equation (2) for health as a binary dependent variable, y_{it}, is derived from the reduced form equation (1) and the structural equation, which is the base model. Rearranging, we obtain

$$y_{it} = \mu \cdot k + R' \cdot \mathrm{N} + D' \cdot \Pi + X' \cdot \mathrm{T} + Z' \cdot \mathrm{O} + \xi_{it},$$

$$\text{where } \xi = \varepsilon + \delta \cdot e \text{ and } \Pi = \Phi \cdot \delta$$

By assumption, the reduced form error, ξ, is not correlated with the explanatory variables above. To estimate (1) and (2) applying least square estimation, let y_{it} and w_{it} be an indicator equal to 1 if the variables satisfy the condition described earlier and 0 otherwise. Then (1) and (2) estimate the Linear Probability Model (LPM) of binary income status, w_{it}, and the LPM of the binary health dependent variable, y_{it}, respectively:

$$\mathrm{E}[w_{it} | k, R, D, X, Z] = \eta \cdot k + R' \cdot \Theta + D' \cdot \Phi + X' \cdot \mathrm{I} + Z' \cdot \Lambda,$$
$$\mathrm{E}[y_{it} | k, R, D, X, Z] = \mu \cdot k + R' \cdot \mathrm{N} + D' \cdot \Pi + X' \cdot \mathrm{T} + Z' \cdot \mathrm{O}.$$

Applying Two Stage Least Squares (2SLS) to estimate the income effect on the binary health dependent variables, y_{it}, with the endogenous covariate, w_{it}, the first-stage regression of the two-stage instrumental variable model is described as

$$w_{it} = \eta \cdot k + R' \cdot \Theta + D' \cdot \Phi + X' \cdot \mathrm{I} + Z' \cdot \Lambda + e_{it}$$

where, by definition, $E(e) = 0$ and $\mathrm{E}[e \mid k, R, D, X, Z] = 0$. Then the OLS fitted values of w_{it} will be applied to estimate the second-stage regression of 2SLS,

$$y_{it} = \gamma \cdot k + R' \cdot \Omega + \delta \cdot \widehat{w_{it}} + X' \cdot \mathrm{A} + Z' \cdot \mathrm{B} + \varepsilon_{it}$$

where, $\widehat{w_{it}} = \mathrm{E}[w_{it} | k, R, D, X, Z]$. The estimation of the 2SLS of the LPM would be

$$\mathrm{E}[y_{it} | k, R, \widehat{w_{it}}, X, Z] = \gamma \cdot k + R' \cdot \Omega + \delta \cdot \widehat{w_{it}} + X' \cdot \mathrm{A} + Z' \cdot \mathrm{B}.$$

DATA

The empirical analysis uses the Behavioral Risk Factor Surveillance System (BRFSS) data from the Centers for Disease Control and Prevention (CDC) from 2001 to 2011 and the total number of observations is 3,296,318 (Table 1). BRFSS gathers monthly random-surveyed cross sectional data. The surveys are conducted by each state on behalf of the CDC. Each department of the states surveys essential questions provided by the CDC and additional module questions. Because survey dates are independently chosen by each state, there are several survey dates in each month of each year. In 2005, the landfall year of Hurricane Katrina, almost all observations were surveyed by landline phone. Only 66 observations were surveyed by cell phone and 250 observations were surveyed by business numbers among the total observations, 355,168. Because almost all observations are surveyed by the landline phone, there are no refugees or those seriously injured by Hurricane Katrina on the survey date. I can use the assumption that there is no direct Hurricane Katrina effect on these individuals' health.

RESULTS

Tables 2 – 3 report the estimates of the Hurricane Katrina income effect on diabetes statuses and household income status. The estimations using the treatment region of GNO's 10 parishes employ regional fixed effect in 52 regions. Diabetes statuses indicate that individuals have never been told they have

diabetes by a healthcare professional in each of the diabetes categories. The estimates of the direct effect of Hurricane Katrina on diabetes are presented in Table 2. The left half of Table 2 reports the estimates using the treatment region of GNO's 10 parishes and the right half of Table 2 reports the estimates using the treatment region of Distance (1) (≤ 21 km). The estimates of the direct effect of Hurricane Katrina on diabetes statuses are all negative and significant at the one percent significance level using either GNO's 10 parishes or Distance (1). The left half estimates of the direct effect of Hurricane Katrina on No Diabetes A1, No Diabetes A2, No Diabetes B1, and No Diabetes B2 are -.0115, -.0125, -.0147, and -.0158, respectively. The right half estimates of direct effect of Hurricane Katrina on No Diabetes A1, No Diabetes A2, No Diabetes B1, and No Diabetes B2, using the treatment region of Distance (1), are -.0142, -.0147, -.0168, -.0172, respectively. The direct effect of Hurricane Katrina on income status for the reduced form estimation of diabetes statuses on income status in Table 3 is all significantly negative. The estimates vary when different treatment regions, GNO's 10 parishes or Distance (1), are employed for the estimations.

Tables 4 and 5 report the effect of income on diabetes statuses to examine the endogeneity of Hurricane Katrina on the income effect on high blood pressure statuses. Table 4 presents OLS estimates of the income effect on diabetes indicators. Table 5 reports that 2SLS instrumental variable estimate in which there is the endogeneity issue of Hurricane Katrina on the income status. Table 4 presents the income effect on diabetes statuses without controlling for endogeneity. Table 5 presents the income effect on diabetes statuses while controlling for endogeneity. As presented before, this study's major hypothesis is whether natural disasters like Hurricane Katrina endogenously determine the income effect on diabetes.

As we compare the first rows of Tables 4 and 5, the income effect estimates of both rows are positive but significantly different whether controlling for endogeneity or not. Because of the difference of the estimated income effects on diabetes statuses between Tables 4 and 5, it is highly suspected that Table 4 has an omitted variable bias. In Table 4, the OLS regression of diabetes statuses on annual household income status (above $17,000) reports the estimates using the treatment region of GNO's 10 parishes on the left half of the table and those using the treatment region of Distance (1) on the right of the table. The estimates of the income effect on diabetes statuses without controlling for endogeneity are all significant at the one percent significance level (Table 4).

The difference in the magnitude of the estimated income effects on diabetes statuses between Tables 4 and 5 also provide evidence that the estimates in Table 4 have an omitted variable bias. The endogeneity test statistics for diabetes statuses within GNO's 10 parishes presented, on the left half of Table 5, are significant, in which the robust F- statistic is significant at the 1 percent significance level. However, the F-statistic is too small and it is highly suspected that there is potential weak instruments in some cases. I use the F- statistic and Durbin- Wu- Hausman test, using robust standard errors at the level, to test for endogeneity. The F- statistic is the square of the t- statistic of the After Hurricane Katrina variable in the

first stage of 2SLS. The Durbin- Wu- Hausman test tests, which is chi-squared distributed, the difference between OLS and IV estimators using robust variance estimates.

CONCLUSION

The estimated direct effects of Hurricane Katrina on positive indicators of diabetes status or household income status (over $17,000) are significantly negative. The effect of income on the binary variables, diabetes, after Hurricane Katrina, are significantly positive in the estimation. From the BRFSS data from the CDC, if individuals have an annual household income status above the federal poverty guideline of $17,000, then it significantly affects their ability to improve their health status such as reducing the risk of diabetes.

As the model estimation satisfies the derivation of the reduced forms of the base model, the sign of the product between coefficient estimate of the income effect on each health status and coefficient estimate of the Katrina effect on income status must be the same as the sign of the coefficient estimate of the direct Katrina effect on each health status. Based on the satisfaction of the model derivation, even though the 2SLS estimates of income effect on general health are biased but consistent. In the estimations of income effect on diabetes, the F- statistic is low in some cases and it is highly suspected that there are some potential weak instruments in the cases. There are also too large IV effect in some cases that causes large income effect on health.

The estimation provides policy implications for natural disaster support functions of the federal and local government on the income of individuals or households also affect the health status of these individuals and it will have a positive effect on individuals' health. When it comes to government policy for disaster support for individuals, it is also critical to consider the effect of income on health. It is not only important to provide victims of natural disasters the direct government support on site, but it is also critical to support communities of the victims of natural disasters for sustainable income sources, such as job opportunities and rebuilding small businesses.

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FIGURES AND TABLES

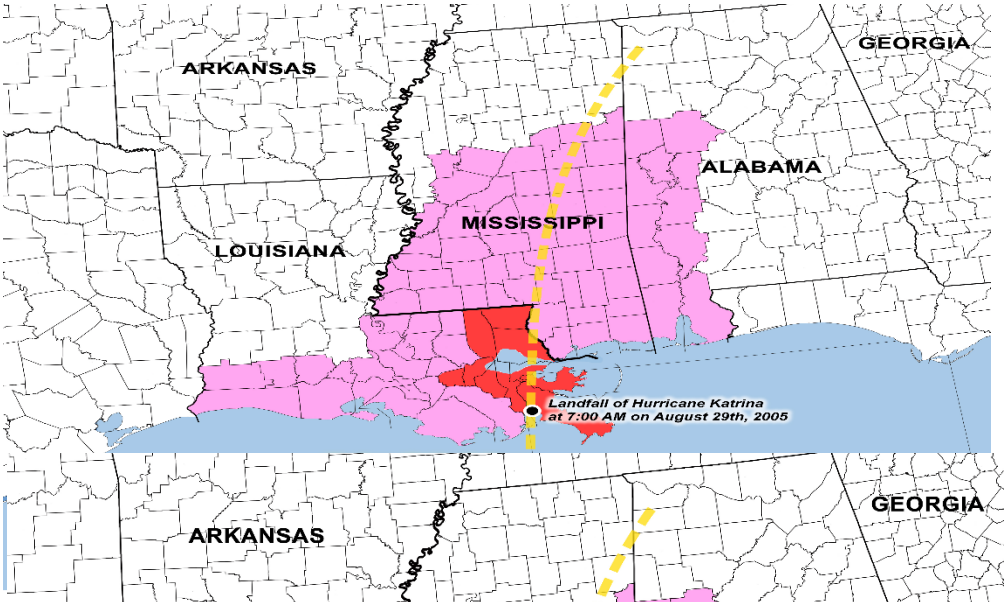

Figure 1: FEMA Designated Damage Area with Greater New Orleans Area (GNO) From Hurricane Katrina 2005

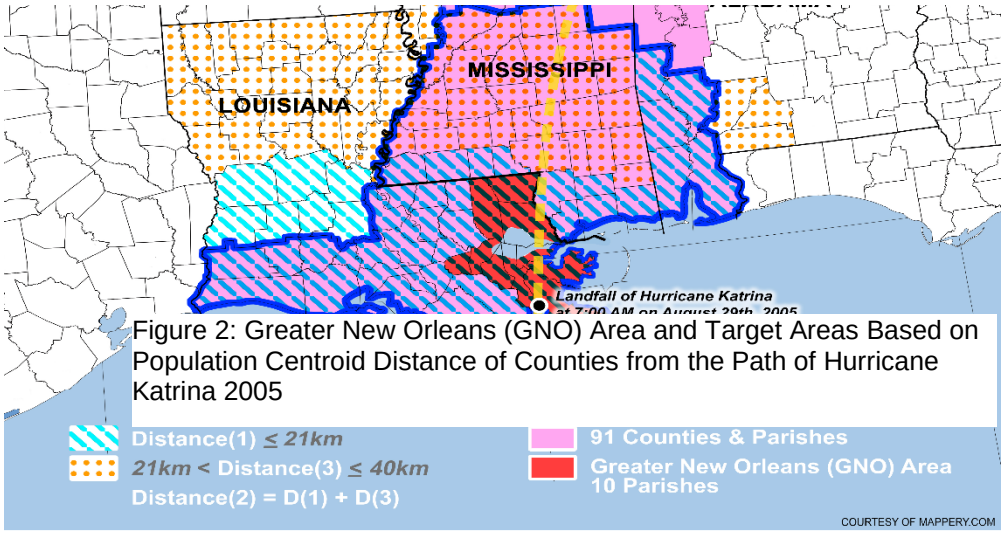

Figure 2: Greater New Orleans (GNO) Area and Target Areas Based on Population Centroid Distance of Counties from the Path of Hurricane Katrina 2005

Table 2: Using BRFSS data from 2001 to 2011,
Linear Probability Model (LPM) Regression of Diabetes and Annual HH Income as Binary Dependent variables on After Hurricane Katrina.

	No Diabetes							
	No Diabetes A1	No Diabetes A2	No Diabetes B1	No Diabetes B2	No Diabetes A1	No Diabetes A2	No Diabetes B1	No Diabetes B2
	GNO's 10 Parishes				Distance ≤ 21			
	Coefficient Estimates of Interest							
After Hurricane Katrina	-.0115***	-.0125***	-.0147***	-.0158***	-.0142***	-.0147***	-.0168***	-.0172***
	(.001)	(.001)	(.001)	(.001)	(.002)	(.001)	(.002)	(.002)
Age	-.0073***	-.0078***	-.0068***	-.0073***	-.0073***	-.0078***	-.0068***	-.0073***
	(.0003)	(.0003)	(.0002)	(.0003)	(.0003)	(.0003)	(.0002)	(.0003)
Age_squared	.00004***	.00004***	.00003***	.00004***	.00004***	.00004***	.00003***	.00004***
	(2.08e-06)	(2.21e-06)	(1.98e-06)	(2.12e-06)	(2.08e-06)	(2.21e-06)	(1.98e-06)	(2.12e-06)
Female	.0189***	.0191***	.0032***	.0033***	.0189***	.0191***	.0032***	.0033***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Married Status	.0172***	.0190***	.0130***	.0148***	.0172***	.0190***	.0130***	.0149***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
White only	.0358***	.0372***	.0415***	.0430***	.0358***	.0372***	.0415***	.0429***
	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)
Black only	-.0349***	-.0356***	-.0283***	-.0289***	-.0349***	-.0356***	-.0282***	-.0289***
	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)
Others	-.0128***	-.0171***	-.0101**	-.0144***	-.0128***	-.0171***	-.0101**	-.0144***
	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)
Education	.0203***	.0219***	.0204***	.0220***	.0203***	.0219***	.0204***	.0220***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Regional Fixed	52 Regions	52 Regions	52 Regions	52 Regions	State	State	State	State
Time Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Effect	State	State	State	State	State	State	State	State
R2	.0574	.0619	.0465	.0513	.0574	.0620	.0465	.0513
No. of Observations	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318

Robust Standard Errors are in parentheses. The control variables consist of age, age_squared from 18 to 65 years, or older, female, married status, races (White only, Black only, Hispanic, and Others) and education. The fixed effects are in state and in time. The regional fixed is either on all 50 states or 52 regions such as 50 states and D.C. - 4 states (Alabama, Louisiana, Mississippi & New York for base state)+ 3 regional areas in three states which are not designated as damage areas by FEMA + two regional areas are designated by FEMA (= GNO's 10 parishes and 81 other counties and parishes that FEMA designated disaster damage area).
Time fixed effect is in each month of each year. Significance is shown with asteriks(*):
*** for p-value less than 0.01, ** for p-value less than 0.05, * for p-value less than 0.1.

Table 3: Using BRFSS data from 2001 to 2011, Linear Probability Model (LPM) Regression of Binary Income Status on After Hurricane Katrina.

	Binary Annual Household Income Status (Over $17,000)			
	GNO's 10		Distance ≤ 21	
	Coefficient Estimates of Interest			
After Hurricane Katrina	-.0065***	-.0063***	-.0058*	-.0052
	(.002)	(.002)	(.003)	(.004)
Age	.0036***	.0036***	.0036***	.0036***
	(.0004)	(.0004)	(.0004)	(.0004)
Age_squared	-.0001***	-.0001***	-.0001***	-.0001***
	(4.19e-06)	(4.19e-06)	(4.20e-06)	(4.19e-06)
Female	-.0439***	-.0439***	-.0439***	-.0439***
	(.002)	(.002)	(.002)	(.002)
Married Status	.2051***	.2051***	.2051***	.2051***
	(.005)	(.005)	(.005)	(.005)
White only	.1128***	.1128***	.1127***	.1127***
	(.009)	(.009)	(.009)	(.009)
Black only	.0145	.0143	.0147	.0141
	(.012)	(.012)	(.012)	(.012)
Others	.0287**	.0287**	.0286**	.0286**
	(.011)	(.011)	(.011)	(.011)
Education	.0981***	.0980***	.0981***	.0981***
	(.003)	(.003)	(.003)	(.003)
Regional Fixed	State	52 Regions	State	52 Regions
Time Fixed	Yes	Yes	Yes	Yes
Cluster Effect	State	State	State	State
R2	0.2234	0.2234	0.2235	0.2234
No. of Observations	3,296,318	3,296,318	3,296,318	3,296,318

Robust Standard Errors are in parentheses. See Table 2.

Table 4: Using BRFSS data from 2001 to 2011,
Linear Probability Model (LPM) Regression of Diabetes as Binary Dependent variables on Income Status (Annual Household Income over $17,000).

	No Diabetes			
	No Diabetes A1	No Diabetes A2	No Diabetes B1	No Diabetes B2
	GNO's 10 Parishes (or distance ≤ 21)			
Coefficient Estimates of Interest				
Income Status	.0554***	.0585***	.0565***	.0596***
	(.001)	(.001)	(.001)	(.001)
Age	-.0075***	-.0080***	-.0070***	-.0075***
	(.0003)	(.0003)	(.0002)	(.0002)
Age_squared	.00004***	.00004***	.00004***	.00004***
	(2.01e-06)	(2.12e-06)	(1.90e-06)	(2.02e-06)
Female	.0213***	.0216***	.0056***	.0060***
	(.001)	(.001)	(.001)	(.001)
Married Status	.0060***	.0070***	.0014*	.0026***
	(.001)	(.001)	(.001)	(.001)
White only	.0295***	.0306***	.0351***	.0362***
	(.003)	(.004)	(.003)	(.004)
Black only	-.0357***	-.0364***	-.0291***	-.0298***
	(.004)	(.004)	(.004)	(.004)
Others	-.0143***	-.0188***	-.0117**	-.0161***
	(.004)	(.005)	(.004)	(.005)
Education	.0148***	.0162***	.0148***	.0162***
	(.001)	(.001)	(.001)	(.001)
Regional Fixed	52 Regions	52 Regions	52 Regions	52 Regions
Time Fixed	Yes	Yes	Yes	Yes
Cluster Effect	State	State	State	State
R2	.0613	.0659	.0503	.0552
No. of Observations	3,296,318	3,296,318	3,296,318	3,296,318

Robust Standard Errors are in parentheses. See Table 2.

Table 5: Using BRFSS data from 2001 to 2011, LPM 2SLS Instrumental Variable Estimation of Other Health as Binary Dependent Variables on Binary Income Status (Annual Income over $17,000) with a Instrumental Variable: After Hurricane Katrina.

	No Diabetes							
	GNO's 10 Parishes				Distance ≤ 21			
	No Diabetes A1	No Diabetes A2	No Diabetes B1	No Diabetes B2	No Diabetes A1	No Diabetes A2	No Diabetes B1	No Diabetes B2
	First Stage: Coefficient Estimates of Interest							
After Hurricane Katrina	-.0063	-.0063	-.0063	-.0063	-.0058	-.0058	-.0058	-.0058
	(.010)	(.010)	(.010)	(.010)	(.008)	(.008)	(.008)	(.008)
	Second Stage: Coefficient Estimates of Interest							
Income Status	1.8220***	1.9856***	2.3378***	2.501***	2.4514	2.5339*	2.8904	2.9729*
	(.589)	(.650)	(.780)	(.840)	(1.495)	(1.447)	(1.850)	(1.800)
Age	-.0138***	-.0149***	-.0152***	-.0163***	-.0161***	-.0169***	-.0172**	-.0180***
	(.002)	(.003)	(.003)	(.003)	(.006)	(.005)	(.007)	(.007)
Age_squared	.0001***	.0001***	.0002***	.0002***	.0002***	.0002**	.0002*	.0002**
	(.00003)	(.00004)	(.00004)	(.00005)	(.0001)	(.0001)	(.0001)	(.0001)
Female	.0988***	.1061***	.1057***	.1130***	.1264*	.1302**	.1300	.1338*
	(.027)	(.030)	(.036)	(.038)	(.066)	(.064)	(.082)	(.080)
Married Status	-.3566***	-.3883***	-.4666***	-.4983***	-.4857	-.5008*	-.5800	-.5950
	(.120)	(.133)	(.160)	(.172)	(.306)	(.296)	(.379)	(.368)
White only	-.1697**	-.1867**	-.2222**	-.2392**	-.2406	-.2484	-.2844	-.2922
	(.072)	(.080)	(.095)	(.103)	(.173)	(.168)	(.213)	(.209)
Black only	-.0610**	-.0640**	-.0617*	-.0648*	-.0709*	-.0728*	-.0707	-.0726
	(.025)	(.028)	(.033)	(.035)	(.041)	(.041)	(.049)	(.049)
Others	-.0651***	-.0741***	-.0772**	-.0863**	-.0830*	-.0897*	-.0928	-.0995*
	(.024)	(.027)	(.032)	(.035)	(.049)	(.049)	(.061)	(.060)
Education	-.1584***	-.1728***	-.2089***	-.2233***	-.2202	-.2266	-.2632	-.2696
	(.060)	(.066)	(.080)	(.086)	(.148)	(.143)	(.183)	(.178)
	First Stage Robust F Statistic							
	7.886***	7.886***	7.886***	7.886***	3.233*	3.233*	3.233*	3.233*
	Robust Durbin-Wu-Hausman test of Endogeneity							
	100.965***	98.621***	152.538***	146.823***	56.040***	100.597***	41.512***	70.777***
Regional Fixed	52 Regions	52 Regions	52 Regions	52 Regions	State	State	State	State
Time Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Effect	State	State	State	State	State	State	State	State
RMSE	.67211	.72729	.83885	.89448	.87099	.90093	1.0172	1.0468
No. of Observations	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318	3,296,318

Robust Standard Errors are in parentheses. See Table 2.

From Local to Global: The Role of Interdisciplinary Place-based Research in Teaching Environmental Economics

Sean P. MacDonald*

ABSTRACT

This paper examines the value of teaching undergraduate Environmental Economics from an interdisciplinary perspective. At the same time it considers the benefits of employing the resource of the immediate community as a laboratory where guided student place-based research on environmental challenges can serve as a valuable tool in gaining a meaningful understanding of both local and global environmental challenges. This process is viewed as one that encourages students to make real connections between the theoretical study of environmental problems and the experience of these challenges in actual communities. At the same time, an interdisciplinary approach – incorporating the perspectives offered by other disciplines – can build upon a broad-based understanding of current environmental challenges.

INTRODUCTION

The incorporation of place-based research in undergraduate study has gained increasing attention relatively recently. The arguments for its practice stress the value of students' gaining more than simply a theoretical understanding of an issue or problem. Direct observation, research and inquiry are viewed as enabling students to acquire an understanding that makes issues real – that gives them life. In the process, students attain the ability to make meaningful connections between the study of a problem and the experience of it.

The practice of place-based research can encompass a number of dimensions. First, it makes students active participants in pursuing their research interests**,** ideally collaborating in small groups on addressing an issue. Second, it often involves interacting with individuals and organizations outside the limits of the classroom, and through that interaction, gathering information through informal interviews and discussions. It also involves some form of documentation of observations through the noting of impressions, taking photographs, and making connections between those observations and secondary research sources. Place-based research also makes possible the development of a multidimensional understanding that integrates the perspectives of other disciplines into the study of a specific issue, topic or problem.

The literature on place-based research as a "high impact educational practice" has been promoted in the literature most notably by George Kuh over the past two decades. Kuh has written extensively on the

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topics of fostering student engagement (1991), the value of student research outside of the classroom (1995, 2008) and how to create the kind of conditions that encourage such practices (2005). An emerging new literature on place-based research has begun to take shape in just the last couple of years, as the foundations of Kuh's initial ideas about how to bring the undergraduate learning process to life has taken root across a growing number of disciplines and institutions. What much of this new literature has in common is the conviction that undergraduate research and learning that is linked to events in the real world or 'hands on' experience brings study and research to life and enables students to make meaningful connections between theory and direct observation and/or practice.

One dimension that has not been widely addressed in the literature is the potential contribution of an *interdisciplinary* approach to place-based research. The goal of this paper is to expand upon this literature, highlighting the benefits of including place-based study in undergraduate research, while at the same time drawing upon the perspectives offered by other disciplines that have the potential to both sharpen the critical thinking process, enable students to make connections among common themes across disciplines, and lead students to unique perspectives on topics of research. This is then discussed in the context of an undergraduate Environmental Economics course currently offered at the New York City College of Technology that is grounded in both place-based research and an interdisciplinary approach to the study of current environmental issues. The paper begins with a review of the literature on place-based research, examines the application of the interdisciplinary perspective, and discusses how this is being applied in the Environmental Economics course. Finally, it offers an example of a current student research project that illustrates the benefits of an interdisciplinary approach to place-based learning.

LITERATURE REVIEW ON PLACE-BASED RESEARCH

George Kuh (2008), in his "High Impact Educational Practices" identifies collaborative projects as linked to two key goals that together work to facilitate active learning. He notes that the process of "learning to work and solve problems" with others serves to reinforce confidence in collaborative problem solving while helping to enhance students' own understanding by developing listening skills and learning to seriously consider the insights and perspectives of others which often derive from diverse cultures and life experiences.

Kudryavtsev, et al (2012) points to the growing attention that the "sense of place" has gained in the literature on environmental education, despite the reality that, until recently, there has been little connection between the abundant "theoretical and empirical sense of place literature" that has proliferated since the 1960's and its application to environmental education even as interest in place-based education has grown in recent years. The authors examine how the application of the existing empirical literature can be applied to defining and developing an understanding of the sense of place from the perspective of environmental

psychology, noting that "affective ties to places may motivate people to be better informed about local environmental issues…"

Based upon much of the literature, the authors concur that the connection to place is a means to nurture connections across many dimensions that are defined as key to the individual's development of a social, emotional, attitudinal and behavioral connection to environment. They note the strong correlation that has been observed between the "strength of place attachment and willingness to actively contribute to solutions" to environmental problems. By extension, they find evidence that a meaningful connection to place encourages "pro-environmental behaviors, attitudes, and awareness" (2012). Thus, this physical connection with the subject of study can effectively promote a higher level of commitment to environmental preservation.

The importance of place attachment is derived both through direct and repeated encounters with a physical location and through indirect learning. Both this *experiential* approach and *instructional* approach are identified as complementary in cultivating a sense of meaning about place (2012).

Kemp (2006) similarly observes that while the use of the term '"place based education"' has appeared in the educational literature relatively recently – over the last ten years – the theoretical literature dates to the late 1960's. Much of this early literature he identifies as rooted primarily in the theoretical and philosophical with a focus on defining what place-based education would include. This includes the concept that place based education "is learning that becomes meaningful when rooted in place." Further "when students become interested in the place in which they live" they become more involved, motivated and "have a tendency to retain more information."

Another benefit of the place-based approach is the opportunity to reconnect young researchers to the natural world. Victor (2013) argues that "Integrating outdoor experiential education into the student experience" provides students with the means to develop an insight into both their own character strengths and those of others, "as well as an opportunity to foster an understanding of their position within the larger world" (2013). The author reports on the findings of a study she conducts of the long-term influence of a place-based and experiential learning on former students of an undergraduate English literature course in which students examined the literature of New England writers through both exploratory writing and actual exploration of the "New England countryside, its people, culture and history." Through interviews with former students, she finds that the experience "nurtured creativity, increased collaboration skills, developed self-confidence/self-knowledge, and reinforced the importance of having a relationship with the outdoors" (2013).

This study offers strong support for the notion that the real world experience of place-based study can provide enduring learning and life skills and curiosity about the world long after students have completed their undergraduate studies. These findings also offer valuable evidence that the immediate goals of place-based study – encouraging critical thinking, collaborative learning, and developing a connection between

the study of a subject or issue and the observation and encounter of that issue in the real world – can have a life-long impact.

Zandvliet (2013) also conducted a study to investigate the question of how students perceive various aspects of an "'ideal'" environment for learning in the context of an institution of higher education. The study's findings reaffirm many of the benefits of place-based and collaborative learning. Students were found to attribute the most value to an environment in which there was group cohesiveness, that promoted active student participation, offered opportunities to interact and share ideas, and that incorporated field activities into the curriculum (2013).

The literature on collaborative interdisciplinary research has examined how students can successfully develop critical thinking skills through active learning that encompasses a variety of disciplinary perspectives on a topic. Bain (2004) emphasizes the role of active student engagement in meaningful learning. He identifies the importance of incorporating interdisciplinary approaches to studying questions and solving problems. To facilitate this process, he stresses the benefits of collaborative work, that integrates different disciplines, and moves beyond students' immediate areas of study and expertise, and in the process encourages new ways to think about how to complete a project. Bain describes an important part of this process as one that involves students in interdisciplinary research on, for example, social, economic, environmental, community and other disciplinary perspectives (Bain, 2004).

Luddick (2001) points to the inherent interdisciplinarity of place-based study. He points to the potential application to the disciplines of "economics, technology, geography, the environment, law, government, education, communication, psychology and a variety of scientific endeavors." At the same time, he stresses the range of skills that are potentially cultivated and strengthened, including those of observation, decision making, writing, research, problem solving, critical thinking, and participation (2001).

PLACE-BASED RESEARCH IN AN INTERDISCIPLINARY COURSE

The Environmental Economics course outlined here incorporates place-based research and inquiry, in combination with other features. These include an interdisciplinary approach featuring guest lecturers from other disciplines, a focus on encouraging active student engagement through a variety of means, including a course blog site designed to promote active exchange of ideas, and a critical analysis of environmental challenges that encompasses more than one discipline.

At the New York City College of Technology, an interdisciplinary course has been defined as one that:

> Involve(s) two or more academic disciplines or fields of study organized around synthesizing distinct perspectives, knowledge, and skills. Interdisciplinary study focuses on questions, problems, and topics too complex or too broad for a single discipline or field to encompass adequately; such studies thrive on drawing connections between seemingly exclusive domains. Usually theme-based, interdisciplinary courses intentionally address issues that require meaningful engagement of multiple academic disciplines. Pedagogical strategies focus on, but are not limited to, inquiry or problem-based learning. (from *Criteria for an Interdisciplinary Course.*(2012) New York City College of Technology, City University of New York)

The theme of the course focuses on how to promote sustainable economic growth and how technology, planning, design, and social and economic priorities can be applied to the goal of addressing global climate change and how working toward that goal strengthens and advances sustainable economic development. This focus encompasses the potential contributions and perspectives offered by guest lecturers and readings from other disciplines in addition to that of Economics. This interdisciplinary approach is designed to provide a comprehensive understanding of the subject and expose students to the knowledge and methodologies of other disciplines' regarding environmental problems. An important goal is for students to learn how to apply the concepts and methodology of other disciplines to the understanding of the many dimensions of global climate change and to recognize the value they contribute to a comprehensive perspective on environmental issues.

Topics covered in the course and discussed by guest lecturers include: (1) the global economic impact of emerging market economies and rapid industrialization (Economics and Sociology); (2) the importance of sustainable land use and agricultural practices(Geosciences); (3) how contextual, emotional and cultural influences shape consumer decision making (Psychology); (4) how and where investment in renewable energy and economic practices is generating measurable benefits in the U.S. economy such as in commercial, industrial and residential settings (Economics); (5) how the expansion of sustainable building and design practices - growth of green building design, construction, engineering and architecture – encourage renewable energy practices, reduce overall energy demand, and promote cleaner energy sources (Architecture and Engineering); (6) why environmental, economic and social justice and public policy initiatives such as expanding investment in public transportation and reducing income inequality are important to the goal of achieving globally sustainable growth; (Public Policy); (7) how sustainable tourism and fair trade work to encourage and promote renewable resources and sustainability (Hospitality Management).

Having already taken an introductory level economics class – either Microeconomics or Macroeconomics - students begin with a basic foundation in the discipline. The introduction of the wide range of issues and problems covered in Environmental Economics that are directly linked to these and other disciplines, expose students to the knowledge and methodologies of other disciplines whose perspectives and knowledge are closely linked to the issues Environmental Economics explores. Much of this knowledge is critical to the development of a more comprehensive understanding of the issues, with the goal of expanding students' perspectives.

Within the first few weeks of class, students are encouraged to define the central topic or question that will be the focus of their semester research project. The goal of students' field research is to encourage the investigation of an environmental practice, problem, project, etc. from the perspective of one or more disciplines. Many students choose to define an issue that is tied to their major field of study. Part of the

process of that study is to connect their investigation to both the perspectives of at least one other discipline and to the notion of how their topic is linked to sustainability from an economic perspective.

INTERDISCIPLINARY FOCUS

The interdisciplinary focus connects directly with students' field research. In this particular course, the focus of that place-based research largely draws upon the resources of the Brooklyn waterfront, a rapidly evolving area that combines vibrant new state-of-the art projects, LEED certified buildings that house new business start-ups focused on sustainable product design and production, and urban rooftop gardening projects, together with renewed efforts at revitalizing and renewing communities that have been designated Superfund clean-up sites by the Environmental Protection Agency.[1]

Student researchers, having been exposed in the classroom to the knowledge and methods of inquiry of other disciplines from invited guest lecturers, select a site to visit that relates to the subject of their research topic. A key goal in incorporating the perspectives of more than one discipline in their field and secondary research is to link their inquiry to the theme of economic sustainability.

To develop a clearer picture of the practice of interdisciplinary place-based research, an example might focus on, for instance, the study of the impact of a local water pollution problem. This ideally would involve a visit to the site and to a local organization directly involved in addressing issues related to the site and the surrounding community. The Gowanus Canal in Brooklyn, NY, which was designated a superfund clean-up site by the Environmental Protection Agency in March 2010, has spawned a vibrant community response through the Gowanus Canal Conservancy and other community organizations who are activity involved in community renewal and in educating the public about the status of the clean-up, the environmental challenges the canal faces, and the progress of work toward revitalizing the ecological, residential, and business life of the community.

The Gowanus Canal Conservancy, a non-profit community organization has taken a central role in much of this work, becoming a valuable resource, initiating local conservation projects, organizing walking tours, highlighting the community's resiliency in the face of the challenges, working on restoration and resiliency projects, and coordinating community educational outreach through an 'Urban Ecology Lecture Series' and public and educational tours.

Student place-based research at this site could be guided by the question of '*How the local economy has been impacted and progress toward recovery,'* and might begin by examining the historical evolution of the site. The Canal, which dates to 1869, served as a major transportation route between Brooklyn and New York City (Manhattan) when the two were separate cities. Today, it is one of the nation's "most extensively contaminated water bodies" according to the EPA's Region 2 Superfund decision. Surrounded by chemical plants, tanneries, gas plants and other manufacturing activities that routinely dumped wastes

into the canal, compounded by storm water runoff … the site contains ”PCB’s, coal tar wastes, heavy metals and volatile organics” (EPA, 2014).

The project would examine how the revitalization of the surrounding community is working toward economic sustainability through the site’s adoption of a system to capture storm water run-off, creation of an educational center, and cultivation of the original natural habitat in the community. The study of the site would investigate issues of sustainable land use, active measures to reduce further water pollution and locate this within the context of rebuilding a sustainable local economy.

One example of student research currently underway involves a student applying place-based research to his work on the Solar Decathlon Project, a Department of Energy funded project involving 30 universities nationwide that have been challenged to design and build a model for an energy efficient house. The Department of Energy website describes the competition as follows:

> Solar Decathlon challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of the competition is the team that best blends affordability consumer appeal, and design excellence with optimal energy production and maximum efficiency” (2014). The project at New York City of Technology, involves faculty and students across a number of disciplines ranging from architectural engineering technology to mechanical, computer and electrical engineering technology, among others. (2014)

The student’s project will involve demonstrating how both his collaborative involvement in the design and planning process and active participation in interdisciplinary team work (with other students and faculty) enhances his knowledge of the contributions of other disciplines, and the importance of real world experience in learning and achieving a goal related to sustainable design and energy. He will also research secondary research on solar energy technology, sustainable design and other related topics and how these relate directly to the issue of how investment in renewable energy promotes sustainable economic growth and development.

In the process, the goal is for the student researcher to sharpen critical thinking skills, to examine, study and evaluate his experience from the perspective of more than one discipline, to recognize how this project and research are linked to the theme of how policies and practices can promote sustainable economic development, and to connect and integrate cross-discipline knowledge to draw conclusions.

ENDNOTES

1. An example here includes the Brooklyn Navy Yard, a multi-acre space that has recently undergone significant renovation and reconversion to a site for new businesses, both large and small, including film producer Steiner Studios; new buildings featuring sustainable construction, materials and energy sources that are beginning to house many new small businesses focused on environmentally

conscientious products and practices; a sprawling rooftop 'Urban Grange' farm that cultivates and markets produce, while serving as a natural site for collection of rainwater run-off and as an example of the greening and cooling of rooftops.

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A New Revenue Source for Small Cities in Upstate New York

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ABSTRACT

This paper proposes a policy response to some fiscal challenges in small Upstate New York cities that have significant public and private college student populations. These populations require unfunded outlays to ensure public safety for college students, which add to municipal fiscal stress. We undertake an empirical analysis of some affected small cities, and propose a targeted fee to help balance city budgets negatively effected by the greater expenditures needed to ensure the safety of residents.

INTRODUCTION

Under New York State's tax system, cities rely heavily on property tax revenues to fund operations. In the last four decades, small city governments in Upstate New York have suffered declines in property tax revenues from depopulation, increased poverty rates, vacant housing, and a rising proportion of tax-exempt properties. A recent statewide cap on annual property tax increases has further compromised municipal finances in Upstate cities. After discussing some factors that created this dismal fiscal environment, we examine general fund revenues, expenditures, and budgetary balances for the year 2012 in six small Upstate cities: Cortland, Elmira, Geneva, Oneonta, Oswego, and Plattsburgh. We identify negative fiscal consequences from the presence of colleges in these municipalities, and we propose a targeted fee to be paid by students to provide supplemental revenues to fund public safety services. Finally, we show how this new source of revenue would help reduce the structural budget deficits in the six cities.

SIX SMALL CITIES IN UPSTATE NEW YORK

The small municipalities in our study share four characteristics in common. First, each is legally defined as a "city," but with a population of less than 30,000 residents (as of the 2010 U.S. Census of the Population). Second, the cities are located Upstate, a geographic region generally construed to be the part of New York State that is north and west of Rockland and Westchester counties, metropolitan New York City, and Long Island. Third, each city hosts at least one private and/or public residential college. Finally, each city has professional police and fire departments. Six Upstate cities—Cortland, Elmira, Geneva, Oneonta, Oswego, and Plattsburgh—meet the four criteria. A larger sample of municipalities, one that includes villages and towns, would have been desirable for our study of the contemporary challenges for

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funding public safety in communities where colleges are located. But many Upstate villages and towns with a private and/or public residential college do not have professionally trained police and fire departments. Some municipalities have one or the other, and some have neither. Indeed, it is this characteristic that excludes a larger number of municipalities from our consideration.

BUDGET CHALLENGES IN THE SAMPLE GROUP OF SMALL UPSTATE CITIES

Since 1970, four negative trends in economic development have compromised the fiscal viability of Cortland, Elmira, Geneva, Oneonta, Oswego, and Plattsburgh. These include: 1) the decline of medium and large scale commercial enterprises, 2) a stagnant or declining population base, 3) a rising inventory of vacant or abandoned housing, and 4) a rising share of tax exempt properties as a percentage of all properties. Each of these negative trends is intertwined with the other three negative factors. In the past four decades, our six small Upstate cities have lost employment in manufacturing and commercial enterprises. Those losses are captured in the structural shift from manufacturing employment to services and government employment in the United States as a whole, and in the exodus of medium and large sized employers from the Upstate region. The Federal Reserve marks the overall decline in the percentage of employment in manufacturing in the United States from 26.4% in 1970 to 10.1% in 2010 (Federal Reserve Economic Data, 2015, Series USAPEFANA). Declines in manufacturing employment correlate with declining population trends in five of the six cities from 1970 to 2010. With the exception of Plattsburgh, which saw a modest 7% population increase in the 40 years, population declines in the other five cities ranged from 2% (Cortland) to 27% (Elmira). In total, the population for our six cities declined 14%, from 132,017 in 1970 to 113,697 in 2010, representing a 14% decrease (Census.gov and Office of the New York State Comptroller, 2004). Depopulation generated a rising inventory of vacant or abandoned housing, the third negative development for municipal finances. Surplus housing stock and an eroding property tax base were juxtaposed to the final negative trend for economic development in these Upstate cities—a rising share of tax-exempt property as a percentage of all properties. As not-for-profit cultural and religious organizations, and county, state, and federal government offices moved into or replaced properties that had been in private commercial hands, property tax revenues were put under increasing pressure. In total, the New York State Comptroller estimates that over $2.5 billion in property valuations currently enjoy tax-exempt status in our six Upstate cities, with 42% of property in those cities in the tax-exempt category (Office of the New York State Comptroller, 2015a). The imposition of a statewide cap on annual property tax increases has further strained the abilities of small cities to fund critical operations, and it is not surprising that the Comptroller's Office has conducted annual "fiscal stress tests" on all municipalities in New York State since 2012.

The origins and cumulative characteristics of the process of economic decline in Upstate New York were mapped a decade ago in two Brookings Institution studies on the 1990s economy. Pendell and

Christopherson (2004) underscores the collapse in incomes that coincided with rising poverty rates. The authors claim that personal income growth in the Upstate region grew at half the national rate in the 1990s, and was accompanied by an increase in concentrated poverty (concurrent to significant declines in national poverty rates). Two distinct aspects of the income decline in the Upstate region are identified in the study. First, the best-educated and highest-skilled workers earned markedly lower wages than similar workers elsewhere. Discrepancies in wage rates encouraged workers to leave Upstate New York for other regions within the state or in the nation that offered higher earnings. A second incomes problem was indicated in that the lowest income earners Upstate did not realize the benefits of a national recovery from the flat income growth that had persisted from the mid-1970s to the early 1990s in the United States as a whole. Low-income earners Upstate instead saw their incomes fall in the 1990s, again corresponding to rising poverty rates among those who continued to reside in the region (Pendell and Christopherson, 2004).

Pendall (2003) previously identified another negative employment and incomes trend relative to out-migration that began to compromise municipal finances in small Upstate cities during the 1990s. Upstate cities lost 40,000 households in the decade, while unincorporated Upstate towns gained 160,000 households. Characterized by Pendall as an aspect of *sprawl,* this shift eroded city tax bases, increased vacant housing, and compromised home ownership. As the population of Upstate cities declined by 7.3% in the 1990s, the population of unincorporated towns increased 5.8%. Assessed property values in Upstate cities also declined from $45.1 trillion to $41.9 trillion (in constant year 2000 dollars) over the ten year period. Pendall further points out that the change coincided with shrinkage in the size of Upstate city households as the remaining population aged, divorce rates rose, and the number of marriages declined (Pendall, 2003).

THE RISE OF THE STATE UNIVERSITY OF NEW YORK IN SMALL UPSTATE CITIES

As the economy of Upstate New York experienced relative economic decline in private sector employment and real property values, four of our six cities—Cortland, Oneonta, Oswego, and Plattsburgh—benefitted as sites for the sizable expansion of State University of New York (SUNY) campuses in Upstate New York. The development of SUNY was inextricably linked with a regionalized development plan for New York State. In 1960, the Heald Commission Legislative Report made a socio-political-economic argument for the expansion of SUNY by noting that the increased demand for college would launch a period of “skyrocketing growth for as far as we can see into the future.” SUNY would be a “social servant” to meet local and regional needs (Roskens and White, 1968, p. 23). Following recommendations from the Heald Report, the State University Construction Fund (S.U.C.F.) was created in March, 1962 to proceed with SUNY’s statewide expansion (Geizer, 1974). New campus construction was accompanied by improvements in public capital throughout the Upstate region during the 1960s. Branch spurs of the

Interstate Highway system were built to provide transportation linkages, and it is not coincidental that every SUNY residential college campus is within ten miles of an extension of this arterial network.

A decentralized SUNY was expected to add much in the way of new employment, incomes and attendant multiplier effects in the communities that hosted the newly constructed campuses. Human capital creation through the expansion of SUNY presupposed population retention and a future return on state investments (Board of Regents, 1972). These positive externalities were anticipated to provide increased state and local revenues from sales and income taxes. But the confident forecasts found in legislative and commission reports and from the New York State Regents were wrong. Over the last four decades, the decentralized SUNY campuses in small Upstate municipalities instead replaced for-profit manufacturing and commercial enterprises. Despite considerable state investments in the expansion of SUNY, the expected returns would not be forthcoming as the private sector economy of Upstate New York declined after 1970.

Four of the six municipalities in our study benefitted from the expansive growth of SUNY. In the last forty years, the SUNY residential four-year colleges in Cortland, Oneonta, Oswego, and Plattsburgh each grew to accommodate over 5,000 students. Conventional economic multiplier arguments would point to the benefits that accrued from additional student spending in the hosting cities. The two other small cities in our study—Elmira (Elmira College founded 1855) and Geneva (Hobart College founded 1822)—had enjoyed similar positive wealth effects from the presence of a private residential college for more than 150 years. Oneonta is unique in our study in that it hosts both a public and private residential college (Hartwick College has been located in Oneonta since 1926). But student spending was a weak substitute for the exodus of spending by residents who had occupied traditional households and worked for private sector employers.

NEGATIVE CONSEQUENCES FOR MUNICIPAL FINANCES FROM THE GROWTH OF RESIDENTIAL COLLEGES IN SMALL UPSTATE CITIES

After 1960, the influx of SUNY students into five of our six Upstate cities presents an important caveat to our understanding of accounting for population statistics in these municipalities. Full time students, according to the United States Bureau of the Census and electoral voting statutes in New York State, are treated as year round residents of their college community. The Bureau of the Census counts college students living away from their parental home while attending college at the on-campus or off-campus residence where they live and sleep most of the time (Census.gov). And New York State voter registration laws consider a student attending a four year college as a resident of the municipality where the college is located.

The population figures below, in Table 1 Student Population, Selected Small Cities, 2010, include residents in households as well as student residents at the private and/or public colleges in those cities.

The current percentage of students as a proportion to total residents ranges from a low of 5% in Elmira to a high of 53% in Oneonta in our six Upstate cities. All told, college students make up 27% of the total population for the six cities.

Table 1: Student Population, Selected Small Cities, 2010

	Total Population	Student Population*	Students as % Total
Cortland	19,204	6400	33
Elmira	29,200	1408	5
Geneva	13,261	2368	18
Oneonta	13,901	7418	53
Oswego	18,142	7328	40
Plattsburgh	19,989	5639	28

* Undergraduate students only, as of 2013.

Source: National Center for Education Statistics, http://nces.ed.gov/globallocator.

The surge in SUNY enrollments in five of our Upstate cities after 1960 effectively offset what would have been *even steeper declines* in the populations of those cities. This means the declines in private sector employment, households, and incomes were even more pronounced in the five cities in our study with SUNY institutions. Table 2 Adjusted Population Declines in Non-Student Residents, Selected Small Cities, quantifies the severity in the population loss of year round non-student residents after the expansion of SUNY. The first column in the table, “Additional SUNY Students Since 1960,” is the difference between full time student enrollment in 1960 and 2013. The additional SUNY students in Cortland, Oneonta, Oswego, and Plattsburgh are then subtracted from the most recent Census population figures for 2010, which yields the fourth column, “Adjusted 2010 Population.” These adjusted figures are then used to calculate the last column, “% Change 1970 to 2010.” In total, the “swapping” of new SUNY students for permanent residents suggests that our six Upstate cities lost an average of 27% of their non-student populations in the four decades from 1970 to 2010. While the expansion of SUNY no doubt brought student spending multipliers to these cities, the positive benefits of those effects are considerably less than those that would come from residents who live in households supported by incomes from employment in private sector commercial enterprises; whether large, medium, or small.

Table 2: Adjusted Population Declines in Non-Student Residents, Selected Small Cities

	Additional SUNY Students Since 1960	Population 1970	Population 2010	Adjusted 2010 Population	% Change 1970 to 2010
Cortland	4001	19,621	19,204	15,203	-23
Elmira	0	39,945	29,200	29,200	-27
Geneva	0	16,793	13,261	13,261	-21
Oneonta	3999	16,030	13,901	9,902	-38
Oswego	5071	20,913	18,142	13,071	-37
Plattsburgh	4231	18,715	19,989	15,758	-16

Source: United States Bureau of the Census and Office of the New York State Comptroller (2004); Enrollment data were provided by the SUNY Institutional Research Office.

The rising proportion of property tax exemptions relative to total properties that accompany the expansion of SUNY in four of these municipalities further magnifies the negative consequences of these population shifts over the four decades. In addition to the loss in overall tax revenues, property owners had to absorb higher costs for public safety that are attributable to the presence of college students. As shown in Table 3 General Fund Revenues and Selected Small Cities, 2012, between 32% and 44% of annual expenditures in our six Upstate cities are devoted to public safety (fire and police protection). Total revenue and total expenditures data are for each city's General Funds, so capital project funds, the proceeds of debt, and inter-fund transfers from reserves are excluded. We also do not include revenues from federal and state aid.

Table 3: General Fund Total Revenues and Expenditures, Selected Small Cities, 2012

	Total Revenues (in $)	Total Expenditures (in $)	Surplus/ Deficit (in $)	Expenditures for Public Safety (in $)	PubSafe as % of Total Expend.
Cortland	17,329,174	17,693,994	-364,820	7,479,365	40
Elmira	28,575,804	29,940,196	-1,364,392	11,863,276	39
Geneva	15,278,619	16,097,916	-819,297	6,160,935	38
Oneonta	14,259,998	14,343,137	-83,139	6,314,775	44
Oswego	28,665,445	30,083,049	-1,417,604	9,538,447	32
Plattsburgh	20,277,594	22,743,349	-2,465,754	8,150,249	37

Source: New York State Comptroller

Property tax exemptions and the rising proportion of students in the total population have combined to consequently impose a structural gap in city budgets. The enlarged share of tax-exempt property has reduced a primary revenue source to finance essential services, and the unfunded expense for the provisioning of public safety has shifted an increasing burden of those costs to a shrinking number of municipal taxpayers. As the composition of city residents has shifted away from taxpaying households to college students in our Upstate cities, non-student households have been forced to bear an even higher proportion of public safety expenditures. Per capita total spending and per capita spending for public safety are compared below in Table 4 Total Spending and Public Safety Expenditures, Per Capita, Selected Cities, 2012. The Public Safety Spending, per Capita, means that the annual spending per student for public safety in our six Upstate cities ranges from a low of $389 per year (Cortland) to a high of $526 per year (Oswego). Average Total per Capita Spending is $1,165 for the six cities, and average per Capita Public Safety Spending is $441. In our six cities, 38% of all municipal spending is allocated to the provisioning of Public Safety services.

Table 4: Total Spending and Public Safety Expenditures, Per Capita, Selected Cities, 2012

	Total Spending, per Capita (in $)	Public Safety Spending, per Capita (in $)
Cortland	921	389
Elmira	1025	402
Geneva	1214	465
Oneonta	1032	454
Oswego	1658	526
Plattsburgh	1138	408

Source: New York State Comptroller

NEW YORK STATE COLLEGE PUBLIC SAFETY FEE PROPOSAL

Given these realities, we propose a New York State College Public Safety Fee to mitigate the fiscal challenges faced by small cities in Upstate New York with large college student populations. Because these populations require highly trained personnel and equipment to ensure public safety, an unfunded burden has been placed on municipal finances generally, and on property owning taxpayers specifically. Under provisions of federal and state law, college students enjoy the same rights as year round residents. Since residential college students consume the same set of public services as those that are consumed by

property owners and renting residents, a classic “free rider” problem exists. Students attending college in Upstate cities benefit from public safety services without paying for the cost of those services.

Table 5 Student Population, Fee Revenue, and Budget Deficits, Selected Small Cities examines the results from hypothetically charging college students a $100 fee that would provide revenues dedicated to funding public safety services in our six Upstate cities. Such a fee would have returned an additional total revenue stream to our municipalities in 2012 ranging from a low of $140,800 in Elmira to a high of $741,800 in Oneonta. Although the $100 fee would cover about 25% of the cost of public safety in Cortland, Elmira, and Plattsburgh, the 2012 general fund budget deficits in Cortland and Oneonta would have turned into modest surpluses, and the deficit in Oswego would have been cut in half.

Table 5: Student Population Fee Revenue and Budget, Selected Small Cities

	Student Population	Fee Revenue ($100 fee)	Original Deficit (in $)	Deficit with New Revenue (in $)
Cortland	6400	640,000	-364,820	275,180
Elmira	1408	140,800	-1,364,392	-1,223,592
Geneva	2368	236,800	-819,297	-582,497
Oneonta	7418	741,800	-83,139	658,804
Oswego	7328	732,800	-1,417,604	-684,804
Plattsburgh	5639	563,900	-2,465,754	-1,901,854

CONCLUSION

Our findings demonstrate that under existing federal and state laws defining residency, college students in our Upstate small cities enjoy benefits from services funded only by non-student residents. We have shown how colleges contribute to budgetary distress in Upstate small cities, and have identified an inequity where local property owners bear the full burden of unfair taxation in the provisioning of essential public services. Those results call for the possibility of levying a special fee on residential college students to support the provisioning of public safety services. More generally, there may be additional legal concerns on fairness since some residents currently bear the costs for free riders who utilize essential public safety services and reside at colleges.

ENDNOTES

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provided valuable insights and a better understanding about the public safety needs of college student populations.

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Do Small Businesses Create More Jobs? Evidence for New York State from Quarterly Workforce Indicators

Arindam Mandal* and Mankirat Singh†

ABSTRACT

The view that small businesses create the most jobs remains appealing to policymakers and small business advocates in the U.S. While early empirical studies provided support for this perception, a variety of subsequent empirical studies have highlighted statistical and measurement pitfalls underlying much of the evidence in support of this perception. Some of these shortcomings were driven by lack of availability of suitable data to properly measure the impact of small businesses on job creation. In this paper, we have used relatively new dataset – Longitudinal Household-Employer Dynamics or Quarterly Workforce Indicators – to revisit the debate on the role of small businesses in job creation in New York State. We find strong evidence that in New York State, small businesses play an important role in overall job creation. However, along with small businesses, large businesses and age of firms also plays an important role in overall job creation.

INTRODUCTION

"Small businesses create 2 out of every 3 jobs in this economy, so our recovery depends on them."
(Obama, 2012)

Since the seminal studies conducted by Birch (1979, 1981, 1987), it has been a recurring question in the discipline of Small Business Economics as to what extent small businesses contribute towards net job creation. This paper contributes to this topic in following ways. First, we use a new dataset – Longitudinal Employer-Household Dynamics (LEHD) or Quarterly Workforce Indicators (QWI) by the U.S. Census Bureau to revisit the debate. Second, we test role of small businesses in job creation primarily for New York State (NYS). Finally, unlike in prior studies which primarily focused on manufacturing, our data caters to a wide range of industries across NYS economy.

It is often claimed that small firms are responsible for a disproportionately large share of new jobs that are created in the U.S. economy. If true, this speaks well of the entrepreneurial spirit of the U.S. economy, whereby newcomers introduce new ideas or production processes that lead to new and improved products or services. This perception is popular among politicians of different political persuasions, small business advocates, and the business press.

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In the provocative work of Birch (1979, 1981, 1987), where he argued that small businesses are the primary engines of job growth, claiming that 66% of all net new jobs in the United States between 1969 and 1976 were created by firms with twenty or fewer employees, and 81.5% were created by firms with one hundred or fewer employees. The important role of small businesses in job creation fit perfectly with the U.S. government's long tradition of supporting small businesses. As early as 1953, the U.S. Congress passed the Small Business Act with the intention of aiding, counseling, assisting, and protecting the interests of small businesses. The Small Business Administration has helped fund – and still continues to - and assist small businesses. The SBA does this by providing loans, contracts, and counseling to small businesses. Birch's findings fed into this thinking and quickly became conventional wisdom. Since then, his findings have often been cited as justification for favorable government regulations, tax incentives, and support programs for small businesses. More recently, President Obama enacted the Small Business Jobs Act of 2010 in hopes to help small businesses thrive and grow towards economic recovery. The SBA Act of 2010 includes reduced fees, higher loan limits, increased funding for start-up costs, coverage of a wider demographic of businesses, and many more policies that will help the creation of small businesses, and in turn, help the creation of more jobs.

Davis et al. (1996) critiqued Birch's conclusions based on both methodology and data quality. More recent studies have found empirical evidence that goes against the lucrative small business theory (Haltiwanger et al. 2013). These studies suggest that there is either no relationship or inverse relationship between firm size and growth. In other words, it does not matter whether on the size of a firm is big or small, it is not the main cause for net job growth.

In this paper we revisit the role of small businesses in creating jobs for New York State using the LEHD or QWI dataset by the U.S. Census Bureau. The rest of the paper is organized as follows: section (II) provides a short literature review, section (III) describes the LEHD or QWI dataset, section (IV) describes different measurement concepts, section (V) discusses econometric model and data analysis and finally section (VI) concludes.

LITERATURE REVIEW

Birch (1979, 1981,1987) provided hard evidences in support of the important role of small businesses in creating majority of jobs in the U.S. Birch's work prompted numerous researchers to consider his methods and to test his hypothesis in different countries. Kirchhoff and Phillips (1988) examine the contribution of small and large firms to U.S. job growth. They find that firms with fewer than 100 employees are the major sources of net job creation. Using Canadian data on the manufacturing sector, Baldwin and Picot (1995) find that net job creation by small manufacturing establishments is greater than that of large establishments. Broersma and Gautier (1997), using firm-level data for the Netherlands, find that small firms contribute more to net job creation than large ones. For the United Kingdom, Barnes and Haskel (2002) find that small

establishments contribute more to net job creation. Voulgaris, Papadogonas, and Agiomirgianakis (2005) also find that small firms create more jobs on net, using data from Greece.

Davis et al. (1996a) criticize the statistical analysis leading to Birch's conclusions based at least three statistical pitfalls, viz. (1) the size distribution fallacy, (2) the confusion between net and gross job creation, and (3) the regression to the mean bias. The dataset in Birch's study was biased since he classified businesses by size for a given base year. When businesses are classified by size for a given base-year, firms that are not small but experienced have a transitory negative shock to their employment will appear to be small for the moment. Additionally, firms that are not small but classified small due to random measurement errors. To avoid statistical pitfalls related to the size distribution fallacy and the regression to the mean bias, Davis et al. propose computing job creation and destruction rates from the base period (t-1) to period t relative to the average employment level in these two periods. They argue that the regression fallacy fully explains the relationship between establishment size and job growth, and they find no systematic relationship between manufacturing plant size and job creation when using the average instead of a base-year size measure. Later Hohti (2000), using data from Finland found a conclusion similar to Davis et al., that there is no clear relationship between establishment size and net job creation

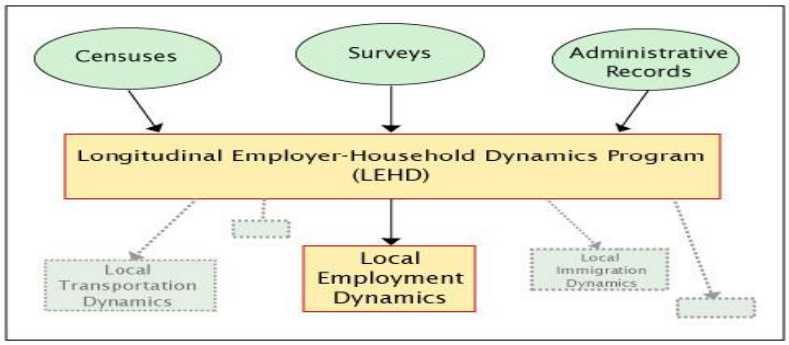
More recently Neumark et al. (2011) recently performed a careful analysis where they avoid the misleading interpretations of the data highlighted by Davis at al. (1996). Using the National Establishment Time Series (NETS) data including coverage across the U.S. private sector from 1992 to 2004, they find an inverse relationship between net growth rates and firm size. Their analysis indicates that small firms contribute disproportionately to net job growth. In addition to a negative relationship between firm size and job creation, Neumark et al. find that the average job destruction for smaller firms are smaller than their average share of job creation. In other words, smaller firms have a positive net job creation rate. However, Haltiwanger et al. (2013) using the U.S. Census Bureau's Longitudinal Business Database (LBD), finds that there is no systematic relationship between firm size and growth once firm age is controlled.

The debate on the role of small businesses is far from being settled. Different studies have used wide range of data sources and reached contradictory conclusions even after correcting for some of the statistical mistakes pointed put by Davis et al. (1996).

DATA

Local Employment Dynamics (LED) is a part of the bigger program by United States Census Bureau called Local Employer-Household Dynamics (LEHD). LEHD uses modern statistical and computing techniques to combine federal and state administrative data on employers and employees with core Census Bureau censuses and surveys. On the other hand, LED is a voluntary partnership between state labor market information agencies and the United States Census Bureau to develop new information about local

labor market conditions at low cost, with no added respondent burden. The difference between LEHD and LED is explained by the following diagram



Source: Quarterly Workforce Indicators, United States Census bureau

Quarterly Workforce Indicators (QWI) provides detailed local estimates of variety of employment and earnings indicators based upon information from LED on a quarterly basis. Employment, earnings, gross job creation and destruction, and worker turnover is available at different levels of geography, typically down to the county or metro area. At each level of geography, they are available by detailed industry (SIC and NAICS), sex, and age of workers. Currently, QWI is available for all the states of the United States, except for Connecticut, Massachusetts, New Hampshire, District of Columbia, Puerto Rico and Virgin Islands.

The Quarterly Workforce Indicators (QWI) are derived from state administrative records and basic demographic information from the Census Bureau. Employment totals from the QWI are not exactly comparable with those from other sources. Generally, coverage and definitions differ between the QWI and data about establishments from administrative records (e.g., the Quarterly Census of Employment and Wages or QCEW), and about workers from surveys (e.g., the decennial census, the American Community Survey, and the Current Population Survey or CPS.). For further information on QWI, refer to Stevens (2007).

For this study we have used Net Employment Change (also Net Job Creation) - the difference between current and previous employment at each business. All the levels data above is converted into rates by dividing the average of present and previous quarter employment. We divide by the average of the present and previous to control for regression fallacy. A pitfall in Birch's study in 1979 was that an additional employee would add too much weight when added to a new firm. To control for this, Davis et al. (1996) suggested that researchers should use the average employment in two periods.

Though LEHD data is available from 2001:Q1 – 2013:Q2, however, our study has been limited to the time period 2005:Q1 to 2013:Q2. This primarily due to the availability of New York State level personal income data from Bureau of Economic Analysis is only available from 2005:Q1. Data is deseasonalized using Census X-13 ARIMA process.

We have five classifications for both size and age. Size class 1 consists of 0-19 employees, size class 2 consists of 20-49 employees, size class 3 consists of 50-249 employees, size class 4 consists of 250-499 employees, and size class 5 consists of 500+ employees. For age classifications, age class 1 consists of 0-1 years, age class 2 consist of 2-3 years, age class 3 consists of 4-5 years, age class 4 consists of 6-10 years, and age class 5 consists of 11+ years. In our study, when we mention small firms we are primarily talking about firms in size class 1 and 2. Size 1 firms are often startup companies who experience fast growth inevitably because of their ability to assemble and acquire capital easily. When we mention large firms, we are talking about firms with 500+ employees. In our research, we have classified young firms, as those who are in age 1 and old firms are 11+ years and older.

THE ESTABLISHMENT-LEVEL AND AGGREGATE GROWTH RATE CONCEPTS

This section describes the job creation rate measures we use in the paper in more detail. Let E_t be employment in year t. In the LEHD, establishment employment is a point-in-time measure reflecting the number of workers on the payroll during the quarter. We measure the job creation rate as follows:

$$g_t = \frac{(E_t - E_{t-1})}{X_t}$$

where

$$X_t = 0.5 * (E_t + E_{t-1})$$

This growth rate measure has become standard in analysis of establishment and firm dynamics because it shares some useful properties of log differences but also accommodates entry and exit. (Haltiwanger et al., 2013)

The above growth rate measure can be flexibly be defined for different aggregations of establishments. For example,

$$g_t = \sum_s \left(\frac{X_{st}}{X_t}\right) g_{st} = \sum_s \left(\frac{X_{st}}{X_t}\right) \sum_{i \in s} \left(\frac{X_{it}}{X_{st}}\right) g_{it}$$

where

$$X_t = \sum_s X_{st} = \sum_s \sum_{i \in s} X_{it}$$

where g_t is the aggregate growth rate and s indexes classifications of establishments into groups defined for any level of aggregation s where s can refer to firm size, or firm age classifications. Thus, the net growth rates for various aggregations of interest are just properly weighted sums of group-level growth rates where the groups are firm size and firm age.

EMPLOYER SIZE, AGE AND NET EMPLOYMENT CHANGE: EMPIRICAL FINDINGS

We take two approaches to investigating whether small businesses create more jobs. First, following the tradition established by Birch (1987) and Davis et al. (1996), we divide businesses into different size and age categories and examine whether there is a significant difference in net job creation rates across firm and establishment size and age categories. Second, we econometrically estimate the relationship between job creation and establishment size and establishment age. Correlations of Net employment change by size and age is given in the following tables.

Table 1: Correlations of Net Job Creation Rate by Firm Size

	Firm Size (0-1)	*Firm Size (20-49)*	*Firm Size (50-249)*	*Firm Size (250-499)*	*Firm Size 500+*	*Firm Size (All)*
Firm Size (0-1)	1.000					
Firm Size (20-49)	0.723	1.000				
Firm Size (50-249)	0.586	0.790	1.000			
Firm Size (250-499)	0.453	0.477	0.560	1.000		
Firm Size 500+	0.260	0.248	0.473	0.499	1.000	
Firm Size (All)	0.636	0.636	0.772	0.667	0.878	1.000

Table 2: Correlations of Net Job Creation Rate by Firm Age

	Age (0-1)	*Age (2-3)*	*Age (4-5)*	*Age (6-10)*	*Age (11+)*	*Age (All)*
Age (0-1)	1.000					
Age (2-3)	0.663	1.000				
Age (4-5)	0.559	0.521	1.000			
Age (6-10)	0.509	0.576	0.373	1.000		
Age (11+)	0.566	0.649	0.629	0.630	1.000	
Age (All)	0.674	0.733	0.679	0.715	0.983	1.000

Table 3: Correlations of Net Job Creation Rate by Firm Size and Age

	Firm Size (0-1)	*Firm Size (20-49)*	*Firm Size (50-249)*	*Firm Size (250-499)*	*Firm Size 500+*	*Firm Size (All)*
Age (0-1)	0.649	0.501	0.517	0.534	0.488	0.670
Age (2-3)	0.458	0.354	0.485	0.480	0.645	0.703
Age (4-5)	0.466	0.547	0.565	0.503	0.550	0.681
Age (6-10)	0.511	0.388	0.479	0.545	0.618	0.704
Age (11+)	0.530	0.589	0.747	0.580	0.873	0.955
Age (All)	0.592	0.606	0.751	0.627	0.871	1.000

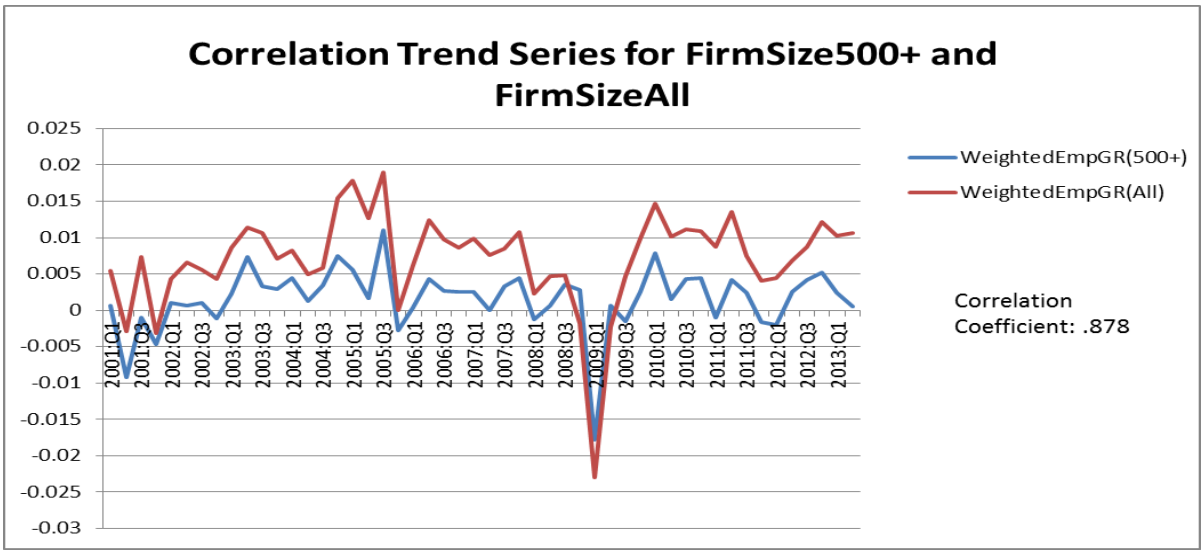
Net employment change rate for New York State (e.g. “Firm Size (All)” and “Age (All)”) is highly correlated with net employment change rate of “Firm Size (500+)”and “Age (11+)”. For example, correlations in net employment change rate for “Firm Size (500+)” and “Firm Size (All)” is 0.878, whereas for other firm sizes this correlation varies between 0.63 and 0.77. Similarly net employment change rate for “Age (11+)” has correlation of 0.983 with “Age (All)”. This correlation for other firm age groups varies between 0.67 and 0.73.

In net employment change rate correlations by size and age, we find that “Firm Size (500+)”and “Age (11+)” are highly correlated at 0.873. This makes sense because older firms are also typically the larger firms. For other age and size groups, the correlation varies between 0.388 and 0.618.

To better understand correlation between two size classes, we graphed two size classifications in table 4.

It is visually apparent that both lines follow a very similar trend line. What this tells us is that the employment growths for firms with 500+ employees have a very large market share, which therefore, is represented by the red line – EMPGR (All) – that aggregates all the employment growth together. In technicality, if firms with 500+ employees, fire a lot of employees, then the aggregate employment growth for all firms will show a decrease that is proportionate to the former. Both lines both very similarly, because employment flows in one class effects employment flows in the other class.

Table 4: Graph of Employment Growth by Firm Size 500+ and Firm Size All



Correlation, however, does not signify causation. To quantify the effects of small businesses on net job creation rate, we use the following specifications.

$$NE_t = \beta_1 + \beta_2 dlog(PI_t) + \beta_3 log(NHE_t) + \beta_4 SF_t + \beta_5 LF_t + \beta_6 AF_t + \varepsilon_t$$

where

NE_t = *Net job creation rate*

PI_t = *Personal income*

NHE_t = *Monthly new hire earnings*

SF_t = *Proportion of net employment by small firms*

LF_t = *Proportion of net employment by large firms*

AF_t = *Proportion of net employment by firms 11yr+*

The control variables in our regression analysis are Personal income *(PI_t),* Monthly new hire earnings *(NHE_t)* and Proportion of net employment by firms 11yr+ *(AF_t).* Personal income is included to account for the macroeconomic factors that affect new job creations. We expect the coefficient of personal income to be positive. The data on personal income is obtained from Bureau of Economic Analysis. Monthly new hire earnings are included to account for the labor market conditions. Higher new hire earnings would imply higher cost of labor and hence less job creation. We expect coefficient of this variable to be negative. The data on monthly new hire earning are obtained from LEHD or QWI. Following Haltiwanger et al. (2013), we controlled for firm age by including the proportion of net employment by firms 11yr+. Both personal income and new hire earning variables are converted into log. The regression results are presented below.

In the table below, different model specifications are marked by (1) – (4). The signs of all coefficients are as we expected in all model specifications. However, statistical significance of the coefficient for

$\log(NHE_t)$ changes based on model specification. For example in model (1), coefficient of $\log(NHE_t)$ is significant and negative, however, coefficient of $\Delta\log(PI_t)$ is positive but insignificant. In model (2), we have included SF_t. The coefficient if SF_t is positive and significant. It implies that net job creation rate generated by small firms plays an important role in overall new job creation rate. However, Haltiwanger et al. (2013) found that when small firms were controlled for age, the importance of small firms in creating jobs is negligible. To account for firm age, we have included the variable AF_t in model (3). The coefficient of AF_t is positive and significant. It implies that age also plays an important role in overall net job creation. However, the size of the coefficient for SF_t declined from 2.377 in model (2) to 0.897 when we controlled for firm age in model (3). Also, coefficient of $\log(NHE_t)$ turned insignificant from significant. In the correlation analysis, we observed that net job creation by large firms are highly correlated with net job creation by firms 11 years and older. Hence, in model (4), we have included LF_t as an additional control variable. The coefficient of LF_t is positive and significant. However, the size of the coefficient of AF_t declined from 1.005 in model (3) to 0.355 in model (4). On the other hand size of the coefficient for SF_t increased to 1.564, whereas the sign of $\log(NHE_t)$ coefficient remained negative but insignificant.

Table 4: Regression Results with Net Job Creation Rate as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)
$\Delta\log(PI_t)$	0.040482 (0.045155)	0.020228 (0.045295)	0.008709 (0.016526)	0.008671 (0.010193)
$\log(NHE_t)$	-0.073838*** (0.015278)	-0.047611*** (0.012103)	-0.001866 (0.005517)	-0.003086 (0.003408)
SF_t		2.377678*** (0.449377)	0.897290*** (0.195758)	1.564328*** (0.155324)
LF_t				0.721991*** (0.105198)
AF_t			1.005038*** (0.072833)	0.355662*** (0.105198)
Constant	0.537591*** (0.128332)	0.379820*** (0.097764)	0.016703 (0.044288)	0.023934 (0.027337)
R^2	0.602585	0.727724	0.965096	0.987196
Adj. R^2	0.560005	0.699558	0.96011	0.984825

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

Based on the analysis above, we may conclude that the large firms, small firms and older firms are all important in job creation in NYS. However, in terms of overall impact, perhaps small firms are more important than other firm sizes and age. In this study we have been able to control both firm size and age along with other macroeconomic labor market variables such new hire earnings and personal income.

CONCLUSION

In this study, we have been able to explore the role of firm size and age in job creation. For the purpose, we have used a LEHD or QWI as our primary source of information. Our study have been able to control for firm age, firm size along with other macroeconomic variables affecting labor market such as personal income and new hire earnings. The study finds that both small firms and larger firms play an important role in job creation. Aged firms also play an important role as well. In terms of importance, we find that small firms are relatively more important in creating new employment than larger firms.

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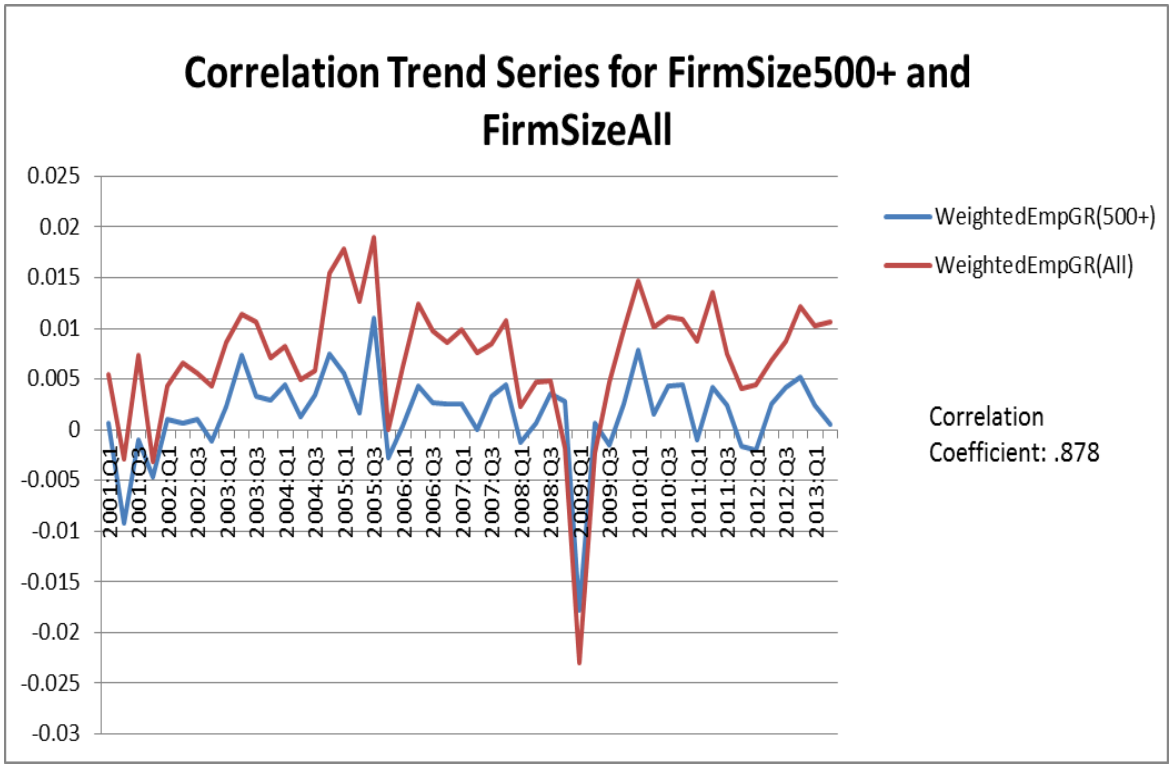
Correlation Trend Series for FirmSize500+ and FirmSizeAll
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0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
2001:Q1
2001:Q3
2002:Q1
2002:Q3
2003:Q1
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2004:Q1
2004:Q3
2005:Q1
2005:Q3
2006:Q1
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2010:Q1
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WeightedEmpGR(All)
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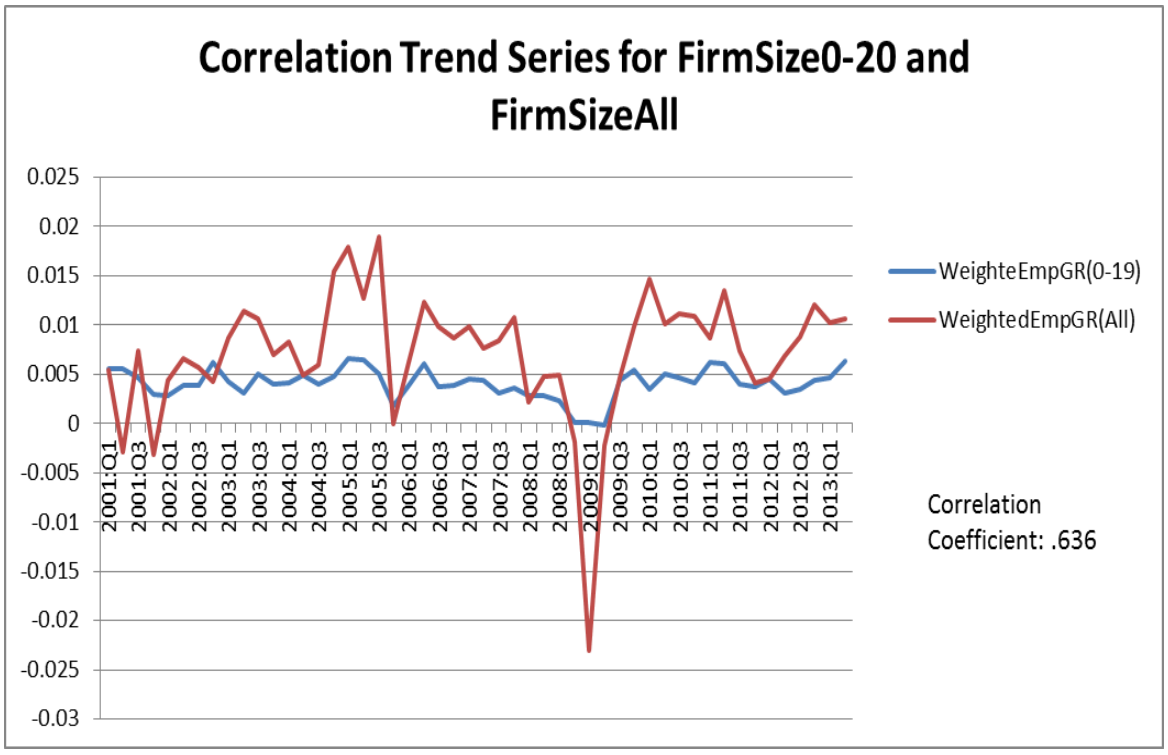
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-0.025
-0.03
2001:Q1
2001:Q3
2002:Q1
2002:Q3
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2010:Q3
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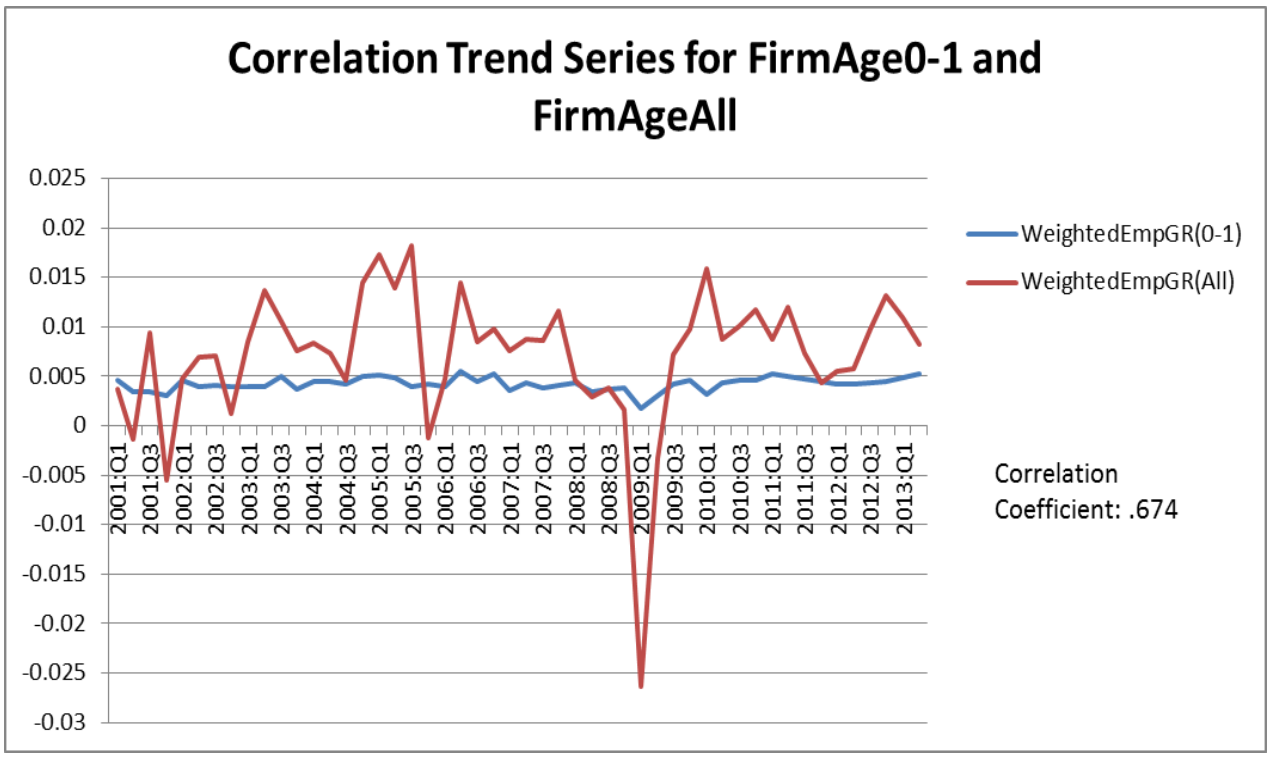
WeighteEmpGR(0-19)
WeightedEmpGR(All)
Correlation Coefficient: .636


Correlation Trend Series for FirmAge0-1 and FirmAgeAll
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0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
2001:Q1
2001:Q3
2002:Q1
2002:Q3
2003:Q1
2003:Q3
2004:Q1
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2010:Q1
2010:Q3
2011:Q1
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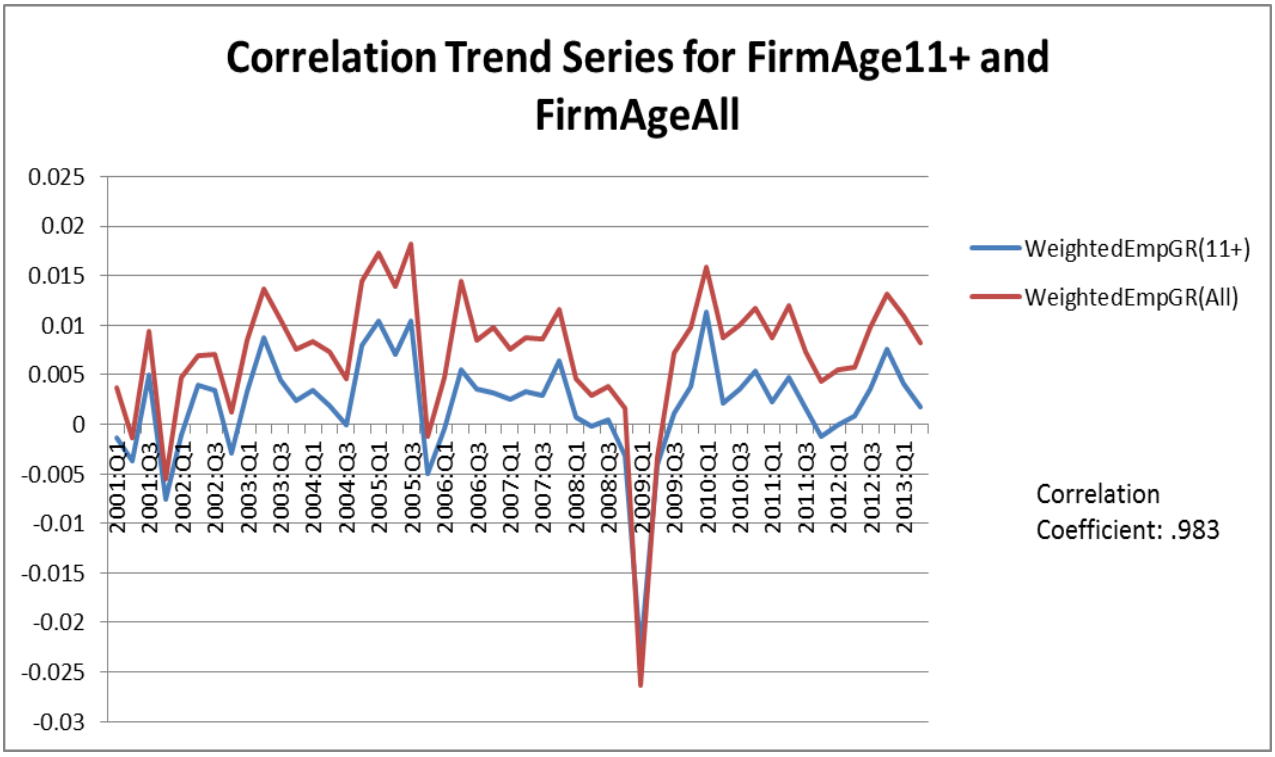
2012:Q1
2012:Q3
2013:Q1
WeightedEmpGR(0-1)
WeightedEmpGR(All)
Correlation Coefficient: .674


Correlation Trend Series for FirmAge11+ and FirmAgeAll
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0.005
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-0.005
-0.01
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-0.03
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2013:Q1
WeightedEmpGR(11+)
WeightedEmpGR(All)
Correlation Coefficient: .983

Electricity Generation and Cap and Trade CO_2 Programs: What changes can be attributed to RGGI, and who benefits?

Todd Metcalfe*

ABSTRACT

This paper estimates that the Regional Greenhouse Gas Initiative (RGGI) has reduced CO_2 emissions in New York State by nearly 5 million tons yearly on average by changing the fuel mixed used for electric generation. This analysis was performed using a database with fossil fuel generation data from the EPA's Air Markets Data Program (AMPD) supplemented with data from the EIA, NOAA, and U.S. Census. These results are important because RGGI is one type of program that would be permitted under EPA's recently proposed Clean Power Plan (CPP) rule. CPP explicitly encourages states to adopt regional trading programs like RGGI.

INTRODUCTION

Burning fossil fuels for electric generation creates CO_2 as a by-product. The amount of CO_2 emitted while generating a megawatt of electricity will vary depending on the fuel type used: coal will emit roughly twice as much CO_2 as gas will. CO_2 from electric generation cannot economically be captured; when a CO_2 cap is imposed on electricity generation, the only way to reduce CO_2 emissions from fossil fuel generation is to change the mix of fuels being used to produce electricity. Changing the fuel mix will also change the levels of generation of conventional pollutants, such as SO_2 and NO_X, which can negatively affect human health. Since gas is favored over coal when CO_2 is capped and produces lower amounts of conventional pollutants, cap and trade programs for CO_2 create ancillary health benefits. This paper examines the longest running U.S. CO_2 control program's effects by estimating changes in the electric generation mix. This examination is achieved using a unique dataset of observed generation levels at fossil fuel plants from the year 2000 to 2013, in New York and Pennsylvania, to estimate that the Regional Greenhouse Gas Initiative (RGGI) has reduced CO_2 emissions in New York State by approximately 4.9 million tons yearly on average. This paper is part of a larger analysis that estimates the ancillary benefits of RGGI from lowered SO_2 and NO_X production, and the distribution of those benefits.

RGGI is a cap and trade program, implemented in the Northeastern United States, which requires fossil fuel electric power generators over 25 MW to purchase allowances, at auction, for every ton of CO_2 emitted from their operations. Currently, there are 9 states in RGGI: Connecticut, Delaware, Maine, Maryland,

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Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Pennsylvania has acted as an "observer" to RGGI, but has not joined. RGGI went into effect on January 1st, 2009.

Understanding the changes in fuel generation mix is important as they help to inform the debate on future programs to curb CO_2 emissions. The electricity sector is the largest source of greenhouse gas emissions in the United States (EPA, 2014b) and has been targeted for reductions by proposed EPA rules. The EPA recently proposed a rule for reducing CO_2 emissions from the electric sector by approximately 30 percent from 2005 levels. The rule calls for these goals to be achieved at the state level, and each state is given a specific emission rate goal to reach these reductions. States are allowed to submit joint plans under this rule, and RGGI is singled out as an example of what such a joint program may look like, provided that the program meets the full level of reductions as required by the rule (EPA, 2014a, p. 34838).

The debate over curbing CO_2 emission makes it important to understand what is gained by these actions, as understanding full benefits are important for informed policy decisions. Reducing CO_2 emissions will have many ancillary benefits to society by reducing costs associated with pollution from burning fossil fuels. Examples of these are environmental damages such as those caused by acid rain, injured human health, and other economic damages or infrastructure deterioration. Risk assessments relating to human health have been used to assign values to changes in environmental quality that result in corresponding gains in human health. Calculating changes in generation are the first step to being able to calculate benefits using risk assessments.

The paper first presents pertinent background about RGGI, CO_2 cap-and-trade programs, and valuing emissions reductions. Next, the dataset constructed and used for the research is described. Then the methods are discussed, followed by the results of the analysis. Finally, conclusions about RGGI's effects on generation are described and future research is detailed.

PRIOR LITERATURE

Previous work on RGGI has focused on the economic impacts of RGGI, consumer demand, and whether or not there has been leakage of CO_2 to states outside of RGGI. Hibbard and Tierney (2011) estimated that RGGI resulted in $1.6 billion of economic value added in to state economies based on the state expenditures from the proceeds of RGGI allowance auctions. Paul et al. (2010) modeled the electricity market in Maryland to determine what the impacts of revenue from RGGI auctions spent on efficiency programs would be on levels of electricity consumption. They found that Maryland's economy would benefit from lower electricity demand and hence lowered electricity bills. Burtraw, Kahn, and Palmer (2006) analyzed the economic impacts of RGGI on power generators, to better understand how the distribution of allowances would impact generators. They found that there would likely be plants that gained value and some that declined in value, and that plants that were outside of the RGGI region would increase in value,

but those that were inside of RGGI would in general decrease in value. The impact on the value of non-emitting plants was not clear (Burtraw, Kahn, and Palmer, 2006).

Kindle, Shawhan, and Swider (2011) tested leakage resulting from RGGI between Pennsylvania and New York using historical data on the scheduled flows of electricity between the two states. Their study did not find evidence supporting CO_2 emissions leakage, and stated that the allowance "price is too low to permit the empirical detection of inter-regional emissions leakage" (Kindle, Shawhan, and Swider, p. 19, 2011).

For this work the most important previous work was performed by Murrray, Maniloff, and Murray. Their work utilizes a yearly database from 1991 to 2011 for CO_2 emissions and electricity generation at the state level for the 48 continental states to estimate the effects of RGGI on electricity generation. Their study concludes that emissions have been reduced for RGGI states, but these reductions were due to a "combination of policy, natural gas market, and macroeconomic factors that emerged in the late 2000s" and that at least one third of these reductions can be attributed to natural gas prices and availability (Murray, Maniloff, and Murray, 2014, p. 25 – 26). Further, they find that RGGI is a factor in the reduction of emissions but they are not able to determine if it is due to carbon allowance prices, demand reductions aspects of the policy, or increased imports from generation in other states (Murray, Maniloff, and Murray, 2014).

DATA

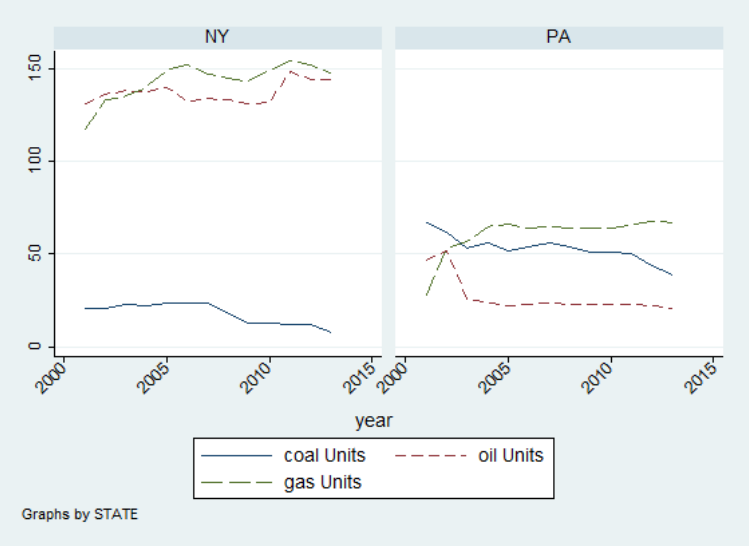
To determine the effect of RGGI on the generation at the plant level this analysis utilizes panel data, spanning the years 2000 to 2013 for New York and Pennsylvania. New York was a founding member of RGGI, however Pennsylvania has not joined. Data was collected from a variety of sources for the information in the database, including the EPA, NOAA, the U.S. Energy Information Administration (EIA), and U.S. Census.

The most important data for this project comes from the EPA's Air Markets Data Program, which has hourly reports from power plants across the country. In general, power plants burning fossil fuels are required to report to the EPA if they have generating capacity greater than 25 megawatts under the Acid Rain Program (ARP) (USEPA, 2009, p. 2). Plants in the ARP program are required to report year round. Other plants can be required to either report year round or only during specific seasons depending on if the plant is subject to the annual CAIR SO_2 and NO_X or the seasonal CAIR NO_x program (USEPA, 2009, p. 68). Data from the ARP exists dating back to 1995, when it was first collected. However, at that time not all plants were required to report: only 110 facilities, nationwide, were originally affected. Starting in 2000, the current ARP rules for reporting were put into place. In general, these plants report hourly their electricity generation and their SO_2, NO_X, and CO_2 emissions.

AMPD gives very detailed fuel definitions, sometimes including multiple fuel types that a plant may burn. These fuel types are collapsed to three main categories, coal, oil, and gas[1]. For example, some plants

have a primary fuel source described as “Diesel Oil, Pipeline Natural Gas” these are mapped to being oil for this analysis. Generation and emissions levels are summed and the data is processed to the monthly level for Pennsylvania and New York.

Chart 1. Units Reporting by Fuel Type for NY and PA 2001 to 2013



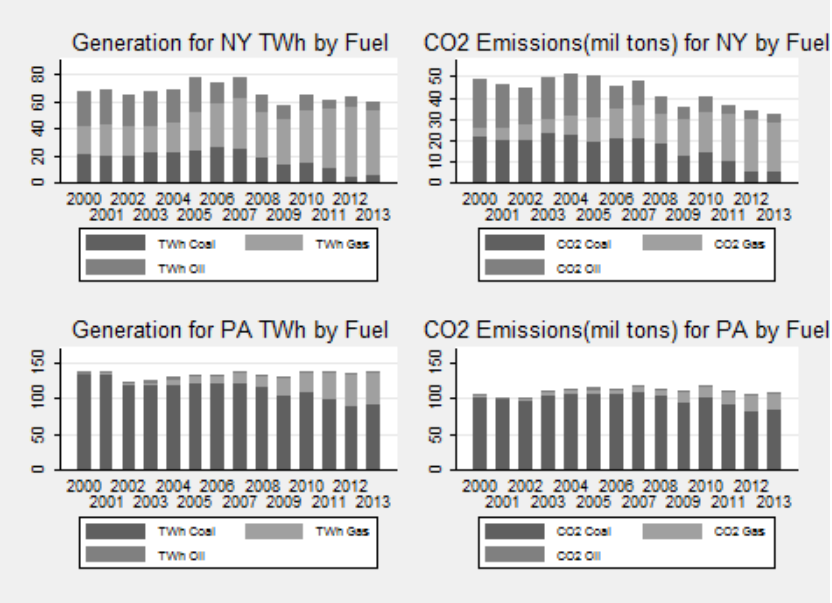
There has been a reduction in the number of coal units[2] reporting in both NY and PA, from 2008 (pre-RGGI) to 2013 (post RGGI). In New York, coal units have gone from 18 to 8, and in Pennsylvania, from 54 to 39. Chart 1 illustrates the change in the number of units by generation. As can be seen in Chart 1 NY has far more generation units in oil and gas than in coal. Also, there has been a drop in the number of coal units over time, and an increase in the number of oil and gas units. In Pennsylvania there as been a downward trend in coal plants, especially after 2010. There has also been a slight increase since about 2010 in the number of gas units.

In NY, the CO2 emissions have had a downward trend, however, this trend is not evident in PA (Chart 2). However, there is has been a significant shift away from generation with coal in NY compared to PA as seen in (see Chart 1). These trends indicate two possible sources of effects from RGGI. First, a unit could elected to not generate electricity in a given time period. The plant could also, produce less generation during a specific time period than it would otherwise. Both demand and generation for electricity are not homogenously distributed, which will impact the program be generation at two points are not perfect substitutes for each other. See Map 1 for fossil fuel generation in 2007.

Average fuel price was obtained from EIA’s Monthly Energy Review, Table 9.9 “Cost of fossil-fuel receipts at electric generating plants.” This provides prices in dollars per million BTU, including taxes for coal, oil, gas, and other fossil fuels. For oil, the variable “Total Petroleum Receipts” was used to approximate the cost to plants. Fuel prices have behaved differently for each fuel per million BTU in the data set from 2000 to 2013. As can be seen in Chart 3, below, coal prices have remained relatively stable over time, with

a slight increase. The cost of gas and oil roughly followed each other until approximately 2009, when the cost of gas fell and the cost of oil increased. Even with the falling price of gas, it is still relatively more expensive per mmbtu than coal.

Chart 2. NY and PA Generation and CO_2 by Year by Fuel Source.



The final step for creating the dataset for this analysis was to fill in the unobserved "observations" where a plant did not run. The data set contains 86,613 observations in total, of these 46,357 were censored, and 40,256 uncensored observations.

Map 1. Generation by County Log of Total Generation for 2007, by Fossil Fuel

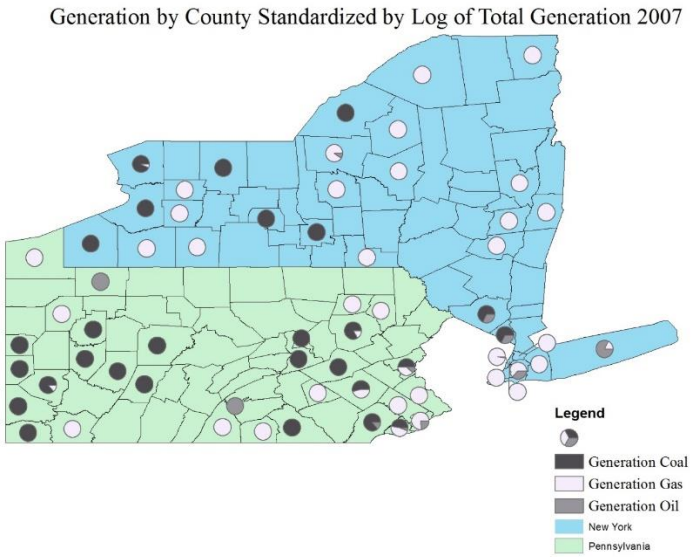
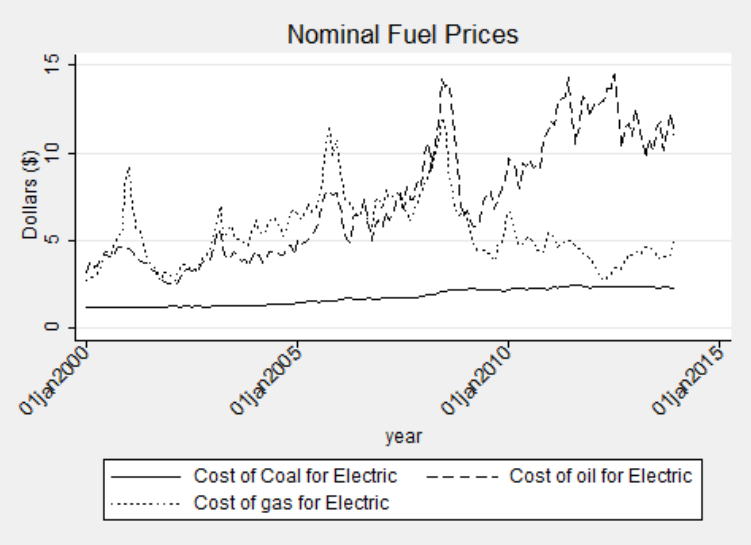


Chart 3. Fuel Prices mmbtu for Coal, Gas, and Oil



METHODS

The decision to run a power plant on a given day or not is complex, depending on the fuel used, time of year, anticipated demand, and characteristics of the individual plants such as age and technology used. The decision that plants face about running in a given time period can lead to biased coefficient estimates due to censoring. Heckman (1976, 1979) corrects for selection bias by first creating a term, the inverse Mills ratio (λ_i) to estimate the likelihood that an observation occurs in the sample. There are two ways that RGGI could affect the operation of power plants. First, it could cause plants to close and go offline entirely. Second, it could cause plants to change their level of generation. A two-step Heckman model is used for this study.

The selection model on whether the plant[3] generates during a given time period is given by the probit model:

$$\Pr(z_{i,t}) = \Phi(\alpha' w_{i,t} + \gamma' R_t)$$

$$z_{i,t} = \begin{cases} 1 \; if \; z^*_{i,t} > 0 \\ 0 \; if \; z^*_{i,t} = 0 \end{cases}$$

Where $z_{i,t}$ is 1 when the plant runs and generates electricity, and $z_{i,t}$ is 0 when the plant is not observed producing electricity. Whether a plant will run during a giving period is based on cost schedules at the plant. As such the selection model of whether a plant will run is predicted based on the $w_{i,t}$ matrix, which consists of the variables that determine the costs of a running a plant, i.e. the size of the plant, age of the plant, and relative monthly price of each fuel. Plants were determined to be running based on the amount of electricity they produced in the previous month. Plants that did not report, or produced less than 300 MWh of electricity during a given month were considered to not run for the selection model.

The generation effects equation is in the form of:

$$y_{i,t} = X_{i,t}\beta + D_i\gamma + D_t\Delta + u_{i,t}$$

Where $y_{i,t}$ is the log of the generation of each plant *i* during each month (*t*). The *X* matrix consists of plant specific data such as fuel type, age of the plant, a categorical value for the size of the generation capacity, monthly temperature minimum's and maximum's (which vary at the county level), and population for each county, and dummy variables for fuel type (which for some plants do vary over time), and an interaction of fuel type and being in RGGI, month and years present in the data set, and the inverse Mills Ratio from the selection equation above. The D_i vector contains dummy variables for the state, the size of the generation capacity by plant. Lastly, the D_t vector contains dummy variables for being in RGGI (any plant in New York after 1/1/2009, note that this is a bit of an oversimplification only having it vary by time, which is acknowledged but helps with illustration), and for fuel price which only varies by time and not plant in this data set.

The selection equation shows how the variables effect whether a plant runs or not (Chart 4). In general plants in New York are more likely to run. Plants are less likely to run the older they are, and as fuel prices go up. The plant size also effects its likelihood to run. All things equal, at the means, the largest plants are most likely to run in the sample, with the smallest plants least likely. We can see that coal plants and gas plants are more likely to run in the sample, and that the RGGI significantly effects gas and oil, which are both less likely to run under RGGI. Coal plants under RGGI (RGGI Coal) is the only variable in the selection model that is not significant. For Any given month, RGGI has not had much of an effect on whether a coal unit runs.

Chart 4. Heckman Selection Equation Coefficients

Variable	Model Coefficient	Z Score	Plant Size Variables	Model Coefficient	Z Score
Coal	0.905***	38.44	10 to 25	1.088***	29.50
Gas	0.445***	28.27	25 to 50	1.332***	37.32
RGGI Coal	0.077	1.32	50 to 75	1.608***	45.45
RGGI Gas	-0.188***	-7.51	75 to 90	2.348***	62.17
RGGI Oil	-0.153***	-4.87	90 to 95	2.318***	57.79
NY	0.323***	20.32	95+	2.443***	59.92
Age	-0.028***	-66.12			
Fuel Price	-0.053***	-18.71			

*** Significant at .01% level, coefficients not listed – temperature (maximum and minimum), population, and control variables for years.

The parameter estimates for the generation equation are shown in Chart 5. RGGI effects equation shows a number important and significant factors effecting energy generation (the log of the generation is the dependent variable). If a plant is in New York, everything else being equal it produces 31.9 percent more electricity, this is likely due to differences in the distribution in plant capacity in the two states. New

York is more heavily weighted to smaller plants, while Pennsylvania's generation is more heavily weighted to larger plants. Coal will generate 146 percent more than oil, while gas will produce 39.1 percent more electricity generation relative to oil. However, when RGGI is introduced the picture changes slightly. Oil interacted with RGGI produces 11.2 percent less electricity, coal interacted with RGGI produces 79.5 percent less electricity, and gas interacted with RGGI produces 30.9 percent less. All of these values are statistically significant.

Chart 5. Heckman Second Stage Equation Coefficients

Variable	Model Coefficient	Z Score	Plant Size Variables	Model Coefficient	Z Score
Coal	1.46***	50.02	10 to 25	-1.594***	-26.03
Gas	0.391***	18.54	25 to 50	-0.971***	-15.81
RGGI Coal	-0.795***	-12.80	50 to 75	0.154**	2.56
RGGI Gas	-0.309***	-10.45	75 to 90	1.077***	17.17
RGGI Oil	-0.112*	-2.51	90 to 95	2.201***	34.15
NY	0.319***	16.65	95+	2.306***	35.34
Fuel Price	-0.033***	-7.42			

*** Significant at .01% level, ** Significant at 1% level, * Significant at 5% level. coefficients not listed – temperature (maximum and minimum), population, and control variables for years. Age excluded from second stage.

CONCLUSIONS

This study uses a unique data set of observed electric generation for fossil fuel plants in New York and Pennsylvania to estimate how RGGI has changed the behavior of these plants. The results from this study indicate that the distribution of pollution resulting from fossil fuel generation will shift in terms of location due to the non-homogenous distribution of generation by fuel type. This shift in location means that different areas will benefit differently from ancillary benefits. This study is part of a larger study, which has used these results to estimate that RGGI has produced nearly $70 million in ancillary benefits through reductions in NOX, SO2, and particulate matter emissions. These benefits are not uniformly distributed, and those in the Western most part of the state and South Eastern area benefit the most from RGGI.

There is still much future research to be done that can be supported with this data, including a more thorough accounting of the health benefits mentioned above. Future work will also increase the frequency of observations to better understand the behavior and response of power plants to cap and trade programs, and to understand dynamics between generation and demand at different times of day when a cap is present. Lastly, it would be interesting in exploring how has RGGI effected the mixture of electricity generation in all of the States belong to RGGI. How has RGGI redistributed electricity generation, and allowances among states.

ACKNOWLEDGEMENTS

I would like to thank Pete Wilcoxen for his comments on this work. This work is part of a larger analysis done to estimate the benefits of RGGI. Please contact the author for the full work.

ENDNOTES

1. Note that there are some plants that burn wood and biomass, however these are not considered for this analysis.
2. Units are used here instead of plants, because units inside of a single plant can be operating on different fuel sources.
3. Plant is used here, however "unit" is a better term. The data is processed at the unit level. However, this is an awkward term due to the EPA's definition for AMPD of unit as "A fossil fuel-fired combustion device" (EPA, 2014b) does not consistently match up definitions of boilers or generators in EIA data.

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Predicting US Bank Failures during 2009

James Murtagh*

ABSTRACT

The purpose of this study is to compare the financial characteristics of failed to surviving banks. We use one-tailed t-tests in examining bank financial ratios to determine if there are significant differences between banks that survived The Great Recession versus those that failed during 2009. The results indicate significant differences between surviving and failing banks, implying that it may be possible to detect banks likely to fail before they collapse. This study evaluates the influence of these variables using regression, logit and probit analysts. Preliminary results suggest early warning measures that would allow regulators to intervene sooner to avert bank failures.

INTRODUCTION

The Great Recession plunged the global financial system into disarray. Small banks, which lacked the capital to withstand severe shocks, were harmed, and some of the oldest financial firms disappeared into bankruptcy or acquisition. In the United States, the Federal Reserve took unprecedented steps to contain the damage and stabilize the financial system. Even with these extraordinary measures, 423 commercial banks failed from 2008 through 2012. The greatest number of failures occurred during 2009, when 126 commercial banks failed.

The Federal Deposit Insurance Corporation also acted, closing many failing banks, and providing insurance payouts to the banks' depositors. Given the size and cost of these actions, any metrics that can detect banks headed for insolvency before it happens would be valuable. This preliminary study evaluates several performance measures performing one-tailed t-tests on a set of 116 banks that failed during 2009, and a set of peer surviving banks of similar asset size and geographic location. Further, this paper aims to understand how the level of these characteristics two and four quarters prior to failure may have contributed to the eventual bank failure.

LITERATURE REVIEW

In examining bank failures during The Great Recession, many factors have been suggested as causes, or at least as indicators, that a depository institution may be headed for trouble. Among the determinants, ratio analysis, as noted below, has been shown to be a promising indicator of troubled banks. The research in this field is currently somewhat limited, however, insofar as we are only just coming out of the financial crisis, and so studies of it are ongoing.

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Cole and White (2012) found that one of the most significant influences on a bank's failure is the asset types the bank held. Banks with higher concentrations in real estate construction and development loans, multi-family mortgages, and commercial mortgages consistently had a higher likelihood of failure in the future as compared to banks with larger holdings of residential, single-family mortgage loans or consumer loans. Cole and White also found that failed banks often had lower capital ratios, particularly referring to the ratio of equity to assets. Lower liquidity, measured by cash and due to assets, investment securities to assets, and brokered deposits to assets, also contributed to bank failures. Lastly, Cole and White found that lower earnings, as measured by return on assets, indicated banks that were more likely to have failed. Samad (2011) identified four specific capital adequacy ratios that were significantly different between banks that survived the financial crisis and those that failed, with the failed banks having lower ratios in all four cases.

In a 2011 study, the Office of the Inspector General (OIG) (2011) found that management can be complicit in an institution's failure, particularly due to strategic decisions made to grow the firm's asset base, the bank's compensation structure, or funding choices. Some management teams' compensation structures helped encourage the offering of additional loans and loosening of underwriting standards, as some firms tied compensation to increases in the bank's loan portfolio. When compensation is tied strictly to the size of the loan portfolio, rather than the quality of the loans therein, management works its way down the credit quality ladder, loaning to less creditworthy parties, and thereby increasing the bank's risk level. The OIG study also found that additional efforts to increase a bank's business, such as expanding into new activities or markets or performing mergers and acquisitions, sometimes conducted without due diligence, also led to bank failures. Similarly to Cole and White, the OIG's study found that asset type is a significant influence on the likelihood of bank failure. Specifically, construction, land, and land development, or CLD, loans and commercial real estate, or CRE loans, were contributors to bank failures. The OIG study, however, specifically found that the cause of bank failures was not so much the exposure to commercial mortgages, but the real estate construction and development loans. Banks that failed also often had higher ratios of non-performing assets (NPAs), and hence lower asset quality overall.

The OIG study also had similar findings to Samad, where a bank's failure to maintain sufficient capital to protect against potential losses was found to be a critical determinant of banks that survived versus those that failed. The level of capital adequacy is particularly important insofar as many of those that failed, since they were making riskier CRE and CLD loans, as noted above, should have had even more capital set aside for potential losses than a bank might "normally" have.

DeYoung and Torna (2013) evaluate whether income from nontraditional banking activities contributed to bank failures during the crisis. They apply a multi-period logit model and find that the probability of distressed bank failure declined with fee-based activities like securities brokerage and insurance sales. In

contrast, they find that venture capital activities, investment banking and asset securitization increased the probability of failure.

METHODOLOGY

The data in this study consists of 116 commercial banks that failed during 2009 and a paired set of surviving banks. The complete list of banks and financial statement values is available from the author upon request. The survivors were based on assets and geographic location. The data was obtained from the Federal Financial Institutions Examination Council website. Reported data is analyzed 2 and 4 quarters prior to the bank failure date. Financial ratios, loan portfolio ratios and capital adequacy measures were calculated for each of the 332 banks in the sample. We examined commonly used performance measures including: the loan loss allowance as a percentage of Total Assets, Capital Adequacy, the rate spread, several measures of the real estate portfolio as a percent of total assets and Tier 1 capital. A one-tailed t-test was performed on these variables, with a general null hypothesis that for each variable, there is no significant difference between the mean ratios for surviving versus failing banks. If the null hypothesis is rejected, the values for these failed bank performance ratios are expected to be consistently less than those of the survivor banks.

Consistent with Cole and White, we evaluate the portion of total loans and leases represented by real estate loans, construction and development loans, commercial mortgages, and multifamily mortgages. The null-hypothesis for each variable is that there is no significant difference between the mean ratios for surviving versus failing banks. If the null hypothesis fails, we expect that the failed banks will have a greater exposure to these types of loans than the survivor banks.

As mentioned above, Samad analyzed capital adequacy as a potential cause of bank failures within the U.S. He evaluated four ratios, including the total equity capital as a percent of total assets (EQCTA), Tier One capital as a percentage of average total assets minus intangible assets (T1RBCATA), Tier One capital as a percentage of risk-weighted assets as defined by the appropriate federal regulator for prompt corrective measure (T1RWB), and total risk-based capital as a percentage of risk-weighted assets as defined by the appropriate federal regulator for prompt corrective measure (TRBCRWA). We examined two of these ratios in this study, with a general null-hypothesis that for each variable, there is no significant difference between the mean ratios for surviving versus failing banks. If the null hypothesis fails, we expected that the failing banks will have lower capital ratios.

BANK PERFORMANCE RATIOS

The descriptive statistics, differences between means, and significance are shown in the table below. Panel A presents the results for two quarters before failure. The results for four quarters before failure are shown in Panel B. In both periods, failing banks exhibit larger loan loss allowances per dollar of Total

Assets. The capital adequacy and spread measures are both lower for failing banks. In addition, Model 2 shows that the real estate construction and land development loans as a percent of Total Assets (RECONTA) and multifamily (5 or more) residential property loans as a percent of Total Assets (REMULTA) description) are larger for failing banks. Loans on 1-4 family residential property (RER14TA) and Tier 1 capital are both lower for the failing set. Both these variables are divided by the Total Assets of the bank.

Table 1: Descriptive Statistics, Differences Between Means, and Significance

Panel A: Two Quarters before Failure (Q=2).

		Failed		Survived			
Model 1	**N**	**Mean**	**StdDev**	**Mean**	**StdDev**	**Difference**	**signif**
LLAllowTA	114	0.0240	0.0169	0.0117	0.0084	0.0123	***
CapAdeqHN	114	0.0641	0.0241	0.1044	0.0296	-0.0403	***
Spread	114	0.0178	0.0121	0.0213	0.0111	-0.0035	**
Model 2							
RECONTA	114	0.2375	0.1392	0.1154	0.0898	0.1221	***
REMULTA	114	0.0367	0.0587	0.0203	0.0237	0.0164	***
RER14TA	114	0.1233	0.1055	0.1547	0.1290	-0.0314	**
T1CapTA	114	0.0623	0.0212	0.0983	0.0288	-0.0359	***
Panel B: Four Quarters before Failure (Q=4).							
Model 1							
LLAllowTA	95	0.0182	0.0227	0.0103	0.0049	0.0079	***
CapAdeqHN	95	0.0854	0.0294	0.1064	0.0399	-0.0210	***
Spread	95	0.0168	0.0082	0.0195	0.0113	-0.0028	*
Model 2							
RECONTA	95	0.2582	0.1515	0.1166	0.0999	0.1416	***
REMULTA	95	0.0389	0.0669	0.0180	0.0225	0.0209	***
RER14TA	95	0.1184	0.1021	0.1561	0.1357	-0.0377	**
T1CapTA	95	0.0811	0.0206	0.1017	0.0396	-0.0206	***

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

BANK FAILURE MODELS

The results of bank failures models two and four quarters prior to failure are shown in Table 2, Panel A. Panel B: Four Quarters before Failure (Q=4) is available from the author upon request. The results of two different models are presented. Model 1 evaluates the influence of the Allowance for Loan Losses as a percent of total assets (LLAllowTA), capital adequacy and the rate spread between interest income and interest expenses. In this model, regression results indicate that bank failure is positively related to the Loan Loss Allowance and negatively related to capital adequacy. The Spread variable is not significant two quarters before failure, but is negative and significant four quarters before failure. Logit and Probit models show that the loan loss allowance positively affects the probability of failure while the capital adequacy and spread have a negative effect. The sign and magnitude of the marginal effects indicate that increasing the loan loss allowance two quarters before failure increases the probability of failure by 14.6%. The marginal

effect is even more apparent four quarters before failure. At that time, an increase in the loan loss allowance increased the probability of failure by 39%. Two quarters before failure, increasing capital adequacy and the spread decrease the probability of failure by 9.7% and 4.7% respectively. Four quarters from failure, the magnitude of the influence reverses. Increased capital adequacy reduced the probability of failure by 5.4% and increased spread dropped the chance of failure by 10%.

Model 2 analyzes the influence of Tier 1 capital as a percent of total assets and evaluates specific real estate assets as a percent of total assets. The regression model finds that the coefficients construction and land development loans and multifamily (5+) real estate loans are positive, 1-4 family residential loans and Tier 1 capital are negative. The coefficient of the 1-4 family residential loans is not significant four quarters before failure. Logit and Probit models find similar results. The marginal effects indicate that increases in Tier 1 capital reduce the probability of failure by 8-10% while increase in the concentration of real estate construction loans and multifamily real estate loans consistently increase the probability of failure by less than 2%.

Table 2: Failure Models

Panel A: Two Quarters before Failure (Q=2).						
A1: **Regression Models**		**Model 1**	**signif**		**Model 2**	**signif**
F value		62.25	***		51.37	***
Adj. R^2		0.4473			0.4702	
	Intercept	1.020	***		0.957	***
	LLAllowTA	10.572	***			
	CapAdeqHN	-7.837	***			
	Spread	-2.465				
				RECONTA	1.221	***
				REMULTA	1.392	**
				RER14TA	-0.367	*
				T1CAPTA	-8.240	***
A2: Logistic Procedure						
Intercept and Covariates		**Model 1**	**signif**		**Model 2**	**signif**
AIC		151.233			143.374	
SIC		164.951			160.521	
Testing Global Null (Beta = 0)			***			***
	Intercept	6.933	***		7.174	***
	LLAllowTA	146.200	***			
	CapAdeqHN	-97.495	***			
	Spread	-46.867	**			
				RECONTA	11.583	***
				REMULTA	18.146	***
				RER14TA	-3.863	
				T1CAPTA	-115.400	***

	Correct	**Incorrect**	**Correct**	**Incorrect**
Fail	94	12	96	12
Survive	102	20	102	18

Table 2: Failure Models

Panel A: Two Quarters before Failure (Q=2).						
% correct		86.0				86.8
Sensitivity		82.5				84.2
Specificity		89.5				89.5
False Positive		11.3				11.1
False Negative		16.4				15.0
A3: QLIM Procedure						
Model Fit		**Model 1**	**signif**		**Model 2**	**signif**
AIC		151.233			143.370	
Schwarz		164.951			160.520	
	Intercept	6.933	***		7.174	***
	LLAllowTA	146.247	***			
	CapAdeqHN	-97.496	***			
	Spread	-46.867	**			
				RECONTA	11.583	***
				REMULTA	18.146	***
				RER14TA	-3.863	
				T1CAPTA	-115.404	***
Marginal Effects						
	LLAllowTA	14.607				
	CapAdeqHN	-9.738				
	Spread	-4.681				
				RECONTA	1.057	
				REMULTA	1.656	
				RER14TA	-0.353	
				T1CAPTA	-10.535	

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level
Panel B: Four Quarters before Failure (Q=4) is available from the author upon request.

CONCLUSIONS

Our analyses show statistically-significant differences between the performance ratios, loan concentration measures, and capital adequacy of banks that failed during 2009 compared to peers that survived. With sample financial data up to 4 quarters prior to failure, there seems to be a period of time where regulators could have noted the soon-to-be-failed banks entering the "danger zone," and stepped in to prevent their collapse. One possible use of this study is to identify possible warning signs that a bank is in trouble. These warning signals may be used to establish more prompt corrective action to possibly save banks from failing. The encouraging statistical results in this preliminary study provide support for undertaking a long-term term study of the nearly 500 banks that failed during The Great Recession.

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An Empirical Test of the Environmental Kuznets Curve for CO2 in G7: A Panel Cointegration Approach

Yusuf Muratoğlu and Erginbay Uğurlu*

ABSTRACT

This paper examines the relationship among CO_2 emissions, energy consumption and GDP for G7 countries over the period 1980–2010. The variables which are used in this paper are energy use, CO_2 emissions and GDP per capita. We test the presence of the environmental Kuznets curve in the G7. To test the relationship panel data approach is used. Kao and Pedroni approaches are used to test the cointegration of the variables. The findings indicate that there is a long-run cointegrated relationship among the variables. The results of the causality tests show that GDP strongly Granger-causes CO_2 emissions and energy consumption.

INTRODUCTION

The relationship between energy consumption and GDP has long been investigated. Energy consumption for production is obtained by burning fossil fuels, and leads to carbon emissions. The environmental Kuznets curve (EKC) is a hypothesized relationship between various indicators of environmental degradation and income and, since the work of Grossmann and Krueger (1991, 1993, 1995), there has been a large amount of both theoretical and empirical work studying this relationship. The EKC hypothesis states that the environmental degradation first increases with per capita national income during the early stages of economic growth, and then declines with per capita GDP after arriving at a threshold, called "turning point". This relationship is named as the EKC because it follows a similar pattern to the income inequality, which was identified by Kuznets (1955). Whereas majority of the previous literature found an inverse U-shaped relationship between economic activity many researchers found different types of functional forms between these variables.

The model may have seven types of functional forms which are defined and drawn as follows:

1. $\beta_1 > 0, \beta_2 < 0 \; and \; \beta_3 > 0$ reveals a cubic polynomial that is called N shaped curve (Fig. a)
2. $\beta_1 < 0, \beta_2 > 0 \; and \; \beta_3 < 0$ reveals an inverse N shaped curve (Fig. b)
3. $\beta_1 < 0, \beta_2 > 0 \; and \; \beta_3 = 0$ reveals a U-shaped relationship (Fig. c) and this equation the turning point level of income is calculated by $\tau = \exp(\frac{-\beta_1}{2\beta_2})$
4. $\beta_1 > 0, \beta_2 < 0 \; and \; \beta_3 = 0$ reveals an inverse U-shaped relationship (Fig. d)

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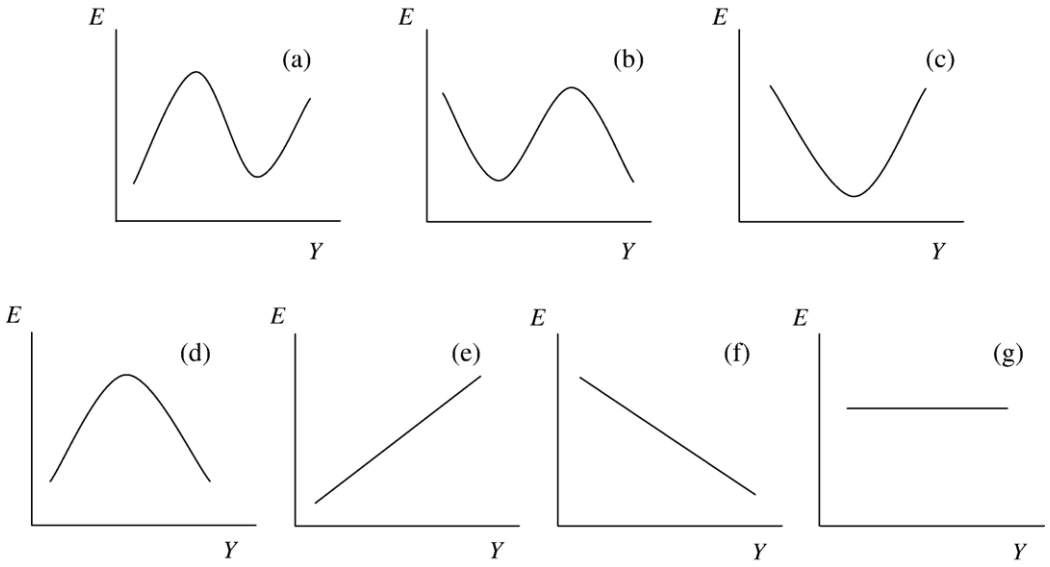
5. $\beta_1 > 0, \beta_2 = \beta_3 = 0$ reveals a monotonically increasing linear curve (Fig. e)
6. $\beta_1 > 0, \beta_2 = \beta_3 = 0$ reveals a monotonically increasing linear relationship (Fig. e)
7. $\beta_1 < 0, \beta_2 = \beta_3 = 0$ reveals a monotonically decreasing linear relationship (Fig. f)



Stern and Common (2001) investigate the EKC relationship for sulfur emissions from 1960 to 1990 for 73 countries and estimate the relationship for the OECD and non-OECD countries. They show that sulfur emissions in fact rise with increasing income at all levels of income.

Stern (1998) provides a critique of the EKC. In that study he identifies seven major problems based on Stern et. al. (1996) which are (a) simultaneity and irreversibility, (b) trade and the EKC, (c) econometric problems, (d) ambient concentrations versus emissions, (e) asymptotic behavior, (f) mean versus median income, (g) aggravation of other environmental problems. Stern (2004) states four main categories of the problem of EKC which are heteroskedasticity, simultaneity and omitted variables bias and cointegration issues. Heteroskedasticity is also discussed in Stern et al. (1996), Schmalensee et al. (1998) and Stern (2002) , simultaneity is addressed in Cole et al. (1997) and Holtz-Eakin and Selden (1995), omitted variables are discussed in Stern and Common (2001).

Wagner (2008) argues several major econometric problems and the spurious relationship of the papers which has found an inverted U-shape type of functional form. The author discusses the problems due to the presence of cross-sectional dependencies that invalidate the use of so called first generation panel unit root and cointegration tests that are designed for cross-sectionally independent panels. Wagner concludes that although first generation methods lead to seemingly strong support for the prevalence of an EKC, this evidence is entirely spurious.

Also Shafik and Bandyopadhyay (1992) estimate three different functional forms which are log-linear,

log-quadratic and logarithmic cubic polynomial to test EKC and the findings support the presence of an inverted-U shaped relationship. Shafik (1994) shows that the relation between emissions of sulfur dioxide and income per capita is characterized by EKC. Grossman and Krueger (1995) use many different pollutants and point out that economic growth itself does not guarantee the cure for problems related to the environment.

Pao and Tsai (2010) use panel cointegration method for the BRIC countries and find a strong unidirectional causality from carbon dioxide emissions and energy consumption to real output in the short-run. In this paper three different causality tests are used i.e., short-run Granger non-causality test, weak exogeneity (long-run non-causality test) and strong exogeneity tests.

This paper investigates the relationship among CO_2 emissions, energy consumption and income level in the G7 countries over the period of 1980-2010. The long run relationship and the causal relationship of the series are investigated. In detecting causal relationship the panel causality approach which is used in Pao and Tsai (2010) is applied.

The remainder of this paper is organized as follows. Section 2 discusses the method used. Section 3 outlines the model and presents the empirical findings. Section 4 is summarizing and concluding the paper.

METHODOLOGY

We investigate the long run relationship of the CO_2 emission, the GDP and the energy consumption of the selected countries. In the analysis of the long run relationship, at first the order of integration for the variables must be determined. If the variables have the same order of integration, cointegration tests will be able to be used. When all series are integrated into the same order different type of cointegration tests can be used such as Kao (1999) and Pedroni (1999, 2004).

The Pedroni and the Kao tests are based on the Engle-Granger (1987) two-step (residual-based) cointegration tests. Whereas the Pedroni and the Kao tests follow the same basic approach, the Kao test specifies cross-section specific intercepts and homogeneous coefficients during the first-stage. As mentioned below, after the Pedroni and the Kao tests find the long run relationship, the fully modified OLS estimator (FMOLS), which is proposed by Pedroni (1996, 2001), is used to show long-run relationship. Kao and Chiang (2000) use feasible pooled FMOLS estimators for heterogeneous cointegrated panels where the long-run variances differ across cross-sections. Based on the existence of the long run relationship short-run dynamics can be investigated using the vector error correction model (VECM) approach suggested by Engle and Granger (1987). In this approach, cointegrated variables must have an error correction mechanism which is contained in VECM by an error correction term (ECT). The VECM is used for correcting disequilibrium in the cointegration relationship, captured by the ECT, as well as to test for the causality among cointegrated variables, both for long-run causality

by the error correction terms and short-run causality by the lagged dynamic terms.

We use three types of causality tests based on Ang (2008), Masih and Masih (1996) and Pao and Tsai (2010); which are short-run Granger non-causality test, weak exogeneity (long-run non-causality test) and strong exogeneity tests respectively.

In the short run Granger non-causality test, the statistical significance of the lagged dynamic terms are tested by the joint null hypothesis. In this test null hypothesis implies that the variables which coefficients are tested do not Granger-cause of the dependent variable of the investigated model. Second type of test is the weak exogeneity test, which is a notion of long-run non-causality test. The null hypothesis of is the weak exogeneity test implies that non-causality from long-run equilibrium deviation in the previous period to dependent variable of the investigated model. Thus this means the testing of the significance of the ECT parameter of the variable. The last type is strong exogeneity test examines the joint significance of both the lagged dynamic terms and ECT parameter.

EMPIRICAL ANALYSIS

In our empirical analysis, we use annual data for G7 countries for the period of 1980 to 2010, except for Germany data which covers 1991-2010 period. This study investigates the relationship among CO_2 emissions, energy use and GDP per capita. The data are collected from the World Bank World Development Indicators. CO_2 emissions are measured in metric tons per capita, per capita real GDP is measured in US dollars at current prices and the per capita energy use is measured in kg of oil equivalent.

Table 1: Results of the Panel Unit Root Tests for G7 countries

Variables	LLC		Breitung		IPS		ADF-Fisher		PP-Fisher	
	Level	1st diff.	Level	1st diff.	Level	1st diff.	Level	1st diff.	Level	1st diff.
LCO2	1.5761	-10.0617***	1.2694	-3.0481***	0.2383	-10.7677***	18.1994	105.9736***	21.0574	109.4035***
LEN	3.1531	-5.0784***	1.9350	-2.2887**	2.1762	-9.4517***	12.8236	95.5348***	9.8340	136.7371***
LGDP	0.3166	-6.6943***	1.6082	-3.5599***	-0.1569	-4.9346***	17.2453	47.6786***	5.0167	57.6370***
$LGDP^2$	0.3821	-6.7094***	1.3892	-3.4872***	-0.2340	-5.0022***	17.6633	48.3158***	4.4309	55.0247***
$LGDP^3$	0.4645	-6.6687***	1.1575	-3.4136***	-0.3777	-5.0676***	18.1829	48.9367***	5.0531	52.9638***

Note: The lag lengths are selected using SIC. *** denotes the rejection of the null hypothesis at 1% level of significance.

Table 2: Results of the Panel Unit Root Tests for G7 except Germany countries

Variables	LLC		Breitung		IPS		ADF-Fisher		PP-Fisher	
	Level	1st diff.	Level	1st diff.	Level	1st diff.	Level	1st diff.	Level	1st diff.
LCO2	1.9664	-9.8858***	1.4694	-2.7764***	1.0418	-9.8771***	11.8995	91.4298***	14.7486	92.0480***
LEN	3.5763	-8.6382***	2.0422	-2.1635**	3.3999	-9.3425***	4.5353	86.0264***	1.5458	113.7884***
LGDP	0.2755	-6.7951***	1.7834	-3.1570***	0.1055	-4.9677***	14.7758	43.5319***	4.6324	53.4180***
$LGDP^2$	0.3348	-6.8066***	1.5595	-3.0786***	0.0073	-5.0330***	15.2572	44.1078***	4.0515	50.8286***
$LGDP^3$	0.4155	-6.8295***	1.3240	-2.9996***	-0.1663	-5.0953***	15.8432	44.6643***	4.6780	48.7859***

Note: The lag lengths are selected using SIC. *** denotes the rejection of the null hypothesis at 1% level of significance.

Table 1 and Table 2 show the results of the panel unit root tests used that are LLC, Breitung, IPS, ADF-F and PP-F panel unit root tests. Whereas LLC and Breitung tests assume that there is a common unit root process across cross-sections, IPS and F-ADF tests assume individual unit root processes across cross-sections. The null hypotheses of these tests are each series in the panel contains a unit root. The results of Table 1 and Table 2 show that the null hypothesis is rejected in first difference thus all series are stationary in their first differences, in other words they are integrated at order one, I(1) .

As it is stated in the methodology section, after it is found that the series are integrated at same level, cointegration tests can be used. Table 3 and Table 4 show the results of the panel cointegration tests.

Table 3: Results of the Panel Cointegration Tests for G7

Pedroni Cointegration Tests		
Test Statistics	**Statistics**	**Weighted Statistics**
Panel v-Statistic	3.8093***	-0.7040
Panel rho-Statistic	1.5962	0.9276
Panel PP-Statistic	-2.1786**	-2.6302***
Panel ADF-Statistic	-2.2462**	-3.1719***
Group rho-Statistic	2.4609	
Group PP-Statistic	-1.5863*	
Group ADF-Statistic	-2.1198**	
Kao cointegration tests		
Test Statistics	**Statistics**	
ADF	-4.5831***	

Note: The lag lengths are selected using SIC. ***, ** and * denote the rejection of the null hypothesis at 1%, 5% and 10 % level of significance.

Table 4: Results of the Panel Cointegration Tests for G7 except Germany

Pedroni Cointegration Tests		
Test Statistics	**Statistics**	**Weighted Statistics**
Panel v-Statistic	3.3265***	3.3265***
Panel rho-Statistic	1.4698	1.4698
Panel PP-Statistic	-2.1702**	-2.1702**
Panel ADF-Statistic	-2.1998**	-2.1998**
Group rho-Statistic	2.1232	
Group PP-Statistic	-2.2712**	
Group ADF-Statistic	-2.8538***	
Kao cointegration tests		
Test Statistics	**Statistics**	
ADF	-4.4425***	

Note: The lag lengths are selected using SIC. ***, ** and * denote the rejection of the null hypothesis at 1%, 5% and 10 % level of significance.

Pedroni test values are divided into two parts; statistics and weighted statistics. The test provides seven statistics and three weighted statistics. Four of the seven statistics reject the null hypothesis of no cointegration and two of the four weighted statistics reject the null hypothesis of no cointegration then the result of the Pedroni test reveals cointegration. Also Kao test indicates cointegration. Hence we find that CO_2 emission, energy consumption and GDP are cointegrated within the G7 countries. Given that the cointegration tests indicate cointegration the log-run panel model can be estimated.

We use FMOLS model to estimate long run relationship for the selected countries. FMOLS can provide us more accurate results due to its advantages such as eliminating the long run correlation problem. The long-run relationship model using panel data framework is as follows:

$$LCO2_{it} = \alpha_{0i} + \alpha_{1i}LEN_{it} + \alpha_{2i}LGDP_{it} + \alpha_{3i}LGDP^{2}_{it} + \alpha_{4i}LGDP^{3}_{it} + u_{it}$$

Table 5: Results of the FMOLS Model

Dependent Variable: $\mathbf{LCO2}$		
Variables	**G7**	**G7 except Germany**
LEN	0.8754***	0.8572***
LGDP	42.0873**	45.7746**
$\mathbf{LGDP^2}$	-4.2974**	-4.6792**
$\mathbf{LGDP^3}$	0.1456**	0.1587**

Note: ***, ** denote the rejection of the null hypothesis at 1%, 5% level of significance.

The results of the FMOLS model show that all variables are statistically significant at 1% level. The sign on energy consumption is positive because a higher level of energy consumption should create economic activity and stimulate CO_2 emissions. The sign of the coefficient of the LGDP is positive, whereas $LGDP^2$ is negative. Lastly the $LGDP^3$ has positive sign. Therefore the results provide an N-shaped relationship between GDP and emissions and thus emissions appear to rise again at high-income levels.

The process continues with the error correction model which is as follows:

$$\Delta LCO2_{it} = \alpha_{1i} + \sum_{j=1}^{p_{11}} \beta_{11ij}\Delta LCO2_{it-j} + \sum_{j=1}^{p_{12}} \beta_{12ij}\Delta LEN_{it-j} + \sum_{j=1}^{p_{13}} \beta_{13ij}\Delta LGDP_{it-j} + \sum_{j=1}^{p_{14}} \beta_{14ij}\Delta LGDP^{2}_{it-j} + \sum_{j=1}^{p_{15}} \beta_{15ij}\Delta LGDP^{3}_{it-j} + \theta_{1i}ECT_{it-1} + \varepsilon_{1it}$$

$$\Delta LEN_{it} = \alpha_{2i} + \sum_{j=1}^{p_{21}} \beta_{21ij}\Delta LCO2_{it-j} + \sum_{j=1}^{p_{22}} \beta_{22ij}\Delta LEN_{it-j} + \sum_{j=1}^{p_{23}} \beta_{23ij}\Delta LGDP_{it-j} + \sum_{j=1}^{p_{24}} \beta_{24ij}\Delta LGDP^{2}_{it-j} + \sum_{j=1}^{p_{25}} \beta_{25ij}\Delta LGDP^{3}_{it-j} + \theta_{2i}ECT_{it-1} + \varepsilon_{2it}$$

$$\Delta LGDP_{it} = \alpha_{3i} + \sum_{j=1}^{p_{31}} \beta_{31ij}\Delta LCO2_{it-j} + \sum_{j=1}^{p_{32}} \beta_{32ij}\Delta LEN_{it-j} + \sum_{j=1}^{p_{33}} \beta_{33ij}\Delta LGDP_{it-j} + \sum_{j=1}^{p_{34}} \beta_{34ij}\Delta LGDP^{2}_{it-j} + \sum_{j=1}^{p_{35}} \beta_{35ij}\Delta LGDP^{3}_{it-j} + \theta_{3i}ECT_{it-1} + \varepsilon_{3it}$$

$$\Delta LGDP^2_{it} = \alpha_{4i} + \sum_{j=1}^{p_{4i}} \beta_{41ij} \Delta LCO2_{it-j} + \sum_{j=1}^{p_{42}} \beta_{42ij} \Delta LEN_{it-j} + \sum_{j=1}^{p_{43}} \beta_{43ij} \Delta LGDP_{it-j} + \sum_{j=1}^{p_{44}} \beta_{44ij} \Delta LGDP^2_{it-j} + \sum_{j=1}^{p_{45}} \beta_{45ij} \Delta LGDP^3_{it-j} + \theta_{4i} ECT_{it-1} + \varepsilon_{4it}$$

$$\Delta LGDP^3_{it} = \alpha_{5i} + \sum_{j=1}^{p_{51}} \beta_{51ij} \Delta LCO2_{it-j} + \sum_{j=1}^{p_{52}} \beta_{52ij} \Delta LEN_{it-j} + \sum_{j=1}^{p_{53}} \beta_{53ij} \Delta LGDP_{it-j} + \sum_{j=1}^{p_{54}} \beta_{54ij} \Delta LGDP^2_{it-j} + \sum_{j=1}^{p_{55}} \beta_{55ij} \Delta LGDP^3_{it-j} + \theta_{5i} ECT_{it-1} + \varepsilon_{5it}$$

where, i=1,…,N denotes country, t=1,…,T denotes the time period, p_{ij} is the optimal lag length determined by the AIC, ε_{it} is assumed to be independent and identically distributed with zero mean and constant variance.

$ECT_{it} = LCO2_{it} - \alpha_{0i} - \alpha_{1i} LEN_{it} - \alpha_{2i} LGDP_{it} - \alpha_{3i} LGDP^2_{it} - \alpha_{4i} LGDP^3_{it}$ and the coefficient of the ECT shows that the adjustment velocity for any shock is leading to a deviation from the long-run equilibrium.

The VECM model is used to test causality tests based on Ang (2008) and Pao and Tsai (2010). Table 6 shows the short-run Granger non-causality test, weak exogeneity (long-run non-causality test) and strong exogeneity tests respectively.

In the first column dependent variables of the model which are investigated is given. The next three columns show the name of the variables of the lagged dynamic terms which are tested by the joint null hypothesis. The null hypotheses which are tested in second column are; $\beta_{r1ip} = 0 \ \forall ip$ r= 2,3,4,5 for each row, where r shows row number. In third column, $\beta_{r2ip} = 0 \ \forall ip$ are tested for each row where r= 1,3,4,5 and shows row number. In the fourth column different form of GDP variables are tested by $\beta_{r3ip} = \beta_{r4ip} = \beta_{r5ip} = 0 \ \forall ip$ where r= 1,2 and shows row number.

The fifth column, which is named ECT, shows the t statistics of the significance of the error correction term of the models investigated. The last three columns represent the joint significance of both the lagged dynamic terms and the ECT parameter. The null hypotheses which are tested in sixth column are; $\beta_{r1ip} = \theta_{1i} = 0 \ \forall ip$ r= 2,3,4,5 for each row, where r shows row number. In seventh column, $\beta_{r2ip} = \theta_{2i} = 0 \ \forall ip$ are tested for each row where r= 1,3,4,5 and shows row number. In the eighth column different form of GDP variables are tested by $\beta_{r3ip} = \beta_{r4ip} = \beta_{r5ip} = \theta_{2i} = 0 \ \forall ip$ where r= 1, 2 and shows row number.

Table 6 shows the results of the panel causality test results for G7. For the short run the null hypothesis of no existence of Granger causality is rejected only for GDP in 1% level and implies that GDP Granger causes CO_2 emissions and energy consumption.

The coefficients of the ECT are significant in CO_2 emission, GDP, GDP^2 and GDP^3 models in 1%, 5%, 5% and, 10% significance level respectively. This result shows the existence of long run relationship.

The joint (short run/long run) results show that the null hypothesis of energy consumption does not cause CO2 emissions is rejected thus energy consumption strongly Granger- causes emissions. Meanwhile for emission and energy consumption models null hypotheses are rejected for GDP. Therefore, GDP strongly Granger-causes CO_2 emissions and energy consumption.

Table 6: Results of the Panel Causality Tests for G7

Dependent variables of the models	Independent variables						
	Short run			Long run	Joint (Short run / Long run)		
	$\Delta LCO2$	ΔLEN	$\Delta LGDP$, $\Delta LGDP^2$, $\Delta LGDP^3$	ECT	$\Delta LCO2$, ECT	ΔLEN, ECT	$\Delta LGDP$, $\Delta LGDP^2$, $\Delta LGDP^3$, ECT
	F-statistics			t-statistics	F-statistics		
$\Delta LCO2$	-	0.2852	2.8759**	-0.1389***	-	2.7102**	3.8786***
ΔLEN	1.8237	-	4.2710***	-0.0072	1.2719	-	3.6998***
$\Delta LGDP$	0.9257	0.4609	-	-0.2849**	2.2773*	1.9443	-
$\Delta LGDP^2$	0.8731	0.3669	-	-5.3680**	2.0508	1.6934	-
$\Delta LGDP^3$	0.8204	0.3004	-	-75.7469*	1.8292	1.4654	-

Note: The lag lengths are selected using SIC. ***, ** and * denote the rejection of the null hypothesis at 1%, 5% and 10 %level of significance.

If balanced (except for Germany) model is considered approximately same results are obtained as seen from the Table 7, short run F-statistics GDP Granger causes energy consumption. The joint F statistics show that the GDP, GDP^2 and GDP^3 are rejected in 1% level of significance for the first model and 5% level of the second model. Thus the existence of a panel long-run cointegration relationship among the variables suggests that there must be Granger causality in only one direction which is from income to other variables. Additionally energy consumption strongly Granger causes CO_2 emissions, the GDP, GDP^2 and GDP^3 in 5%, 10%, 10% and 10% respectively.

Table 7: Results of the Panel Causality Tests for G7 except Germany

Panel causality tests							
Dependent variables of the models	Independent variables						
	Short run			Long run	Joint (Short run / Long run)		
	$\Delta LCO2$	ΔLEN	$\Delta LGDP$, $\Delta LGDP^2$, $\Delta LGDP^3$	ECT	$\Delta LCO2$, ECT	ΔLEN, ECT	$\Delta LGDP$, $\Delta LGDP^2$, $\Delta LGDP^3$, ECT
	F-statistics			t-statistics	F-statistics		
$\Delta LCO2$	-	0.5342	1.8770	-2.4523**	-	3.2076**	3.4681***
ΔLEN	2.4765	-	3.6249**	-0.1359	1.2517	-	2.8635**
$\Delta LGDP$	0.0003	1.5221	-	-2.0462**	2.0938	2.7582*	-
$\Delta LGDP^2$	0.3303	2.0696	-	-1.8910*	1.3232	2.3920*	-
$\Delta LGDP^3$	0.2767	1.9745	-	-1.8106*	1.1861	2.2363*	-

Note: The lag lengths are selected using SIC. ***, ** and * denote the rejection of the null hypothesis at 1%, 5% and 10 %level of significance.

The coefficients of the ECT are significant in all models except for the energy consumption model. Beside that the ECT term must be negative to work and all significant coefficients are negative. This

implies that there is a long run relationship in the VECM equations which have ΔLCO, ΔLGDP, ΔLGDP^2, ΔLGDP^3 dependent variables.

The joint (short run/long run) results show that GDP strongly Granger-causes both emissions and energy consumption, also energy consumption strongly Granger-causes all other variables (except itself).

Summary of the results indicates that there is a bi-directional short-run causal relationship from GDP to CO_2 emission and energy consumption. Error correction term shows that except for the energy consumption model, all models return to equilibrium in other words which all the three variables dynamically interact to restore long-run equilibrium whenever there is a deviation from the cointegrating relationship. Results of the significances of interactive terms of the investigated variables, along with the ECT on both, emissions equation suggests that, in the joint (short run/long run), energy consumption and GDP strongly Granger-causes CO_2 emission. Afterwards the joint test results show that GDP strongly Granger-causes energy consumption and emission strongly Granger-causes CO_2 emission.

CONCLUSION

This paper investigates the relationship between CO_2 emissions and GDP of the G7 countries over the period 1980–2010, except for Germany data which covers the 1991–2005 period. That is why we use two panel data sets one of which is named as a balanced data (for six countries which are G7 without Germany) and the other one is unbalanced (G7) data. Panel cointegration techniques are applied to estimate the relationship of the CO_2 emission GDP and energy consumption. This relationship is widely investigated in literature as an environmental Kuznets Curve and inverse U-shaped functional form. By using panel cointegration techniques both long-and short-run relationship are investigated and also an error-correction model was used to capture the short-run dynamics for both balanced and unbalanced data set.

At first order of integration level of the CO_2 emission, energy consumption and different functional forms of GDP (GDP, GDP^2 and GDP^3) are tested. After it is found that the series same order integrated Pedrioni and Kao cointegration test were used to decide whether the series are cointegrated. Pedrioni and Kao tests conclude that the series are cointegrated. The long run cointegration model shows N-shaped relationship for the variables. After the cointegrated regression models are estimated to see the short run and the long run relationships, VECM models are estimated using ECT term of the cointegrated regression model are interpreted.

The results show that energy consumption and GDP strongly Granger-causes CO_2 emission, GDP strongly Granger-causes energy consumption and emission strongly Granger-causes CO_2 emission.

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Evaluating the Poverty Status of Single Parent Families: Evidence of the Feminization of Poverty

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ABSTRACT

The term feminization of poverty was first introduced in the 1970s to describe the rising number of single female-headed households who were in poverty in the United States. Recently, however, single fathers are a growing demographic group. Using data from the U.S. Census Bureau's 2013 Current Population Survey, we estimate the size of the gender poverty gap of among single-headed families. We extend our analysis using the Oaxaca-Blinder decomposition to assess whether any of this gap can be attributed to discrimination. Our results suggest that the feminization of poverty still persists and that this may be, in part, due to gender-based discrimination.

INTRODUCTION

Over the past three decades, the term feminization of poverty has been used to describe the rising number of single female-headed households who are in poverty (Chant, 2006; Goldberg and Kremen, 1990; Minkler and Stone, 1985; Pearce, 1978, 1990). Recently, however, this rate has decreased to approximately 30 percent (U.S. Census Bureau, 2013b). Furthermore, the number of single fathers has risen. For every single father that existed in 1969, there are 9 single fathers today (Livingston, 2013).

Despite the growing number of single fathers, single mothers may continue to be at greater risk of falling into poverty than their male counterparts. Previous research suggests that the gender poverty gap, the difference in poverty rates for women and men, can be attributed to more women serving as single-heads of families compared to men (Christopher et al., 2002; Bianchi, 1999). But labor market discrimination, pathways into single-parenthood, and the timing of single-parenthood may help to explain why mothers are more at risk than fathers. Indeed, women are more likely to retain custody of children following a couple's dissolution (Starrels, Bould and Nicholas, 1994).

In this paper we explore whether single-mother families are more likely than single-father families to be in poverty. Using data from the U.S. Census Bureau's 2013 Current Population Survey, we estimate a family's probability of being in poverty given its characteristics, including the sex of the family head. We then estimate how much of the poverty gap among single-parent families can be explained by these characteristics and how much of the gap cannot be explained as a means to measure gender-based

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discrimination. We conclude with gendered policy recommendations to address the poverty gap among single parent families.

OVERVIEW OF GENDER DIFFERENCES IN POVERTY

In 2012, women were more likely than men to be in poverty, regardless of age (U.S. Census Bureau, 2013b). The poverty gap also persists among single-parent households. Twenty-four percent of single father families were in poverty compared to 43 percent of single mother families in 2012 (Livingston, 2013). While the number of single mother households (approximately 8.6 million) continues to surpass the number of single father households (approximately 2.6 million), there are only four times as many single mother households today than in 1969, compared to nine times as many single father households (Livingston, 2013). Approximately one-quarter of single parent householders are men, compared to 14 percent in 1960 (Livingston, 2013).

Previous research has estimated a high correlation between being a single mother and being in poverty, controlling for individual, household, and community characteristics (Brown and Hirschl, 1995; Lichtenwalter, 2005; McLaughlin and Sachs, 1988; Starrels, Bould and Nicholas, 1994). Single fathers tend to be older, have higher levels of educational attainment, and are more likely to be White compared to single mothers. While factors such as the parent's level of educational attainment and employment status, and the presence of children have been shown to affect a family's risk of being in poverty, little research is being done to capture the changing social trends in single parenthood and the rise of single father households (Livingston, 2013, Coley, 2001). Indicators such as changing patterns of fatherhood and evidence concerning the impact of paternal involvement on children's development may be causing this population to emerge more rapidly (Coley, 2001).

Inter-household structure and dynamics may also be a factor in explaining why single mothers are at a greater risk of poverty than single fathers. The second parent may be absent for various reasons: divorce or separation, the parents were never married, or incarceration. In cases of divorce or separation, the custodial parent may receive financial support from the absent parent. Historically, women are likely to retain sole or joint custody following a divorce (Cancian and Meyer, 1998; Cancian et al., 2014). More recently fewer mothers retain sole custody of children following a divorce. Joint custody is becoming more common while the percent of fathers with sole custody has remained remarkably stable (Gardner, 1985; Cancian and Meyer, 1998; Cancian et al., 2014). These new trends may contribute to the rising number of single fathers in the United States over the past four decades.

METHODS

The feminization of poverty was first introduced by Pearce (1978) to characterize rising poverty rates of women, single mothers in particular, in the United States.[1] Since then, numerous studies have criticized

Pearce's method as well as developed new approaches to measure the gender poverty gap in the United States and abroad (Bianchi, 1999; Christopher et al., 2002; Kimenyi and Mukum, 1995; McLanahan et al., 1989; McLanahan and Kelly, 1999; Pressman, 1998, 2002; Starrels et al., 1994). Here we examine absolute poverty rates as measured using the official U.S. poverty measure and the feminization of poverty as measured using the poverty gap between single father and mother families.

The Oaxaca-Blinder decomposition method is widely used to estimate discrimination between groups (for articles related to the gender wage gap, see Stanley and Jarrell, 1998; Oaxaca and Ransom, 1999; Deininger, Jin, and Nagarajan, 2013; Fang and Sakellariou, 2011; racial discrimination, see Duncan and Sandy, 2013; Sen, 2014; and learning outcomes, see Tansel, 1999). Blinder (1973) and Oaxaca (1973) lead the standard practice of decomposing the gender wage gap into two portions: a segment attributable to difference in skills between women and men, alongside differences in labor market returns to these skills. The effects of these differing endowments for men and women are estimated using separate regression models. We use the Oaxaca-Blinder decomposition in our analysis in order to determine which factors explain the poverty gap between single male- and female-headed families. The decomposition allows us to estimate the effect of these factors and discrimination on a family's likelihood of being in poverty.

DATA AND MEASURES

We use data from the 2013 March Supplement of the Current Population Survey (CPS) to analyze the poverty gap and income gap of female-headed families and male-headed families in 2012. The CPS is administered by the U.S. Census Bureau to collect annual household-level income data. Households are selected using a probability selection sample of 100,000 households. People who reside in institutions (e.g. nursing homes and prisons) are excluded from the sample. Person-level data is collected from all household members age 15 or older through personal and telephone interviews.

We examine households composed of a single family unit (at least one biological or adopted child under age 25). We exclude complex household and family structures, including households with more than one family, families with a cohabitating partner, and families with foster children[1], to strengthen our assumption of income pooling across household members. Our sample includes 5,916 single parent families: 1,078 male-headed families (18.22 percent) and 4,868 female-headed families (81.78 percent).

Using a probit model, we estimate the probability of a family being in poverty, controlling for the presence of children, the parent's education, the parent's race, the household's geography, and the state unemployment rate. A family is classified as being in poverty if its total income is less than its official poverty threshold[2], as determined by the U.S. Census Bureau. In 2012, the official poverty threshold for a single parent household with two children was $18,498 (U.S. Census Bureau, 2013a). As of 2012, the official poverty rate for the United States was calculated at 15.0 percent. Of these 5,916 families, using national sample weights, approximately 31.5 percent are in poverty[3]. Of the 1,078 male householders, 14.6 percent

fall below the poverty line, and 35.3 percent of the 4,838 female householders fall below the poverty line ($p<0.01$).

EXPLANATORY FACTORS

In general, men and women are most likely to be in poverty at the start and end of adulthood. In our analysis sample, single mothers typically are younger than single fathers: mothers are likely to be 35 to 44 years old and fathers are likely to be 45 to 54 years old ($t=15.89$, $p<0.01$).

Most families in our sample have one child present (47.3 percent). Fewer families have two children (34.2 percent) or three or more children (18.5 percent). When analyzing the distribution of number of children in the household by gender, we find a vast majority of the male-headed families have one child present (60.2 percent). While this percentage is less for female-headed families, the range of the number of children is greater for mothers. Female-headed families are also more likely to have two or more children than their male counterparts. Single fathers have an average of 1.53 children whereas single mothers have an average of 1.85 children ($t=-10.0$; $p<0.01$).

Approximately 52 percent of the householders are White (not Hispanic), and 22 percent are in poverty. Fewer householders are Black (not Hispanic) (23 percent), Hispanic (19 percent), or some other race (5 percent). However, non-White householders are more likely to be in poverty: 43 percent of Black householders, 43 percent of Hispanic householders, and 27 percent of householder of some other race. This is consistent with other studies that have found that non-Whites are more likely to be in poverty (Cawthorne, 2008; Starrels, Bould and Nicholas, 1994).

In our analysis sample, most householders had completed some college (35 percent). Fewer householders had less than a high school diploma (12 percent), a high school diploma or general education degree equivalent (GED) (30 percent), or a Bachelor's degree or more (22 percent).

We also control for whether the household is located in an urban or rural area. Approximately 81 percent of the families reside in an urban area; 17 percent of families reside in a rural area.

Using data from the U.S. Bureau of Labor Statistics, we control for the state average annual unemployment rate (Bureau of Labor Statistics 2012). This variable attempts to control for labor market variations across states. Unemployment rates range from three percent to 11.5 percent, with a mean of approximately 7.8 percent in 2012.

PROBIT MODEL RESULTS

Our main result is that single mothers are 0.134 more likely to be in poverty than single fathers ($p<0.01$), holding all other factors at their means[4] (see table 1). The sex of the family-head uniquely predicts the poverty status of the family unit, suggesting that poverty is still a unique, female experience. Moreover, gender-based discrimination may help to explain why women are more likely to be in poverty. We find that

mothers are more likely to be in poverty at every age. This is consistent with Rank and Hirschl (2001) findings wherein women are more likely to be in poverty at every age. They further conclude that the probability decreases following middle-age and rises during late adulthood. Families are less likely to be in poverty as the householder's age increases above age 41 (p<0.01), with the lower probabilities of being in poverty for older parents (60 year old parents are 0.17 less likely to be in poverty) and higher probabilities of being in poverty for younger parents (20 year old parents are 0.19 more likely to be in poverty). The poverty gap between single mothers and single fathers is widest among young parents and shrinks among older parents. Older parents are more likely to have older children that are no longer a financial burden on them. If the mother or father became a single parent at a young age, they are less likely to have had high educational attainment and work experience, putting them at greater risk for poverty (Card and Wise, 1978).

Table 1: Predicted Probability of Being in Poverty: Probit Estimates

Variable	**Marginal effect**	**Standard error**	
Householder's sex	0.134	0.021	***
Householder's age	-0.009	0.001	***
Number of own children	0.061	0.006	***
Householder's race: Black, not Hispanic	0.079	0.016	***
Householder's race: Hispanic	0.044	0.018	**
Householder's race: Other	0.033	0.028	
Householder's education: High school or less	0.131	0.019	***
Householder's education: Some college	-0.113	0.015	***
Householder's education: Bachelor's degree or more	-0.269	0.021	***
Urban residence	-0.059	0.018	***
State unemployment rate	.001	.004	

Note: Sample of 5,916 families and weighted population estimate of 8,542,754 families. Statistical significance reported at the 10 percent (*), 5 percent (**), and 1 percent (***). Omitted categories: householder's race: White, not Hispanic and householder's educational attainment: high school diploma or GED. Marginal effects calculated at variable means.

A family's probability of being in poverty increases as the number of children in the family increases. We also find that the predicted probabilities of being in poverty by householder's sex are statistically different. Regardless of the number of children in the family, single mothers are more likely to be in poverty than single fathers. Mothers with one child are nearly 0.20 more likely to be in poverty; fathers must have 3 or 4 children before they have a similar increased likelihood of being in poverty. The poverty gap persists among families with less than ten children, and is greatest among families with five or six children. The poverty gap shrinks for families with fifteen or more children, an uncommon occurrence given that the mothers and fathers have fewer than two children on average in our sample. This finding suggests that the poverty gap cannot be explained entirely by differences in the number of children in single mother and single father families.

We also find evidence that suggests that Black (p<0.01) and Hispanic (p<0.05) single parents are more likely to be in poverty compared to White single parents. The probability of being in poverty was two times

greater for Black single parents compared to Hispanic single parents. This is consistent with the literature on race and poverty (Cawthorne, 2008; Starrels, Bould and Nicholas, 1994).

Compared to single-parents with a high school diploma or GED equivalent, single parents who did not graduate from high school are more likely to be in poverty (p<0.01). Single parents with higher levels of educational attainment have a decreasing probability of being in poverty, at an increasing rate. Single parents with a Bachelor's degree or more are more than twice as likely to not be in poverty as single parents with only some college. Indeed, the family-head's educational attainment is the greatest predictor of a family's predicted probability of being in poverty. Though, the family-head's gender is the second greatest factor. This finding is also consistent with the literature, which finds that higher levels of educational attainment are correlated with higher family incomes and lower levels of poverty.

Table 2: Oaxaca-Blinder Decomposition Estimates

Poverty status	**Coefficient**	**Standard error**	
Differential			
Male householder	0.155	0.014	***
Female householder	0.365	0.010	***
Difference	-0.209	0.017	***
Explained			
Householder's age	-0.051	-.006	***
Number of children	-0.022	0.003	***
Householder's race: Black, not Hispanic	-0.013	0.003	***
Householder's race: Hispanic	-.0.003	0.002	***
Householder's race: Other	0.000	0.000	
Householder's education: High school or less	-0.005	0.002	***
Householder's education: Some college	0.005	0.002	***
Householder's education: Bachelor's degree or more	-0.009	0.003	***
Urban residence	0.002	0.001	**
State unemployment rate	-0.000	0.000	
Total	-0.097	0.010	***
Unexplained			
Householder's age	0.456	0.077	***
Number of children	-0.065	0.029	***
Householder's race: Black, not Hispanic	0.009	0.007	
Householder's race: Hispanic	0.009	0.007	
Householder's race: Other	-0.001	0.004	
Householder's education: High school or less	-0.002	0.006	
Householder's education: Some college	0.046	0.012	***
Householder's education: Bachelor's degree or more	0.043	0.009	***
Resides in an urban area	0.049	0.031	
State unemployment rate	0.098	0.066	
Total	-0.113	0.016	***

Note: Sample of 5,916 families and weighted population estimate of 8,542,754 families. Statistical significance reported at the 10 percent (*), 5 percent (**), and 1 percent (***). Omitted categories: householder's race: White, not Hispanic and householder's educational attainment: high school diploma or GED. Marginal effects calculated at variable means.

Single parent families who reside in urban-areas are less likely to be in poverty compared to similar families living in rural-areas (p<0.01). This may in part be due to increased access to public services and more employment opportunities in urban areas (Starrels, Bould and Nicholas, 1994).

OAXACA-BLINDER DECOMPOSITION RESULTS

We used the Oaxaca-Blinder decomposition to estimate the proportion of the poverty gap that could be attributed to discrimination (see table 2). Mothers are more than twice as likely to be in poverty (probability of 0.37) compared to fathers (probability of 0.15)[5]. Approximately 46 percent of the poverty gap can be explained by the family-head's age, race, and level of educational attainment, the number of children in the family, whether the family resides in a rural or urban area, and the family's respective state unemployment rate. Alternatively stated, these factors cannot explain 54 percent of the poverty gap. Variation in the family-head's age and race and the number of children in the family are the greatest explanatory factors of the poverty gap between single mothers and single fathers. Moreover, the family-head's age is the most influential factor in the unexplained component of the poverty wage gap.

Our findings suggest that the timing by which mothers and fathers become single parents may differ significantly and may help to explain why single mothers are at greater risk of being in poverty compared to single fathers. If mothers are likely to become single parents when children are young whereas fathers are more likely to become single parents when children are older, then, even if mothers and fathers begin families at the same age, single mothers will be younger than single fathers[6]. Also, families who enter poverty with young children may remain in poverty longer (Ratcliffe and McKernan, 2010). Coupled with young parents being less likely to have high levels of educational attainment, young mothers who have not completed college may face significant barriers to obtain a college degree given their family responsibilities.

DISCUSSION

We find evidence that suggests that the feminization of poverty stills exists in the United States. While we only examined a subset of families, single parents with no cohabitating partner and with at least one child under age 25, we find that single mothers are more likely to be in poverty than single fathers. Apart from the parent's sex, a parent's level of educational attainment has the greatest effect on the family's predicted probability of being in poverty.

Future research should focus on those factors causing single mothers to be at a greater risk of poverty. Firstly, while we find some evidence to suggest that single mothers and fathers have different pathways to becoming single-parents, additional research is needed to determine how such pathways impact the family's poverty status. Furthermore, families are increasingly more complex, including cohabitating partners (Bumpass and Lu, 1999; Goldstein and Kenney, 2001; Kennedy and Bumpass, 2008) and three or more generations living in one household (Provencher, 2011; Snyder, McLaughlin, and Findeis, 2006). "Grandmother" headed families are becoming more common among families in rural areas (Snyder, McLaughlin, and Findeis, 2006). These families may face particularly severe economic hardship due to their unique structure and source of income (Snyder, McLaughlin, and Findeis, 2006). Finally, research should consider how these changing characteristics influence a family's poverty status, and leverage this

information to inform policymakers on how to develop programs and services for families to reduce their likelihood of falling into poverty.

ENDNOTES

1. A family's poverty status is determined by comparing a family's income to its poverty threshold. A family with income less than its threshold is defined as "in poverty." Poverty rates are calculated as the total number of families in poverty divided by the total number of families. In this paper, we use the official U.S. poverty thresholds as determined by the U.S. Census Bureau.
2. We present national estimates throughout our paper using national sample weights.
3. All regression estimates available from the authors upon request.
4. Hamilton, Martin, and Ventura (2013) found that the majority of women in the United States had their first child between the ages of 20 and 24 in 2012.

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The Impact of Urbanization on CO_2 Emissions in Transition Countries

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ABSTRACT

This paper investigates the relationship among urbanization, energy consumption and CO_2 emissions in the CEE countries. In this paper dynamic causal relationship of urbanization and CO emission is investigated using panel cointegration techniques by taking the period 1995–20010 in to consideration for CEE and Baltic countries. There is a long run relationship between these countries and have a positive relationship both from urbanization and energy consumption to CO_2 emissions. Main results of the causality tests show that strong Granger causality running from CO_2 emissions to urbanization.

INTRODUCTION

Global warming caused by increased greenhouse gas emissions has been widely investigated recent years. Two important reasons of the greenhouse gas emissions are economic growth and energy consumption. However, energy consumption is more severe when accompanied by demographic growth and rural migration into cities. Growing number of population in urban settlements lead to increases in energy consumption (Martínez-Zarzoso and Maruotti, 2011) and the process of urbanization can also encourage the use of mass transport in place of motor vehicles (Jones, 1991). Urbanization and high urban densities might influence economy wide patterns of resource use. Parikh and Shukla (1995) state that; countries undergoing the development transition have greatest potential for incremental degradation. Buckley and Mini (2000) focus on cities of transition economies and stated that in ECA[1] is the second most urbanized region with urban population of 67 percent. Just as many countries of the region may be considered "over-industrialized," they may also be considered "overurbanized."

This paper aims to investigate the relationship between urbanization, energy consumption, and CO_2 emission in the European transition economies using Panel Cointegration Method with annual data for 1995-2010 period. To see the whether long run and short run relationship is exist or not, we will use Pedroni (1999, 2004) and Kao (1999) cointegration test then Granger causality based on the vector error-correction model (VECM) respectively.

The study focuses on transition economies in Europe. Transition economies are the economies of the countries which are changing from a centrally planned economy to a free market. The process has

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been experienced applied in China, the former Soviet Union and Communist bloc countries of Europe, and many third world countries. The IMF[2] listed countries with transition economies in two main classifications; transition economies in Europe and the former Soviet Union and transition economies in Asia. First classification separated in three sub-classifications: Central and Eastern European economies (CEE), the Baltics and the Commonwealth of Independent States (CIS).

- CEE: Albania, Bulgaria, Croatia, Czech Republic, FYR Macedonia, Hungary, Poland, Romania, Slovak Republic, Slovenia
- Baltics: Estonia, Latvia, Lithuania
- CIS: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan

We select European transition countries which are CEE and Baltics except FYR Macedonia because of data availability then the data set includes 13 countries. For these countries relationship between urbanization, energy consumption, and CO_2 emission is investigated. To test this relationship the Pedroni (1999) and the Kao (1999) tests are based on the Engle-Granger (1987) two-step (residual-based) cointegration tests are used. The fully modified OLS estimator (FMOLS), which is proposed by Pedroni (1996, 2001), is used to show long-run relationship. Based on the existence of the long run relationship short-run dynamics can be investigated using the vector error correction model (VECM) approach suggested by Engle and Granger (1987).

LITERATURE REVIEW

The relationship between urbanization, energy consumption and carbon dioxide emission has been investigated by a number of researchers.

Dietz and Rosa (1997) and York et al. (2003) study the impact of population on CO_2 emissions and energy use within the framework of the IPAT1 model. Both two studies find that the elasticity of CO_2 emissions and energy use with respect to population are close to unity.

Parikh and Shukla (1995) examine the variations of the aggregate energy requirements of economies or urbanization for developed and developing countries and find that the emissions and energy consumption were positively correlated with the urbanization level. Karaca et al. (1995) uses annual mean values of temperature data of Istanbul and Ankara stations and analyzes these data They find that the urbanization in these cities increases the pollution level in Turkey.

Wang et al. (2003) use Pressure-State-Response (PSR) and Balanced Scorecard (BSC) for Shandong Province from 2005 to 2009 with factor component analysis. They find that overall level of sustainable development is in an upward trend in Shandong in the study period. Martinez-Zarzoso and Maruotti (2011) analyzes the impact of urbanization on CO_2 emissions in developing countries from 1975 to 2003. They use STIRPAT formulation for three groups of countries and find that for the first and third

sets of countries the elasticity emission urbanization is positive and for the second group urbanization is not statistically significant. Also Martínez-Zarzoso et al. (2007) found a differential impact of population on emissions for old and new EU members.

Sadorsky (2004) uses a dynamic model is to capture both short-run and long-run impacts of income, urbanization, and industrialization on energy intensity. The results of Sadorsky paper show that increasing income reduces energy intensity in developing countries. Hossain (2011) find that urbanization had a long run positive relationship with CO_2 emission in newly industrialized countries (NIC) using the time series data for the period 1971–2007. O'Neill et al. (2012) use a computable general equilibrium model to investigate the impact of urbanization of energy use in China and India. They find that the urbanization has a somewhat less than proportional effect on energy use and carbon emission for both countries.

Zhu et al. (2012) find weak evidence of an inverted U-shape relationship between urbanization and CO2 emission using semi-parametric panel data model with fixed effects. Al-Mulali et al. (2012) investigate relationship between urbanization, energy consumption, and CO2 emission for East Asia and Pacific, East Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, South Asia, Sub-Saharan Africa, and Western Europe countries. They found that majority of the countries positive long relationship between the variables used. Zhang and Lin (2012) use panel data covering 29 provinces of China over the period 1995–2010 and find that urbanization would increase energy consumption and CO_2 emissions. Also Al-Mulali et al (2013) investigate same relationship for MENA countries and find that slowing down the urbanization level can help reduce the level of pollution and energy consumption.

METHODOLOGY:

Data

Our data set include CEE and Baltics except FYR Macedonia which covers 13 countries. Data of these countries are reported since the early 1990's after their economies began to open up. The data used in this paper are urban population as an indicator of urbanization, total primary energy consumption and the total carbon dioxide emission. The source of the data are World Development Indicators (WDI) for urban population and Energy Information Administration (EIA) for total primary energy consumption and the total carbon dioxide emission, then the data are titled CO_2, EC and UR respectively. The period used is 1995-2010.

Method

In this paper relationship between urbanization, energy consumption, and CO_2 emission is investigated. The first step is to examine the stationarity of the variables; then if the variables are same

order integrated the panel unit root test will be utilized. Various unit root tests are used namely LLC defined by Levin e. al. (2002), Breitung defined by Breitung (2000), IPS defined by Im et al. (2003) and Fisher-type tests using Augmented Dickey–Fuller (ADF-F) and PP (PP-F) defined by Maddala and Wu (1999) and Choi (2001) .

If the variables are same order integrated, the Pedroni and Kao cointegration tests will be used to examine the bi-directional long run relationship between the variables. From the long run estimated regression the residuals of the long run regression is refined and named as an error correction term (ECT). Then the VECM is used for correcting disequilibrium in the cointegration relationship, captured by the ECT, as well as to test for the causality among cointegrated variables, both for long-run causality by the error correction terms and short-run causality by the lagged dynamic terms.

We use three type of causality tests based on Ang (2008) and Pao and Tsai (2010); which are short-run Granger non-causality test, weak exogeneity (long-run non-causality test) and strong exogeneity tests respectively.

In the first type the statistical significance of the lagged dynamic terms is tested by F test with the null hypothesis variables which coefficients are tested do not Granger-cause of the dependent variable of the investigated model. Second type of test is the test of the ECT, which has null hypothesis which implies that non-causality from long-run equilibrium deviation in the previous period to dependent variable of the investigated model. The last type is strong exogeneity test examines the joint significance of both the lagged dynamic terms and ECT parameter. Because of this test concludes by testing the joint significance of both the lagged dynamic terms and ECT it imposes stronger restrictions and satisfies both Granger non-causality and weak exogeneity.

EMPRICAL RESULTS

The first step of empirical application is testing stationarity of the variables. Table 1 shows the result of the panel unit root tests used that are LLC, Breitung, IPS, ADF-F and PP-F panel unit root tests.

Whereas LLC and Breitung tests assume that there is a common unit root process across cross-sections, IPS and F-ADF tests assume individual unit root processes across cross-sections. The null hypotheses of these tests are each series in the panel contains a unit root. Although different test results are obtained if overall the unit root test results considered majority of the tests concluded that all series are stationary in their first differences, in other words they are integrated at order one, I(1) .

Table 1: Results of the Panel Unit Roots Tests

Variables	LLC		Breitung		IPS	
	Level	**1st diff.**	**Level**	**1st diff.**	**Level**	**1st diff.**
CO_2	-1.0339	-9.0536***	-0.1062	-2.0033**	-0.3958	-7.6956***
EC	-1.8490**	-10.5623***	-1.8297**	-3.1374***	-1.0437	-8.0561***
UR	-2.0609**	-1.7200**	-0.3819	-0.0707	-0.8270	-1.9485**

Variables	ADF-Fisher		PP-Fisher	
	Level	**1st diff.**	**Level**	**1st diff.**
CO_2	29.0296	92.4276***	29.0296	92.4276***
EC	29.0859	95.1922***	29.0859	95.1922***
UR	34.0658*	39.5875**	34.0658*	39.5875**

Note: The lag lengths are selected using SIC. ***,***,* denotes the rejection of the null hypothesis at 1% ,%5,%10 level of significance.

Table 2: Results of the Panel Cointegration Tests

Pedroni Cointegration Tests		
Test	**Statistics**	**Weighted Statistics**
Panel v-Statistic	1.8076**	-2.9187
Panel rho-Statistic	0.6757	0.6774
Panel PP-Statistic	-2.3059**	-2.6596***
Panel ADF-Statistic	-4.0047***	-3.2972***
Group rho-Statistic	2.0129	
Group PP-Statistic	-2.9139***	
Group ADF-Statistic	-5.1656***	
Kao cointegration tests		
Test	Statistics	
ADF	-2.6233***	

Note: The lag lengths are selected using SIC. ***,** and * denote the rejection of the null hypothesis at 1%, 5% and 10 % level of significance.

Table 2 shows Pedroni and Kao cointegration test results. Four of the seven statistics of Pedrioni reject the null hypothesis of no cointegration and two of the four weighted statistics reject the null hypothesis of no cointegration thus the result of the Pedroni test concluded that the cointegrating regression exist for these variables. Kao test has one statistics and the null hypothesis of no cointegration is rejected in 1% level significance. Based on cointegration test results the log-run panel model is estimated which's general equation is below:

$$CO2_{it} = \alpha_{0i} + \alpha_{1i}EC_{it} + \alpha_{2i}UR_{it} + u_{it}$$

We use FMOLS model to estimate cointegrating regression model for both grouped and pooled model. Phillips & Hansen (1990) is based on FMOLS estimators also Pedroni (1996) proposed new small sample results for the group mean panel FMOLS model. In this model group mean estimator is based on the so called "between dimension" of the panel, while the pooled estimators are based on the "'within dimension" of the panel. Pooled FMOLS estimators are used in Kao and Chiang (2000) for heterogeneous cointegrated panels. Pedroni (2001, 2004) proposed various techniques to estimate systems of cointegrated variables using the Fully Modified OLS. This cointegration equation corrects for endogeneity and serial correlation to the OLS estimator.

Table 3: Cointegrating Regression

	Model	
Variables	**FMOLS- Pooled**	**FMOLS- Grouped**
EC	3.7474***	8.7611***
UR	3.0935***	2.9107***
R^2	0,9622	0,9523

***,** and * denote the rejection of the null hypothesis at 1%, 5% and 10 % level of significance.

Table 3 shows the cointegrating regression model. All coefficients of the models are statistically significant in 1% level. Energy consumption and urbanization have a positive effect on CO_2 emission as it expected. Whereas in the grouped model effect of energy consumption is considerably higher than urbanization, in pooled model it is slightly close.

The error-correction terms are derived from long-run cointegrating relationships which are FMOLS-pooled and FMOLS-grouped and named as an ECT. To test for long-run and short-run causality among cointegrated variables the vector error correction model (VECM) is used for correcting disequilibrium. To test for panel causality, a panel-based VECM is specified as follows:

$$\Delta CO2_{it} = \alpha_{1i} + \sum_{j=1}^{p_{11}} \beta_{11ij}\Delta CO2_{it-j} + \sum_{j=1}^{p_{12}} \beta_{12ij}\Delta EC_{it-j} + \sum_{j=1}^{p_{13}} \beta_{13ij}\Delta UR_{it-j} + \theta_{1i}ECT_{it-1} + \varepsilon_{1it}$$

$$\Delta \mathrm{EC}_{\mathrm{it}} = \alpha_{2\mathrm{i}} + \sum_{j=1}^{p_{21}} \beta_{21\mathrm{ij}} \Delta \mathrm{CO2}_{\mathrm{it-j}} + \sum_{j=1}^{p_{22}} \beta_{22\mathrm{ij}} \Delta \mathrm{EC}_{\mathrm{it-j}} + \sum_{j=1}^{p_{23}} \beta_{23\mathrm{ij}} \Delta UR_{\mathrm{it-j}} + \theta_{2i} ECT_{\mathrm{it-1}} + \varepsilon_{2it}$$

$$\Delta \mathrm{UR}_{\mathrm{it}} = \alpha_{3\mathrm{i}} + \sum_{j=1}^{p_{31}} \beta_{31\mathrm{ij}} \Delta \mathrm{CO2}_{\mathrm{it-j}} + \sum_{j=1}^{p_{32}} \beta_{22\mathrm{ij}} \Delta \mathrm{EC}_{\mathrm{it-j}} + \sum_{j=1}^{p_{33}} \beta_{23\mathrm{ij}} \Delta UR_{\mathrm{it-j}} + \theta_{3i} ECT_{\mathrm{it-1}} + \varepsilon_{3it}$$

where $\mathrm{ECT}_{\mathrm{it}} = \mathrm{CO2}_{\mathrm{it}} - \alpha_{0\mathrm{i}} - \alpha_{1\mathrm{i}} \mathrm{EC}_{\mathrm{it}} - \alpha_{2\mathrm{i}} \mathrm{UR}_{\mathrm{it}} - u_{\mathrm{it}}$

At first, short run causality is tested by testing the lagged dynamic terms of the models except lagged independent variables. The null hypotheses tested are tabled in Table 4.

Table 4: Summary of the Panel Causality Tests Hypothesis I

Dependent variables	**Null hypothesis of short run**		
	ΔCO_2	**ΔEC**	**ΔUR**
ΔCO_2	-	$\beta_{12\mathrm{ip}} = 0\ \forall \mathrm{ip}$	$\beta_{13\mathrm{ip}} = 0\ \forall \mathrm{ip}$
ΔEC	$\beta_{21\mathrm{ip}} = 0\ \forall \mathrm{ip}$	-	$\beta_{23\mathrm{ip}} = 0\ \forall \mathrm{ip}$
ΔUR	$\beta_{31\mathrm{ip}} = 0\ \forall \mathrm{ip}$	$\beta_{32\mathrm{ip}} = 0\ \forall \mathrm{ip}$	-

Then the short run causality is tested by ECT term using t statistics. At last strong exogeneity is tested using F statistics of significance of lagged dynamic terms and ECT. The null hypotheses are represented in Table 5.

Table 5: Summary of the Panel Causality Tests Hypothesis II

Dependent variables		**Null hypothesis of long run and joint (Short run / Long run)**		
	Long run	**Joint (Short run / Long run)**		
	ECT	**ΔCO_2, ECT**	**ΔEC, ECT**	**ΔUR, ECT**
ΔCO_2	θ_{1i}=0 $\forall$ip	-	$\beta_{12\mathrm{ip}} = \theta_{1i} = 0\ \forall \mathrm{ip}$	$\beta_{13\mathrm{ip}} = \theta_{1i} = 0\ \forall \mathrm{ip}$
ΔEC	θ_{2i}=0 $\forall$ip	$\beta_{21\mathrm{ip}} = \theta_{2i} = 0\ \forall \mathrm{ip}$	-	$\beta_{23\mathrm{ip}} = \theta_{2i} = 0\ \forall \mathrm{ip}$
ΔUR	θ_{3i}=0 $\forall$ip	$\beta_{31\mathrm{ip}} = \theta_{3i} = \forall \mathrm{ip}$	$\beta_{32\mathrm{ip}} = \theta_{3i} = 0\ \forall \mathrm{ip}$	-

Table 6: Results of the Panel Causality Tests (FMOLS Pooled Model Resids)

Dependent variables	Independent variables						
	Short run			Long run	Joint (Short run / Long run)		
	ΔCO_2	ΔEC	ΔUR	ECT	ΔCO_2,ECT	ΔEC,ECT	ΔUR,ECT
	F-statistics			t-statistics	F-statistics		
ΔCO_2	-	0.5400	3.0299*	-1.8480*	-	1.5792	2.5851*
ΔEC	2.1228	-	5.9699**	-1.0041	1.8825	-	3.0753**
ΔUR	4.4900**	1.0304	-	0.7038	2.8447*	0.9732	-

Note: The lag lengths are selected using SIC. ***,** and * denote the rejection of the null hypothesis at 1%, 5% and 10 %level of significance.

Table 6 shows causality test results for FMOLS-pooled model. Short run test results show that short run the null hypothesis of no existence of Granger causality is rejected for CO_2 variable in urbanization VECM and for urbanization variable for CO_2 VECM and energy consumption VECM model. This result implies that there is one way causality for these three variables, therefore CO_2 granger causes urbanization and urbanization granger causes CO_2 emissions and energy consumption.

Result of the weak exogeneity test of the dependent variable, which is a notion of long-run non-causality test shows that only CO_2 model has long run relationship. However, the statistical significances of interactive terms of change in CO_2 emissions, along with the ECT in urbanization mean that there is strong Granger causality running from energy consumption to urbanization. Also for urbanization the results shows that strong granger causality running from urbanization to emissions and energy consumption.

Table 7: Results of the Panel Causality Tests (FMOLS Grouped Model Resids)

Dependent variables	Independent variables						
	Short run			Long run	Joint (Short run / Long run)		
	ΔCO_2	ΔEC	ΔUR	ECT	ΔCO_2, ECT	ΔEC, ECT	ΔUR, ECT
	F-statistics			t-statistics	F-statistics		
ΔCO_2	-	0.6122	2.1579	-1.9288*	-	1.6818	2.6898**
ΔEC	2.3024	-	5.1466**	-0.4555	1.4754	-	2.6624*
ΔUR	6.1064**	2.0881	-	-1.1102	3.2250**	1.3451	-

Note: The lag lengths are selected using SIC. ***,** and * denote the rejection of the null hypothesis at 1%, 5% and 10 %level of significance.

Table 7 shows causality test results for FMOLS-grouped model. For the short run the null hypothesis for CO_2 variable in urbanization VECM and for urbanization variable for energy consumption VECM in 5% level. This result implies that CO2 granger causes urbanization and urbanization granger causes energy consumption. Result of the weak exogeneity test of the dependent variable, which is a notion of long-run non-causality test shows that only CO_2 model has long run relationship. However, the statistical significances of interactive terms of change in CO_2 emissions along with the ECT in urbanization mean that there is strong Granger causality running from CO_2 emissions to urbanization. Also for urbanization the results shows that strong Granger causality running from urbanization to emissions and energy consumption.

CONCLUSION

The investigation of the effect of urbanization and energy consumption on CO_2 emissions in transition countries of Europe is goal of the paper. To achieve this goal, the panel model cointegration method was utilized taking the period 1995–2010 into consideration. The cointegration used are Pedroni and Kao cointegration and FMOLS model used the estimate long run cointegration model.

The cointegration tests showed that there is a cointegration between investigated variables and the relationship between urbanization and energy consumption is positive for the panel of country over the period. In addition Granger causality results reveal that there were long and short run causal relationships between the variables. CO_2 granger causes urbanization and urbanization Granger causes energy consumption and there is strong Granger causality running from CO_2 emissions to urbanization and urbanization to CO_2 emissions and energy consumption. Also it is found that only CO_2 model has long run relationship.

On the conclusion the investigated variables have uni-directional causality. Thus slowing down the urbanization level can help reduce the both energy consumption and CO_2 emission. However tests results show causality from CO_2 to urbanization this implies vicious circle.

ENDNOTES

1. The CEE comprises 12 countries. The World Bank's Eastern Europe and Central Asia (ECA) Region covers the 27 countries above, plus Turkey
2. http://www.imf.org/external/np/exr/ib/2000/110300.htm#I

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Determinants of a College Basketball Team's Revenue

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ABSTRACT

This paper shows empirical evidence of how a men's college basketball program's revenue is affected by several determinants, with results based on data from the past eight seasons. Important factors to consider when analyzing a college basketball team's revenue include; advertising, ticket pricing, performance during the previous season and the past three games, performance of a local rival's program in the previous season, quality of opponents faced, time of the event, and the Gross State Product. This article evaluates these determinants on the basis of a regression analysis to provide information about how significantly they affect a college program's revenue.

INTRODUCTION

College athletics today have a huge impact on campuses across the nation. Thousands of students, alumni and parents tune in and or attend college sporting events which can generate large revenues for institutions. The focus of this research is on a four year private, catholic college located in North Easter New York. The college is a non-profit organization which focuses on improving the college as a whole and its community by reinvesting the revenue generated by the basketball program into the college and its athletic programs. Over the past decade college sports have helped create an atmosphere that is very competitive and passionate. College basketball is one of the most popular college sports to attend and to watch. The evaluated college is compared to other Division 1 programs a smaller college. However, their basketball team is still very competitive and has appeared in eleven national tournaments, six of which have been at the NCAA tournament. Over the past decade the program has seen a lot of success, but they have also battled many hardships.

Even though the success of the team has changed throughout the years the one thing that has never changed is the support from the students, alumni, faculty, and the community. At every home game the arena is filled with students, alumni, faculty, as well as the local community that attend to watch great basketball and support their favorite team. In this research article the effect of different determinants on a college basketball program's revenue is being analyzed. Collecting data of past ticket sales, the price of the tickets, as well as the attendance for each game will enable the determination of the amount of revenue generated from this program. Some determinants being considered are the advertisement expenses for each game, the opponent's team quality, the performance of the crosstown rival's basketball program,

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whether the games are being held during the week or on weekends as well as the time of the game, and finally a demographic factor being the Gross State Product of New York. Past research has shown that a college basketball program has an essential branding aspect whose impact is greater than the profitability of the institution because it leads to an increase of the college's national profile (Smith, 2008).

Starting out with a literature survey whose purpose is to outline hypothesis of various authors regarding relating topics and pointing out their most significant determinants of revenue will draw a connection between previous done research and this research article. The following section exhibits the data used for the research, as well as the data analysis describing the regression model applied to find significant determinants for future forecasts of the team's revenue. The final part of this article will summarize the results of the research ending in a conclusion.

LITERARY SURVEY

Many articles have done similar research. Most of the authors focused on how college athletic program's profitability is affected by different determinants. Research by Gerdy (2000) has shown that a successful college athletic program positively affects the institution's revenue due to a greater national profile and especially a greater attention from the local community which increases funding. Other authors see demographic factors as a more significant determinant of college basketball revenue. Brown (1995) claims in his article about revenue of college basketball programs that the income of the fan base has a significant impact on revenues generated throughout a college basketball season. In his research he looked at the per capita income of the city in which a college basketball program is located which is one of many ways to determine the income of the fan base. Some authors have looked at this topic from a different point of view. Another significant determinant of college basketball revenue is according to Nemhauser and Trick (1997) the scheduling process of the home and away games. The authors claim that it is very important not to have too many or too few home games. Finding the optimum balance in the number of home and away games is substantial to generate the highest possible revenue. In addition research has proven that having the last game of the season at home can give revenue numbers a significant boost. Another crucial factor in scheduling games is looking at the strength of the opponent. You can increase the game attendance and consequently the revenue by facing a lot of strong opponents. However, this could lead to a worse winning record or even a losing record which could eventually lead to a drop in the overall game attendance numbers.

Similar research has been done by Lane, Nagel and Netz (2012). To predict revenues generated during a college basketball season, the authors used a number of determinants. Among others, they used the team's performance during previous seasons by looking at the team's ranking index. In addition, the home game arena's capacity was used as a determinant since a greater capacity will enable more fans to come to the college's games and therefore, higher ticket sales and revenues can be generated. Another

interesting revenue determinant used by these authors was a Nike dummy which measured if the team was sponsored by Nike. If this was the case, they assumed that a college sponsored by Nike will have access to the country's greatest high school recruits. Having the best recruits will increase the performance of the team and consequently increase the ticket demand and interest in the team by the fans. This will lead to greater ticket sales and an increase in revenues.

McEvoy (2005) did not examine determinants of the athletic program's revenues but used the performance of the athletic program as an indicator of student enrollment at the associated college. After previous research in the same area by McCormick and Tinsley (1987) and Murphy and Trandel (1994) McEvoy focused on the four main college sports, men's basketball and football as well as women's basketball and volleyball. The result of his research demonstrated that there was a positive relationship between undergraduate admissions and the athletic program's performance. However, not all sports indicated the same impact on admissions. The most significant determinant of undergraduate admissions was the performance of the football program. Other authors like Toma and Cross (1998) also claim that the performance of the men's basketball program can have a significant impact on undergraduate admissions at a college. Their research highlights that after a successful season and winning a championship the number of applications at the institution increases.

DATA AND MODEL

The model underlying this research article has been established from data collected throughout the team's past eight seasons during the years 2006 until 2014. Each game's revenue as well as ticket prices and advertisement expenses have been recorded and are being taken into consideration for the analysis. The following regression equation will be the basis of the analysis:

$$REV_i = \alpha_0 + \alpha_1 COMPDAY_i + \alpha_2 COMPTIME_i + \alpha_3 OPPQUAL_i + \alpha_4 Total\_Adv_i + \alpha_5 We\_Tk\_Pr_i + \alpha_6 GAMEREC_i + \alpha_7 PREPERFORM_i + \alpha_8 RIVPERFORM_i + \alpha_9 GSP_i$$

The college team plays all their home games in an arena located off campus. The capacity of more than 17,000 seats is a big positive of the arena. However, the arena is being used for many different events and is not available at all times. Like previously mentioned, the game scheduling process can have a great impact on the revenue generated throughout a season. In this model, revenue is the dependent y variable because the model is supposed to predict the future revenue amount per season. The various x variables listed above determine the amount of revenue generated each season and will be looked at closer in the following paragraphs.

COMPDAY refers to the day of the competition. The games are either being held during the week or on the weekend. After examining the game attendance numbers of the past eight seasons, it clarifies that in general more people attend games on the weekend instead of games being held during the week. Since this is the case it can be used as a revenue determinant because the day on which a season game is being

held affects the attendance numbers and consequently the ticket sales which determine the corresponding revenue. In the same way, the second variable, the time of the competition, has an important role for the ticket revenue.

COMPTIME takes into consideration whether the game takes place during the day or at night. Night games are generally more popular and lead to a greater attendance and higher ticket sales. During a regular season, on average 14 games are being scheduled. The quality of the opposing teams, OPPQUAL, differs throughout the whole season. Research has shown that more people attend games against a team with a high quality. High quality can either refer to the strength of the opponent or whether the opposing team is a rival. In order to use the opponent's quality in the regression model, the quality of the teams has to be expressed numerically. A survey completed by current players provided a ranking index for each opponent faced throughout the past eight seasons. A quality of one refers to a weak opponent and a quality of five refers to a very strong opponent. Historically, the highest game attendance has been reached each year during games against the crosstown rival university.

In recent years, the college's athletic department has focused more on advertising their men's basketball program. Expenses for various advertisement campaigns have been increased with the goal of increasing the attendance numbers throughout the basketball season. The different parts are television, radio, printed and outdoor advertisement. Recently, small amounts per season have also been invested into internet advertisement to adapt to the societal changes and the increasing involvement with social media. The amount of advertisement spent for each game has been allocated providing a total amount of advertisement spent for each game (Total_Adv) to include the effect it has on each dollar of revenue generated.

Ticket prices are the best measurable determinant of revenue. The effect of a price change can instantly be seen in the amount of revenue generated. Therefore, this variable is very significant to reach the optimum revenue. However, determining the optimum ticket price has difficulties. The demand for the team's tickets is relatively elastic. Generally, the higher the ticket price, the lower the demand. The reason for the elasticity is the existence of a substitute product, the basketball games of the crosstown rival university. The college basketball team focused on in this research does not have to fear to lose their loyal fans but it is in competition with their crosstown rival for neutral spectators who just want to see a good basketball game. If the ticket prices of the rival are significantly lower, the neutral spectators will attend their games because they will be able to see a qualitative equal game for a lower price. This example clarifies the importance of ticket prices. This research focuses on the prices of season, regular, group and discounted children/student tickets leading to a weighted average ticket price (We_Tk_Pr) per game.

In every field nowadays performance is one of the most important measurements of quality. It is also an important determinant of revenue. The better the performance of your product, the higher is the demand for it. Thus, the higher is the revenue. In this research three variables have been used to measure the

performance. GAMEREC refers to basketball team's record in the previous three games. The team's performance can either increase or decrease the revenue. In case of a winning record in the previous three games a greater attendance than in the previous games can be expected which increases revenue. Similar, a losing record decreases the interest of the fans but even more the interest of the neutral spectators who have the possibility of attending other Division I Men's Basketball games at the rival university.

The variable PREPERFORM indicates whether the previous season was a successful or an unsuccessful season. A season can be seen as successful if the team either had a winning record or if the team won a championship. A good performance during the previous year will lead to a greater interest by the community and fans and higher ticket sales in the following season because the team is expected to perform as well as before. RIVPERFORM refers to the performance of the crosstown rival's basketball program during the previous season. If the rival performs better, more people will be interested in watching their games. The demand by neutral spectators for tickets will decrease because of the superior performance of the rival's basketball team. All three performance variables are non-numerical measures. During the analysis a winning record received the value 1 and a losing record the value 0. Similarly, if the team outperformed the crosstown rival in the previous season, the season received the value 1 and if the rival performed better, the season received a 0.

Finally, a variable measuring the state of the economy can always expected to be a significant determinant of revenue. The Gross State Product (GSP) of New York has been listed throughout the years 2006-2013, the length of this research. The GSP measures the annual expenditures in a specific state and can be helpful in determining the revenue of a college basketball program. An increasing GSP of New York leads to the assumption of an increasing income level of the fan base of the college's basketball team located in New York. If the fan base has more money available for leisure activities, it is likely that more people attend college basketball games. Likewise a decreasing GSP of New York could lead to a decreasing attendance at college basketball games because the fan base has less money available to spend.

RESULTS

In every aspect of organizational analysis, empirical evidence is worth more than a theoretical approach. Table 1 shows the results of testing the previous stated assumptions about various determinants of college basketball revenue. Some of the variables proved to affect revenues, whereas other than assumed some of the variables did not show significant evidence of their effect on generating revenue throughout a college basketball season. At a predetermined significance level of 0.05 (5%) four of the suggested nine variables prove to have a significant effect on generating revenue since their p-value is less than 5%. The p-value or significance tests the null hypothesis stating that all coefficients are equal to zero. If this is the case, the coefficient has no effect on the dependent variable, which is revenue. A p-value or

significance lower than the predetermined 0.05 enables the rejection of the null hypothesis and proves the significance of the coefficient.

The time of the competition (COMPTIME), the weighted average ticket price (We_Tk_Pr), the performance in the last three games (GAMEREC), the performance in the previous year (PREPERFORM) and the Gross State Product (GSP) are insignificant with p-values of 0.382, 0.127, 0.604, 0.874 and 0.667 respectively. Since these variables were included in the regression model, it has to be valued as insufficient for a forecast to predict future revenues due to the low R-squared value of 0.483. The R-squared statistic determines the strength of a regression model since it measures the explained variation of the data. Values between 0 and 1 are possible whereas an R-square statistic close to 1 is desired. A statistic of 1 would indicate that 100% of the data variability around the mean can be described by the underlying model. This model's R-square statistic with a value of 0.483 indicates that only 48.30% of the variability can be described by this model which is not enough to give a significant revenue forecast.

Table 1: Coefficients

	Step-1: Regression			Step-2: Regression			Step-3: Regression		
Variable	**Stand. Coefficient** Beta	**T stat**	**Sig.**	**Stand. Coeff.** Beta	**T stat**	**Sig.**	**Stand. Coeff.** Beta	**T stat**	**Sig.**
Constant		.314	.754		1215	.237		6.598	.000
X1_COMPDAY	.359*	4.131	.000	.319*	4.112	.000	.283*	3.918	.000
X2_COMP TIME	.075	.878	.382	.069	.868	.387		Removed	
X3_OPP QUAL	.330*	4.172	.000	.311*	4.278	.000	.327*	4.560	.000
X4_Total_Adv	.277*	3.300	.001	.277*	3.636	.000	.307*	4.112	.000
X5_We_Tk_Pr	.151	1.539	.127	.101	1.370	.174		Removed	
X6_GAMEREC	.044	.520	.604		Removed			Removed	
X7_PRE PERFORM	-.031	-.159	.874		Removed			Removed	
X8_RIV PERFORM	.278*	2.531	.013	.305*	4.209	.000	.311*	4.266	.000
X9_GSP	-.079	-.432	.667		Removed			Removed	
	R-square=0.483			R-square=0.481			R-square=0.465		

*. Significant at the 0.05 level (2-tailed)
Dependent Variable: Y_REV

Although the model as a whole cannot be used to determine future revenues, it provides comprehensive information about the researched variables. All variables which are significant in determining the revenue also have a positive effect on revenue. Meaning, as the variable increases the revenue can be expected to increase as well. For example, when the college basketball team faces an opponent with a high quality, higher revenues can be expected. In order to use the model to forecast revenues the insignificant variables have to be eliminated from the regression model. This process provides a three step regression listed in table 1. After all insignificant variables have been eliminated the following significant variables are left. COMPDAY referring to the day of the competition, OPPQUAL measuring the quality of the opposing teams, Total_Adv standing for the total advertisement spent at each game and RIVPERFORM referring to the performance of the crosstown rival's basketball program during the previous season. This process leaves

Table2: OPPQUAL effect on revenues

OppQual		Y_Rev	Total_Adv	We_Tk_Pr
	Mean	53845.900	2859.567	15.200
1	N	3	3	3
	Std. Deviation	19220.6465	2682.9799	1.4799
	Mean	51908.420	3321.787	15.060
2	N	15	15	15
	Std. Deviation	8314.4191	2273.6068	.8253
	Mean	54541.396	4153.398	15.235
3	N	48	48	48
	Std. Deviation	10353.2065	3136.2862	.9120
	Mean	57852.944	4185.631	15.212
4	N	16	16	16
	Std. Deviation	10516.4422	3745.0535	.6334
	Mean	69662.161	5205.381	15.384
5	N	31	31	31
	Std. Deviation	22703.7974	3565.7213	1.1446

all significant variables with p-values of 0.000. COMPDAY is as expected a determinant which affects revenue. For management this can be an important indicator for the scheduling process. Analyzing the data indicated that the game attendance was generally greater at games held on a weekend instead of during the week. OPPQUAL has one of the highest impacts on revenues. Table 2 lists mean revenues, total advertisement spent and weighted average ticket prices per game at each opponent quality. The significance of the opponent quality as a revenue determinant is reflected in the substantial increase of the revenue means. On average, against opponents with a team quality of five, an increase in revenues of at

least $10,000 can be expected. Especially games against the crosstown rival or NCAA ranked teams clarify the effect the opponent quality has on revenue. Every season those games generate the highest revenue due to the high attendance numbers. Also interesting is the allocation of the total advertisement spent per season. Besides advertisements for the whole season, most of the advertisement money is spent for games against opponents with a higher quality. This could be an additional factor why those games generate the most revenue.

The total advertisement expense (Total_Adv) affects revenues largely. However, the advertisement expenses cannot be increased infinitely. Regarding advertisement expenses, it is important for the management to find the optimum point at which the additional dollar of revenue generated by an additional dollar spent on advertisement is maximized. At some point you cannot efficiently increase the number of people reached by the advertisement and each additional dollar spent on advertisement decreases profits since the maximum possible revenue affected by advertisement has already been reached.

Both performance variables demonstrate to have an impact on revenues simply considering the mean revenue generated throughout the last eight basketball seasons. Table 3 provides an overview about the mean revenue generated per game in a season following an unsuccessful (PREPERFORM=0) and successful (PREPERFORM=1) year by the college basketball team. As expected a strong performance in the previous season leads to an increase in revenues per game on average by $4,539.59 compared to revenues generated throughout a season following an unsuccessful year. However, taking into consideration the regression result, the effect on revenue by PREPERFORM is not sufficient due to the high p-value of 0.874. The high value can be explained by the coefficient's high standard error of 6955.297 referring to a high variation of revenues leading to an insignificance of the PREPERFORM effect on revenue.

Table 3: PREPERFORM effect on revenue

PREPERFORM		Y_REV	Total_Adv	We_Tk_Pr
0.	Mean	55938.18	4422.681	15.476
	N	42	42	42
	Std. Dev.	12696.48	3202.9312	.3786
1.	Mean	60477.77	4230.32	15.114
	N	71	71	71
	Std. Dev.	17609.07	3293.3341	1.1405
Total	Mean	58790.48	4301.819	15.249
	N	113	113	113
	Std. Dev.	16145.49	3257.0180	.9424

Table 4: RIVPERFORM effect on revenue

RIVPERFORM		Y_REV	Total_Adv	We_Tk_Pr
0.	Mean	54375.4	3780.743	15.173
	N	70	70	70
	Std. Dev.	15687.4	3420.1396	.7022
1.	Mean	65977.6	5150.081	15.372
	N	43	43	43
	Std. Dev.	14334.0	2807.5159	1.2381
Total	Mean	58790.4	4301.819	15.249
	N	113	113	113
	Std. Dev.	16145.4	3257.0180	.9424

In addition neutral spectators who just want to see a good basketball game will also take into consideration the performance of the rival university. Therefore RIVPERFORM has an additional impact on revenues explained by the low p-value which proves the variables significance as well as the results presented in table 4. It gives a brief overview about the effect of RIVPERFORM on revenues. The revenue in seasons in which the team outperformed their rival (RIVPERFORM=1) shows on average significantly higher revenues of $65,977.69 per game compared to seasons in which the rival performed better (RIVPERFORM=0) with revenues averaging $55,938.19 per game.

The economic variable GSP does not affect the college basketball team's revenues with a high p-value of 0.667. Also surprising is that the assumption, that an increase in GSP would increase the game attendance and revenues, has to be revised. The analysis shows GSP with a negative coefficient which leads to the conclusion that an increase in GSP would decrease revenue and a decrease in GSP increase revenue. Consequently college basketball tickets are an inferior good in the state of New York, meaning that as income levels rise, the demand for men's college basketball tickets decreases. However, this effect is not significant enough to impact revenue numbers throughout a season.

Conclusion

This research has proven that any available data can be informative and helpful for the management of a business, in this case a college basketball program. Data has been used to apply previous established theories and establish empirical evidence about the significance of various revenue determinants for a college basketball team. The variables COMPDAY, OPPQUAL, Total_Adv and RIVPERFORM can all be used in forecasting future revenues due to their proven significance in this regression model. For future research available data of the significant variables or predictions of outcomes of these variables in future college basketball seasons can be used to forecast revenues using the provided final regression equation:

$$\hat{Y} = 20347.76 + 11757.92X_1 + 4910.59X_3 + 1.40X_4 + 8852.22X_8$$

ENDNOTES

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2. The tables and regression results will be provided by the authors upon request.

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