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DOES LOWERING THE INTEREST RATE STIMULATE ECONOMIC
GROWTH? AN ANALYSIS OF CURRENT MACROECONOMIC POLICY

by

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A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Finance
in the College of Business
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ABSTRACT

The effectiveness of monetary policy moving forward from the subprime mortgage crisis has come into question by academics and economists from around the world. The unconventional monetary policy tools implemented have left central banks in a tough spot in terms of an exit from these policies in an environment where economic growth and inflation targets still have not been reached ten years after the onset of the recession. One of the main criticisms by economists is the prolonged easy monetary policy implemented by central banks, which have left interest rates at near zero levels since the recession and are just now beginning to cautiously consider raising rates.

In this paper, I examined the relationship between GDP growth and economic variables that could possibly affect it, including interest rates, unemployment, labor force participation rates, shadow interest rates, stock market performance, and bond market performance. I studied the relationship by running regressions on time series data collected from the economies and central banks of the United States, European Union, and Japan. I found no statistically significant relationship between interest rates and GDP growth as well as positive values for the interest rate coefficients for two out of three of my regressions. However, I did conclude that the unemployment rate, and bond market performance did have a positive relationship with GDP growth in Europe and Japan. This warrants further study and usage of policy tools that affect these variables to lessen the severity of future recessions and have a positive effect on economic growth.

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Chapter One: Introduction

Since the end of the Great Recession, many economists around the world have questioned the effectiveness of central bank monetary policy in today's global economy. In January 2016, at the World Economic Forum in Davos, Switzerland, Raghuram Rajan, then Governor of the Reserve Bank of India, spoke of the recent developments in global macroeconomic policy: "Monetary stimulus has largely run its course." He stated that post-crisis, "we may have reduced the room for other policies", and hinted at the ongoing economic stagnation that is plaguing major economies today.

Monetary policy and the roles of central banks have evolved over time, especially over the last century. Initially thought to have little effect on the economy, central banks have become autonomous government agencies playing a major role in economic stability. Through monetary policy, they are able to control the money supply and availability of credit in the country, thus affecting short-term interest rates and economic growth. Effective central bank policies have increased economic stability worldwide throughout the 20th century. Expansionary policy is implemented during recessions by increasing the supply of money to combat unemployment and stimulate economic growth. Contractionary policy is implemented during booms to combat rising inflation and stop an expanding economy from overheating. Central banks have different tools they can use to implement effective policy measures.

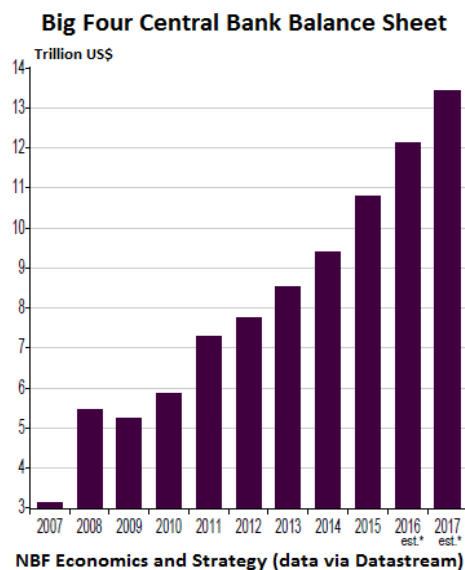
Conventional monetary policy tools include open market operations, discount interest rates, and reserve requirements. Open market operations involve the purchase and sale of securities, usually low-risk government-issued bonds, to affect the supply of money. When

bankers want to increase the money supply, they will purchase securities from banks thus increasing reserves in the banking system. The opposite is done when the goal is to reduce the money supply; the central bank will sell securities to commercial banks, thus reducing reserves in the banking system. These open market operations are conducted by the respective central bank's trading desk. Central banks use open market operations to set their target rates, which in turn provide liquidity to the banking system. Target rates are usually the overnight-unsecured interbank lending rates on bank reserves. Target rates are specified as the Federal Funds Rate for the U.S. Federal Reserve, the Main Refinancing Operations Rate for the European Central Bank, and the Unsecured Overnight Call Rate for the Bank of Japan. The third conventional monetary policy tool used by central banks is reserve requirements. Bank reserve requirements are the amount of funds to be held on reserve by commercial banks, as either cash or deposits with the central bank. Reserve requirements are a provision to ensure liquidity in the banking system, but can also be used as an effective monetary policy tool. By increasing the reserve ratio, or percentage of deposits to be kept as cash, the overall money supply is reduced and interest rates rise. This occurs because commercial banks must hold more cash therefore lending less, reducing the available money supply in the economy. Reducing the reserve ratio has the opposite effect, increasing the money supply and reducing interest rates. By adjusting short-term interest rates central banks can affect short-term economic growth. Low interest rates encourage business investment and consumption, while high interest rates induce saving and reduce consumption.

The negative shock to the global economy was so great during the recession that central banks were forced to lower their short-term nominal interest rates to zero. At the “Zero Lower Bound”, unconventional monetary policy tools were required to bring further stimulus and

provide the liquidity necessary to prevent a global economic meltdown. Today known as “Quantitative Easing”, these tools served to provide liquidity to financial institutions and key credit markets through direct collateralized lending, the swapping of illiquid assets for sovereign bonds, the purchase of long-term securities to depress long-term rates in an attempt to stimulate aggregate demand, and the use of forward guidance. When central banks could no longer provide stimulus through short-term interest rates, they attempted to do so by changing the composition and size of their balance sheets. Central banks provided collateralized loans to sound financial institutions and took over their illiquid assets in an attempt to stabilize credit markets. The scope of these asset purchase programs was unprecedented and never seen before, but deemed necessary to stop the recession in its tracks. The U.S. Federal Reserve (Fed), European Central Bank (ECB), Bank of Japan (BOJ), and the Bank of England (BOE) increased the size of their combined balance sheets by almost \$11 trillion from 2007-2014. Many economists attribute the actions of central bankers around the world in the aftermath of the recession as having reduced the length and severity of the economic downturn.

Figure 1: Central Bank Balance Sheet Growth



Since the first round of QE in the U.S., unemployment has fallen from a high of 10% in 2009 to about 5% today, although growth has been slow and may be stalling. The Federal Open Market Committee's main focus has shifted into getting inflation closer to its target of 2%, which has remained a challenge to the Fed as it prepares to raise rates. In Europe, the ECB's quantitative easing program has been used as an instrument to try to push inflation to its target rate of 2%. The "Public Sector Purchase Programme" was enacted in March 2015 and will inject €1 trillion into the economy through sovereign debt purchases to boost inflation. The Bank of Japan first began its fight against deflation with quantitative easing from 2001-2007. After the subprime crisis, the Japanese economy experienced negative growth and once again negative inflation. The BOJ began another round of quantitative easing in 2011, expanding its asset purchase program by ¥5 trillion. In 2013 the central bank announced purchases would be expanding by ¥70 trillion, and in 2014 expanded purchases even further by ¥80 trillion.

However, there are still many concerns surrounding the health of the global economy in the aftermath of the Great Recession. Some economists and bankers have theorized that prolonged easy monetary policy has done more harm than good. Ultra-low interest rates may actually be doing the reverse of what they are intended to do. At such extremely low rates, there is fear that households are being incentivized to increase their saving rather than consumption. The theory behind this notion is that workers saving for retirement are worried that at such low rates they may not be able to reach their target level of saving in time to retire, therefore increasing their savings and reducing consumption. Many households saw a substantial loss of wealth during the recession, leaving many with liquidity constraints that limit their borrowing to be able to increase consumption in the present term. This problem particularly affects middle

class families whom, as opposed to the rich, did not have adequate savings to maintain their level of consumption. Low interest rates can also have positive effects on consumers. When interest rates are low, equity markets tend to be higher, increasing private wealth. Low rates also allow for cheaper borrowing for households without liquidity constraints. Finally, households with adjustable rate mortgage agreements from before the recession saw a substantial decrease in the size of their mortgage payment once short-term lending rates were brought down to near-zero levels. Many households used this additional disposable income to deleverage in the wake of the financial crisis. The question of whether years of easy monetary policy action by central banks has been successful in stimulating aggregate demand has yet to be answered, due to lackluster GDP growth, low inflation, and low household consumption.

Another concern with recent macroeconomic policy is that after several rounds of quantitative easing and trillions of dollars being pumped into the global economy, asset prices have been propped up at a level above their intrinsic value, creating a potentially dangerous asset bubble. At the World Economic Forum in 2016, central banker Raghuram Rajan commented on the effect of these policies by saying: "We are not sure what the fundamental value of any asset is...asset prices are still trying to find their appropriate level." In 2015, George Soros delivered a warning of the possible political consequences of the ECB's asset purchase programs at the Davos World Economic Forum: "It will benefit the owners of assets and actually wages will remain under pressure through competition and unemployment." Policymakers must understand the consequences that come with their actions. At some point monetary policy must be combined with effective fiscal policy and structural reform to be effective.

Today, interest rates around the world remain at near-zero levels. The U.S. economy seems to be picking up as GDP and inflation begin to reach target levels. The Federal Reserve recently raised rates for the first time since the crisis in December 2015, and has been very cautious in raising rates since then. The European economy is also beginning to show signs of improvement as deflationary concerns begin to wind down. The ECB is beginning to consider slowly tapering off their asset purchase programs and is not expected to raise rates at least until the tapering process begins. The BOJ has kept rates steady in the wake of the Fed's increases and has showed no signs of slowing down their stimulus program. Economic analysts have predicted that inflation in Japan may reach the BOJ's target rate in late 2017, at which point the BOJ may consider a change in monetary policy. It has been ten years since the beginning of the Great Recession and we are just now beginning to see shifts in global macroeconomic policy. The measures implemented around the world during the crisis may have lessened the severity of the crisis, but it may have made monetary policy less effective moving forward. This paper will explore the effects of global macroeconomic policy focusing on the economies and central banks of the United States, European Union, and Japan.

Chapter Two: Literature Review

Bossone (2013) discussed the unconventional monetary policy tools implemented by central banks in the wake of the recession. He credits quantitative and credit easing with preventing a global financial meltdown, but also criticizes the measures for the distributional inequality created by the policies. Bossone states: “QE injects money to owners of assets who benefit from QE-stirred bond and asset-price rises, but represent a tiny minority with a low propensity to consume. Conversely, QE does not reach common people (with higher propensity to consume) and deprives them of interest incomes: with given or falling incomes, and prices expected to rise, they may even reduce consumption.”

Krippner (2012) establishes a framework for representing the yield curve in a zero lower bound environment. He builds on the theory established in the 1995 paper “Interest Rates as Options” by Fischer Black. The intuition behind the model is based on the fact that interest rates are bound at zero because holding physical currency provides a risk-free alternative to a negative interest rate. Krippner develops a bond option pricing model for the value to investors to hold currency at an interest rate of zero. This allows the value of the option to be effectively removed from the yield curve, leaving a “shadow yield curve” that represents the policy yield curve that would exist if the option to hold physical currency were removed. The calculated shadow rate can then be compared to market short-term rates to observe the effect of easy monetary policy. To prove this, Krippner plotted the shadow yield curve against the U.S. yield curve for monthly observations from December 1986-2011. Once the market rate become constrained at zero, we observed negative values for the shadow yield curve and large drops in the rate associated with three monetary policy events: QE1 announcement in 2008, negative forward guidance from the

FOMC in 2010, and the FOMC's announcement of keeping target rates near-zero for the foreseeable future in 2011. Using this methodology we are able to measure changing monetary policy stance once the actual rate reaches zero by creating an "effective" policy rate below the zero lower bound.

The relationship between interest rates and economic growth has garnered much attention from the academic world in the past. Bosworth (2014) examines the long-term determinants of interest rates, and in particular the relationship between the variations in interest rates and the rate of economic growth. The analysis focuses on foreign versus domestic pressures on determining real interest rates in an individual G-7 economy. The analysis found a weak correlation between the rate of growth and real interest rates. Bosworth compares his findings to the standard Solow-Swan model, which is based on the assumption that interest rates have a positive correlation with economic growth, due to their effect on saving and investment within the model. Furthermore, his research suggests that global capital markets are highly integrated, and real interest rates are largely determined by foreign as well as domestic factors.

Hansen and Seshadri (2013) study the long-run relationship between real interest rates and economic growth. The researchers constructed a regression using annual U.S. data for real interest rates, labor productivity, real earnings growth, and real aggregate GDP growth for the time period of 1901-2011. Their findings point to a "moderately negative" correlation. The average correlation between real interest rates and labor productivity, real wage growth, and real GDP growth was -0.20, implying that the real interest rate is countercyclical. They explain this by stating that long-run costs due to periods of low interest rates would be offset by periods of high productivity growth.

D'Adda and Scorcu (2001) conducted an empirical study on the relationship between real interest rates and economic growth by constructing regressions using data from 20 industrialized economies for the time period 1965-1994. The empirical evidence observed by the researchers supports the traditional view of a positive relationship between growth and capital accumulation, and a negative relationship between accumulation and the real interest rate. The researchers estimated that a one percent increase in the real interest rate resulted in a fifth of a percentage point decrease in the average growth rate.

Semuel and Nurina (2015) concluded that there is a positive relationship between inflation and interest rates to GDP. The researchers collected data on historical inflation, interest rates, and exchange rates in Indonesia from 2005-2013. They noted that: “countries in the developing stages such as Indonesia can be said to have economic growth that is quite vulnerable to the turmoil in developed countries like the United States (Bank Indonesia, 2013). However, in this case Indonesia is considered to have a significant economic growth and able to survive. This can be seen by the Indonesian stability amid the global crisis in 2008, which Indonesia is able to continue its economic growth, especially after the 2008 crisis ended (Bank Indonesia, 2013).” They constructed a partial least squares model to test the hypotheses and describe the relationship between the dependent and independent variables and found a significant negative relationship between interest rates and GDP.

Di Maggio, Kermani, and Ramcharan (2014) explored if the unconventional monetary policies implemented during the crisis succeeded in boosting aggregate demand. They observed the changes in monthly payments of borrowers with adjustable rate mortgages originated from 2005-2007, and then analyzed household consumption and saving behavior as interest rates

changed. The data showed that the monthly mortgage payment for the average borrower decreased by \$900 when interest rates were lowered. The average household then increased their monthly car purchases (durable goods) by 40%, but at the same time allocated an additional 15% of the income to deleverage by paying down their mortgage faster. The researchers concluded by stating that: “Low interest rates have stimulated consumption of durable goods, but the expansionary effect is partially dampened by households’ desire to deleverage voluntarily.”

Chapter Three: Data and Methods

In this paper, I will examine the effectiveness of expansionary central bank monetary policy on stimulating economic growth since the end of the Great Recession by studying the relationship between economic growth and interest rates, as well as the relationship between economic growth and other variables. The dependent variable in my study will be the GDP growth rate to represent economic growth, and the independent variables will be the target interest rate, shadow rate, unemployment rate, labor force participation rate, a proxy for stock market performance, and a proxy for bond market performance. I will use the tickers SPY and TLT to represent the American stock and bond markets, EZU and IEGL to represent the European stock and bond markets, and EWJ and VANJGBY to represent the Japanese stock and bond markets, respectively. The three central banks to be studied will be the United States Federal Reserve, the European Central Bank, and the Bank of Japan. I will use monthly economic data from each central bank's respective economy from January 2009 to July 2016. This specific time period was chosen to limit any misrepresentation of the results based on the extreme volatility experienced in financial markets directly after the subprime mortgage crisis began in 2008. The data was collected from Bloomberg, the World Bank, and the International Monetary Fund. Once the data has been collected, I will run three separate ordinary least squared regressions for each respective economic region, the United States, European Union, and Japan, to determine the relationship between the dependent and independent variables.

Chapter Four: Findings

United States

Table 1: U.S. Regression Results

Variable	Observations	P-Value	Lower 95%	Upper 95%
Interest Rate	91	0.7519	-1.815	1.315
Shadow Rate	91	0.973	-0.1024	0.106
Unemployment	91	0.1417	-0.058	0.401
LFP	91	0.4121	-0.262	0.632
SPY	91	0.1315	-0.003	0.024
TLT	91	0.6149	-0.011	0.019

The regression results for the economic data collected from the United States show that the alphas are not statistically significant from zero at the 0.05 confidence level using a p-value test for significance, therefore not allowing me to reject the null hypothesis that there is no relationship between the independent variables and GDP growth. The p-values for the alphas are: 0.7519, 0.973, 0.1417, 0.4121, 0.1315, and 0.6149 for the interest rate, shadow rate, unemployment, labor force participation, stock market performance, and bond market performance, respectively. The adjusted R-squared for the model is -0.038, meaning it explains little to no variation in GDP during the time period. I suspect this could be a result of the volatility in American financial markets and asset price distortions caused by the financial crisis and subsequent economic stimulus. Additionally, many other factors that contribute to GDP growth that were not included in the model, such as political and psychological factors, which are difficult to capture in an empirical model. The coefficients from the analysis resulted in the following regression equation:

Equation 1:

$$GDP = -14.85 - 0.25(I) + 0.002(SR) + 0.17(UE) + 0.19(LFP) + 0.01(SPY) + 0.004(TLT)$$

I=interest rate

SR=shadow rate

UE=unemployment rate

LFP=labor force participation rate

SPY=stock market performance

TLT=bond market performance

The data shows a negative relationship between GDP and interest rates, and a positive relationship between GDP and shadow rates, unemployment rate, labor force participation rate, stock market performance, and bond market performance.

European Union

Table 2: E.U. Regression Results

Variable	Observations	P-Value	Lower 95%	Upper 95%
Interest Rate	91	0.0618	-0.991	4.018
Shadow Rate	91	0.0132	0.571	2.271
Unemployment	91	1.03E-06	1.131	2.5
LFP	91	0.5137	-0.791	1.569
EZU	91	0.0036	-0.247	-0.01
IEGL	91	0.0038	0.017	0.084

The p-values for the alphas for the variables shadow rate, unemployment rate, stock market performance, and bond market performance for the data representing the European Union show to be statistically significant from zero at the 0.05 confidence level. This allows me to reject the null that hypothesis which states these variables have no relationship with GDP growth. The p-values for the alphas are: 0.0618, 0.0132, 1.0322E-06, 0.5137, 0.0336, and 0.0038, for the interest rate, shadow rate, unemployment rate, labor force participation rate, stock market performance, and bond market performance, respectively. The adjusted R-squared for the model is 0.357, so the model is a relatively good fit; the independent variables capture some of

the variation in GDP during the time period observed. The coefficients from the analysis result in the following regression equation:

Equation 2:

$$GDP = -54.22 + 1.96(I) + 1.42(SR) + 1.82(UE) + 0.39(LFP) - 0.13(EZU) + 0.05(IEGL)$$

I=interest rate

SR=shadow rate

UE=unemployment rate

LFP=labor force participation rate

EZU=stock market performance

IEGL=bond market performance

The data shows a positive relationship between GDP growth and interest rates, shadow rates, unemployment rate, labor force participation rate, and bond market performance. A negative relationship is displayed between GDP growth and stock market performance.

Japan

Table 3: Japan Regression Results

Variable	Observations	P-Value	Lower 95%	Upper 95%
Interest Rate	91	0.729	-16.687	23.759
Shadow Rate	91	0.3534	-0.635	0.229
Unemployment	91	1.88E-05	1.883	4.821
LFP	91	0.005	-1.866	-0.346
EWJ	91	0.145	-0.112	0.75
VANJGBY	91	0.005	0.0008	0.0042

At the 0.05 confidence level, the p-values for the alphas for the variables unemployment, labor force participation, and bond market performance show to be statistically significant from zero using a p-value test. This allows me to reject the null hypothesis that there is no relationship between these variables and GDP growth. The p-values for the alphas are: 0.7289, 0.3534, 1.8787E-05, 0.0049, 0.1448, and 0.0050 for the interest rate, shadow rate, unemployment rate,

labor force participation rate, stock market performance, and bond market performance. The adjusted R-squared for the model is 0.2980, showing the model is a moderately good fit, capturing some of the variation in GDP growth. The coefficients from the analysis result in the following regression equation:

Equation 3:

$$GDP=10.61+3.54(I)-0.20(SR) +3.53(UE)-1.11(LFP)+032(EWJ)+0.002(VANJGBY)$$

I=interest rate

SR=shadow rate

UE=unemployment rate

LFP=labor force participation rate

EWJ=stock market performance

VANJGBY=bond market performance

The regression equation shows a positive relationship between GDP growth and interest rates, unemployment rate, stock market performance, and bond market performance. A negative relationship is displayed between GDP growth, the shadow rate, and the labor force participation rate.

Chapter Five: Conclusions

The purpose of this research was to determine whether monetary stimulus was effective in a zero lower bound environment. Overall, the financial and labor market distortions and variations in asset prices and interest rates over the observed time period caused by the crisis and subsequent economic stimulus makes it difficult to draw solid conclusions from the data collected. Additionally, there are many more variables that affect economic growth that were not included in the study that could affect the results and fit of the models constructed.

The theoretical framework behind my research relies on past studies on the relationship between interest rate and economic growth, the use of shadow rates as a metric of monetary policy effectiveness in a zero lower bound environment, as well as empirical studies on the effect of easy monetary policy boosting aggregate demand.

According to my results, there is no statistically significant relationship between interest rates and economic growth. Two out of my three models showed a positive relationship between GDP and the interest rate. My model also showed that the most statistically significant factors that affect GDP growth are unemployment and bond market performance. I was able to reject the null hypothesis for these variables in two out of the three models. Both variables had a positive relationship with growth.

In conclusion, Quantitative Easing was successful in lessening the severity of the economic recession, however the prolonged easy policy implemented since 2008 has not been as efficient in stimulating the economy. At the zero lower bound, economic stimulus is not as effective as during times of conventional easing. Further research is warranted into the use of the unconventional monetary policy tools and their effect on the economy.

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