Spring 5-15-2022

The Effect of Quantitative Easing on the U.S. Stock Market and Wealth Inequality

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Senior Honors Project

Submitted in partial fulfillment of the graduation requirements of the Westover Honors College

Westover Honors College

May, 2022

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Abstract

My thesis will investigate and attempt to find a causal relationship between Quantitative Easing (QE) and the U.S. stock market since 2003. The secondary effects will then be explored to see if stock prices impact wealth inequality. To find the causal relationship between the QE and the stock market, a regression model will be used. It predicts the magnitude of effects of QE and other variables that may impact stock prices. Since 2007-2009, the Federal Reserve has used QE as a means to spur economic growth. This expansionary monetary policy has impacted many financial markets, including the U.S. stock market. Finding the extent to which QE impacts the stock market may have implications for further trickle-down effects throughout the economy, and detailing the effects on wealth inequality is the ultimate goal of this paper. After the effects are quantified, it may lead to the Federal Reserve needing to adapt its policy, develop other methods to stimulate the economy, or continue to directly purchase financial assets.

I. Introduction

Since the Great Recession of the late 2000s, the Federal Reserve has used unconventional monetary policy tools to stabilize markets. The Federal Reserve, the acting central bank for the United States, is the lead regulator for financial institutions and has a dual mandate of stable unemployment and inflation. Historically, the Federal Reserve has intervened using the Federal Funds Rate, which is an overnight rate that other banks and financial institutions lend to one another. In times of distress, the Federal Reserve typically lowers rates to zero or close to zero percent to spur the economy and lending.

During the 2007-2009 Great Recession, the Federal Reserve set interest rates to zero but this did not spur economic recovery. Thus, they started directly buying US Treasury Bonds as well as Mortgage-Backed Securities (MBS) to try and stimulate economic growth. For example, the Federal Reserve would buy a treasury bond from a commercial bank, such as JP Morgan Chase or Bank of America. This in turn increases the Federal Reserve's asset side of its balance sheet. However, the balance sheet equation requires assets and liabilities to be balanced out. The Federal Reserve would have to increase its liabilities, which include other commercial banks' reserves. When other banks have increased reserves but do not receive interest on this excess, they will lend it out to individuals or corporations to receive a higher interest. The direct purchase of bonds by the Federal Reserve can be referred to as Large Scale Asset Purchases (LSAPs), or more commonly as Quantitative Easing (QE). These direct market purchases have large impacts across different financial markets including the stock market. While the stock market took severe dips in the Great Recession and the COVID-19 recession, it quickly recovered for sustained growth and has averaged roughly 10% annual returns historically. This recovery was due in large part to government and Federal Reserve stimulus, with both stimulus

measures playing large roles in spurring economic growth. These effects reached not only markets and the economy, but also American households, with different subgroups owning different types and amounts of assets. Thus, it is important to research how much this QE has impacted stock prices and possibly increased their value. Additionally, if there is a correlation found, it may be useful to try and estimate stock performance had there been no QE.

In the last few decades, the issue of wealth inequality in the United States has grown substantially amid a rapidly fluctuating economy. On a micro-economic level, the United States is hurt by growing wealth inequality due to limits on general equality of opportunity and overall standards of living. On a macroeconomic level, data shows that it slows economic growth (Ingraham, 2018). Wealth is usually measured by the value and type of assets that households hold. Other than the physical household itself, other assets include bonds, certificates of deposits, and stocks. While income is included in overall wealth, wealth inequality differs from income inequality due to "income" being focused on compensation from a service or job. Many financial markets, but particularly the stock market, may provide benefits to some individuals more than others. Fiscal stimulus, as well as a monetary stimulus, played large roles in spurring economic growth and helped bring the U.S. out of recessions. However, both stimulus measures may have had adverse effects on measurements such as wealth inequality. While QE did stimulate the economy, this paper will focus on how Quantitative Easing stimulated the US stock market and also worsened wealth inequality.

This paper will attempt to determine if there is a relationship between QE and wealth inequality. The paper will look to find a relationship by presenting QE and stock market data, running a regression, and providing a qualitative analysis of wealth in the United States. While there is limited literature on this topic due to its novelty in relation to history, there are plenty of

primary sources on the subject. In addition to primary sources, many secondary sources that are not listed in this paper such as the *Wall Street Journal* suggest QE has an impact on stocks and wealth inequality. Regression is a common tool to try and find causal relationships between one or more variables, such as QE and wealth inequality. The data used for the regression will be described and there will be a prediction for how the model will look based on the previous literature, as well as financial and economic principles. The regression will be run using Microsoft Excel. Lastly, the qualitative analysis will take the regression outputs and apply them to the Federal Reserve's website data on American household wealth. This will answer the secondary question of the paper regarding whether QE may or may not affect wealth inequality. The research is significant given the potential effects of QE on financial markets, as well as its subsequent trickle-down effects on other economic measurements. Wealth inequality can lead to a range of issues for a country, such as less economic growth, higher crime, worse health, etc. Therefore, it is important to research whether or not the Federal Reserve is increasing the wealth gap inadvertently. If this is the case, they may need to change policies or find other tools to use to spur economic growth in times of recession.

II. Literature Review

Many economists agree that QE does lead to higher asset prices in financial markets, including the stock market. During recessions, including the Great Recession, the Federal Reserve can stabilize financial markets with the purchase of financial assets in the open market. This includes U.S. Treasuries and Mortgage-Backed Securities (MBS), and these purchases provide excess liquidity to banks because their reserves increase along with their balance sheet. Banks can then lend this out cheaply due to depressed interest rates set by the Federal Reserve

and the Fed's large purchases of bonds[1] (Mahajan, 2015). Mahajan explains that when all other forms of monetary policy have been exhausted, particularly after interest rates hit zero, then QE must occur to stimulate the economy. Without it, the economy would stagnate and experience a weaker recovery. However, Mahajan concedes that the timing of tapering QE, as well as having a correct and strong plan, is crucial to avoiding adverse effects such as inflation or slowing economic growth.

Many of the aforementioned papers looked at broader effects of QE including wealth inequality. Wealth inequality has been a growing problem in the United States for many decades and has accelerated even further since the turn of the century. While Ingraham (2018) states that wealth inequality can increase Gross Domestic Product[2], or "GDP", in less developed countries, Ingraham found that developed countries including the US do not see this economic growth. The Organization for Economic Co-operation and Development reports that roughly 5% of GDP per capita[3] growth was not realized due to wealth inequality between 1990 and 2010 (Ingraham, 2018). Ingraham continues, stating that wealth inequality hampers social mobility by decreasing education and skill attainment opportunities for lower-class families. From 2001 until 2016, median upper-income wealth increased by 33%, while middle-income wealth shrank by 20% and lower-income by 45% (Horowitz, et al. 2020). These statistics are relevant and in need of exploration due to the fact that Quantitative Easing also started during this period. In general, however, this overall increase in money available and subsequent investment in the US economy will spur GDP growth (Panyasombat, 2012). This increase in money supply is one of the overall

[1] Bond prices have an inverse relationship with interest rates due to supply and demand/incentivization. Bond prices will increase with more demand, but bonds with higher yields (thus higher returns) will be demanded more heavily. Yields include a calculation based off the price, and since demand is increasing and subsequently the price, then the overall return will decrease because there is less return/capital appreciation.

[2] Gross Domestic Product – the total sum of a country's goods and services for a given year

[3] GDP per capita – takes the Gross Domestic Product and divides it by the total number of citizens in the specified country

goals of monetary policy in hopes of spurring economic growth in times of recessions (Lima, et. al, 2016). There are different measures of money in the economy, but there are three main ones in the U.S. First is the M1 money supply which includes cash and demand deposits, while the M2 is M1 plus savings accounts and deposits. The M3 money supply equates to M2 plus deposits of institutional money funds, large term deposit rates, overnight agreements, and eurodollars (Lima et. al, 2016). Using an autoregressive distributed lag and least-squares model, Lima finds that the M3 had the strongest correlation with stock market returns and QE. Using a vector autoregressive model, Huston and Spencer (2016) found that QE had a large impact on equity market pricing and overall consumption and investment.

Al-Jassar and Moosa (2019) measure the impact of QE on the stock market using a time-series approach. In their regression model, the paper states that there is indeed a relationship between QE, more specifically the size of the Federal Reserve's balance sheet, with increasing stock prices. However, the issue is that the data is not entirely conclusive. There are many suggestions that argue variables outside of QE still play a large role in affecting stock market prices. Specifically, secular trends, business cycle rotations, and political news still had large impacts on returns. The work of Chandrasekhar et. al (2018) also supports this, suggesting factors like QE and manipulation of unemployment numbers led to large speculation and asset bubbles. Chandrasekhar et. al (2018) write, "Financial institutions burdened with liquidity were willing to lend, to avoid being penalized with low-interest rates on deposits with the central bank. The recovery was also facilitated by the return of borrowers to the debt market, encouraged by the boom in equity and real estate markets" (p. 414). The "return of borrowers" and "burdened with liquidity" suggested that financial institutions were more willing to lend to citizens due to excess money to lend as well. Additionally, more companies and households were

willing to borrow because they could do so at a low rate. Those who had access to the market see abnormal historic returns but also heightened valuations. Measured by the Shiller P/E[4] ratio, the stock market had the highest valuation since the dot-com bubble of the early 2000s.

Chung (2017) continues and suggests that banks can invest this excess liquidity in the stock market themselves, injecting money into the economy and overall money supply. Additionally, with low rates of lending, these banks will provide cash, particularly to wealthier households, who in turn will invest in more volatile assets like the equity market because assets like certificates of deposits and savings accounts provide minimal returns. This will continue to increase equity market prices and other financial assets because households need to obtain an adequate return in their portfolios. Bivens (2016) suggests that these actions will increase wealth inequality, as wealthier, upper-class households hold stocks and bonds disproportionately more than lower and middle-income families.

The largest argument that QE does not increase wealth inequality is that QE's effect on other economic measures re-balances wealth. In particular, the Federal Reserve focuses on QE's impact on unemployment and housing prices since these two are important assets for the lower and middle wealth classes. If unemployment is low and lower wealth classes receive more overall income, then it will counterbalance the rate at which stock market prices are increasing. Similarly, if housing prices are increasing, then the middle class and lower class wealth will also increase as homes are a large portion of the middle-class wealth. Thus, these increases may balance out the effects of increasing equity prices, in which case the wealth gap is not widened. Bivens's research involved comparing different types of stimulus policies on financial asset

[4] P/E represents the current price of an asset divided by its overall earnings, which is usually Net Income divided by shares outstanding. In this instance, Kenton (2021) suggests that the Shiller P/E ratio measures a broad stock index and its earnings over a 10 year period. It is adjusted for inflation, and can suggest whether markets are overvalued or undervalued.

prices, such as legislation and QE, as well as looking at the effects with no stimulus. He writes, "...housing is a much larger share of assets for the middle-class than it is for wealthier households... Boosting house prices reduces inequality because home equity represents such a large share of middle-class wealth..." (Bivens, 2016, p. 1). He concluded that while fiscal policies were better for lessening wealth inequality, monetary policy did not worsen it (Bivens, 2016).

Watkins (2014) finds similar conclusions in his paper looking at QE and its trickle-down effects. While Watkins describes that QE incentivizes banks to lend and asset prices to increase, he states that QE has even more indirect effects on the broader economy. QE should be impacting the broader economy through three streams of income. Firstly, rising asset prices will have two somewhat adverse effects. Certain capital gains will need to be taken and thus be re-invested into the economy. On the other hand, expectations of continually rising asset prices will increase investment, and to amplify gains, investors will borrow and invest. Thirdly, unrelated to asset prices and similar to Bivens's (2016) claim, the ability to refinance with lower rates is available to borrowers. Their excess profits, from decreasing outflows and excess cash, can then be reinvested into the economy. The issue becomes, particularly for lower-income households, that this excess money has to be directly consumable or lead to increased business hiring. Since QE does not increase income and the less wealthy do not have access/exposure to QE's effect on financial markets, they do not benefit further from increasing wealth inequality (Watkins, 2014) The data indicates that unemployment grew slower than asset prices, suggesting these effects are dis-equalizing.

Montecino's paper finds that QE does indeed increase equity prices, but also has positive or "equalizing" effects on employment growth and housing prices. The paper suggests that to fix

any problems stemming from QE, more direct monetary policies would be required. However, Monetcino also proposes that fiscal policy is more likely to address the problem due to its more direct effects. He believes that a fiscal policy with specific aid to labor, tax, and wage can reduce problems stemming from QE. Joyce et. al (2012) states that asset purchasing by the central bank declines risk premia[5], and allows households to boost wealth and consumption. Within Joyce's paper, some economists suggest that QE has only short-term impacts on the stock market and that effects die out over time. Joyce continues and suggests that QE impacts GDP and inflation through trickle-down effects on the economy.

Meegan and Corbet explain that QE has a large spillover effect and creates market contagion. Market contagion is the idea that when economies increase or decrease, there will be effects on other economies around the world. This would apply to QE in that if it stimulates the U.S. economy, it may also impact other countries' markets. The idea of market contagion also supports the efficient market hypothesis, which believes that the market is always priced with all information available. However, Meegan and Corbet found that there was no substantial contagion, and of the 62 markets they studied only 44 percent had some contagion (2018).

A goal of QE is to provide additional stimulus in times of distress, thus creating secondary effects. Romero (2016) discusses how famous economist Milton Friedman would view the current Federal Reserve's policy. Romero suggests that Friedman wanted QE for monetary effects instead of portfolio balancing or interest rate changes. Furthermore, Romero does not believe that New Classical or New Keynesian economists would support QE (2016). He believes that the QE cannot withstand in the long run because interest rates will revert back to low or negative levels. Furthermore, the relative monetary base becomes too volatile and even harder to deal with in future recessions (Romero, 2016).

[5] Risk premia – The rate of return expected over the risk free investment rate, usually measured by treasury yield

Many members of the Federal Open Market Committee, or FOMC, have been asked about the effect of QE on wealth inequality. When James Bullard, president of the St. Louis Federal Reserve, was asked, he suggested that wealth inequality is the largest problem of three inequalities: wealth, income, and consumption. However, while Bullard does believe that QE affects equity prices, he disagreed with the idea that it exacerbates wealth inequality (Bullard & McClough, 2014). Bullard believes that the wealthier individuals are older and at some point will pass on their large wealth in equities to their families. Thus, younger family members who are less wealthy will become wealthier as generations pass. Bullard added that when QE first started, equities were historically undervalued, and reached standard values when he spoke (2014). If Bullard speaks for the Federal Reserve, then the implications and beliefs on policy are that QE does not extend wealth inequality.

Birdsong supports claims from Ingraham on the effects of wealth inequality on a nation in that long-term growth is hurt, poverty levels increase, government policies are weakened, and the wealthy gain more political power, increasing political instability (2015). Long-term growth is hurt because lower-class and middle-class citizens will lose belief in the broader economic system and thus put less investment or work into the economy. On a government scale, because inequality increases lower class citizens will not believe in the programs as there is “no way out”. This is also in large part due to the wealthy having more money and thus being able to influence politics. With no strong belief in government, health care programs erode, causing another issue in the general health of the economy (Birdsong, 2015).

Scheffler also suggests that wealth inequality exacerbates instability in health care, education, and politics. He adds that wealth inequality also lessens social mobility and can lead to philosophical effects. Due to inequalities, the wealthy class can alienate themselves, believing

that they deserve this wealth through hard work and should not have to distribute it out. The lower class will feel there is no way out because the wealthy are in control and programs are not useful because they come from the wealthy (Scheffler, 2020). Over time, these attitudes can erode society and government. Scheffler writes that it can turn "democracy into a plutocracy" and an "economic caste system" is created (2020).

This paper will vary from the literature discussed based on more relevant data and research. Literature and research are limited on Quantitative Easing due to it being relatively "new" in the context of economic history. There was a large focus on it coming out of the Great Recession due to its unconventionality, however, less research was written in the late 2010s. Research on the topic will likely pick up again due to the increase of QE due to the COVID-19 recession, as well as the ability to see long-term effects of QE start to appear. This paper includes research published in the late 2010s and early 2020s that many other papers did not include, as these papers were written in the early 2010s. Additionally, only one or two reviews used a time-series approach, while other previous literature used various other statistical and qualitative approaches.

III. Description of Data

The dependent variable for the regression to measure the U.S. stock market was an Exchange-Traded Fund with the ticker "SPY". It mirrors the S&P 500 index which over the past few decades has been considered the most inclusive and best measure of the U.S. stock market. While in the past few years the weightings have been a bit misconstrued, over the data period chosen it was the best index to use and measure U.S. stock market performance. The data was collected from the Bloomberg Terminal, a financial platform that is used across the world and

tracks market and data in almost every financial market. The terminal's wide and uniform use makes it a great source of data for financial information.

To effectively measure the Quantitative Easing policy enacted by the Federal Reserve, the Federal Reserve's balance sheet size was used. The balance sheet includes the total assets and liabilities the Federal Reserve purchased in its QE programs as well as other open market operations. The data for QE was taken from the Federal Reserve Bank of St. Louis or "FRED". The FRED database contains large amounts of economic and financial data and is run by the St. Louis Federal Reserve regional bank. The Quantitative Easing values were in billions to provide a better coefficient. Other independent variable data taken from FRED are the Bond Index (LBUSTRUU), the M3 Money supply, CBOE Volatility Index (VIX), the 10-Year U.S. Treasury Yield, and Personal Consumption Expenditures or PCE. Of these three, the VIX is the only one that may have been taken from the Bloomberg Terminal instead. Otherwise, the macroeconomic data makes more sense coming from the Federal Reserve. Since the Federal Reserve is the central bank implementing policies, they have to measure the very effects of its monetary actions. Additionally, they are an independent government agency and have kept their data/database up for years. For each variable, monthly data was taken and analyzed.

The bond index chosen was LBUSTRUU, which was taken from the Bloomberg Terminal and was the only independent variable not coming from FRED. This index was chosen due to its inclusivity of different types of bonds including Treasuries, mortgage-backed securities (MBS), corporates, asset-backed securities (ABS), and commercial mortgage-backed securities (CMBS). In trying to measure performance between the stock market and bonds, having a general bond index is better than measuring each individually. Separating each may have some beneficial factors in comparing different asset markets, but that also means more variables and

macroeconomic factors could affect the analysis. Month counts were used to adjust for time throughout the data. In turn, this helps adjust for seasonality through the regression and dataset. It was not interpreted nor discussed to see if there were any effects on the stock market.

The M3 money supply was chosen due to its inclusion of the M1 and M2 money supply. Additionally, Lima et. al, saw the strongest correlation in their research (2016). M3 also includes more information on large financial institutions and corporations, including the effects the Federal Reserve has in working with some of these institutions. The PCE was used to account for inflation throughout the data set. While the Consumer Price Index, or CPI, also measures inflation, the PCE is more effective and relevant as the Federal Reserve uses PCE as its measure of inflation. Inflation erodes overall returns but also explains some increases in prices over time. The VIX is a measurement of volatility and stability in the stock market based on options on the S&P 500. It is a large indicator used by many different investors to see the stock market and economic volatility during specific periods. The 10-Year Treasury yield was used to measure interest rates over time. This yield is often considered the risk-free rate and different lending rates are set based on the 10-year yield. Additionally, QE from the Federal Reserve involved directly buying 10-year Treasuries. This may suggest using both the bond index and the yield measurement as they may be too correlated.

IV. Model Development

The method of measuring the impact of QE on stock market prices is through a regression model. The expected equation before running the regression was as follows:

$$y_t\,(\text{SPY}) = b_0 + b_1\,(\text{QE}) + -b_2\,(\text{PCE}) + -b_3\,(\text{VIX}) + b_4\,(\text{10-Year})$$

The null hypothesis (h_0), states that the independent variables of QE, VIX, 10-year yield, PCE, and numbers of months have no impact on the performance of the U.S. stock market. The alternative hypothesis (h_a) would suggest that the independent variables have a significant effect on U.S. stock prices, or that they will increase the value of the U.S. stock market. However, the main focus and variable in question are QE. Previous literature and the prediction of this paper would conclude that QE (b_1) would have a positive sign for the coefficient in the equation. The effects of QE on interest rates and lending incentivize households and institutions to purchase equities instead of bonds. Thus, the larger the Federal Reserve balance sheet, decreasing interest rates, and more money in the system the stock market should benefit from QE.

The bond market would be expected to perform inversely to the U.S. stock market, suggesting a negative coefficient for b_4. As mentioned, with QE interest rates are moved lower. If interest rates are lower, there will be less demand for bonds as they provide fewer returns. QE directly purchasing bonds, in coordination with ultra-low rates, may keep bond prices stagnated and within a range over time. Thus, there may be less of a correlation to stock market performance. In times of financial distress, bonds, particularly Treasuries, are safer assets with less risk. When the economy is forecasted to stagnate or go into a recession, many will move riskier assets or cash into bonds to protect from the recession, leading to bond price rallies. While the data set may account for some of these market moves, there may be some evidence for a positive correlation, or a small inverse relationship depending on the economic cycle of the US. The general assumption is that when rates are lower, which the US has seen over the last few decades, then the stock market is more desirable for returns and will perform better.

The VIX is predicted to move inversely to U.S. stock prices and thus the corresponding coefficient in the model, b_3, is predicted to be negative. In times of financial stability, or when

the VIX is lower, then the U.S. stock market should perform better. When the economy is performing well, companies will experience stronger earnings and bottom lines, which will drive up company stock prices. Additionally, in times of less uncertainty, expectations can be priced into the market and there is less concern about future stock prices. In times of financial distress and volatility, investors may sell off or hold cash until volatility decreases. The uncertainty of how long it will take the market to recover as well as any other factors for a given recession may hold back stock returns. The last variable and coefficient, PCE (b_2), is also expected to increase with the U.S. stock market as the U.S. has seen stable and low inflation since the late 1980s. There would be a positive correlation then between inflation and total stock market returns. While inflation is technically eroding the overall returns, inflation will increase in "value" to the overall stock market over time.

V. Methodology

For the model, the ordinary least squares, or OLS, regression analysis was used. An OLS model is a linear regression model used to estimate the correlation between different variables. This regression tests if changes in independent variables cause a change in a dependent variable. The regression was done using a 95% confidence level, requiring P-Values of .05 or less to reject the null hypothesis. Multicollinearity and serial correlation were tested in this model. Multicollinearity is the correlation between independent variables. If the independent variables are highly correlated, then the significance of each is sucked away because they are correlated. This can be measured with the excel function "CORREL". Serial correlation is a common issue in all time-series data such as this. It can cause the coefficients for the independent variables to be skewed, indicating there may be a bias for sign or amount. When high, then the hypotheses cannot be tested or answered significantly. The Durbin-Watson test using residuals and residual

lags was used to test serial correlation. The Durbin Watson tests provide lower and upper bounds for set parameters in the regression. Depending on where the test statistic lies suggests whether or not there was a serial correlation. Additionally, since QE significantly increased during the financial crisis, the data set is divided roughly into two periods, a pre-Great Recession period and a post-Great Recession period. While there is some data before the Great Recession, the focus of this paper is on the post-Great Recession period. Many areas will likely see overlap, such as the Months category with PCE. Because both are assumed to be increasing over time, they should correlate in movement. It should still be used however because it plays a role in equity prices as mentioned previously.

Using OLS, this model attempts to predict the following independent variables' effect on the U.S. stock market: Quantitative Easing, Inflation (PCE), VIX, and the 10-Year Yield. The bond index and M3 money supply were removed due to their high serial correlation and multicollinearity values. This was due to their high amounts of multicollinearity, effects on serial correlation, and the overall effectiveness of the model. LBUSTRUU had high amounts of correlation with the 10-year yield and in the end, the 10-year yield represents the state of the bond market in this paper. The M3 money supply high values also affected its coefficient numbers. Its inclusion of more detailed money in financial institutions also may present overlaps with other variables chosen. To try and improve the overall results, the regression was run without these two variables. While there was an additional independent variable counting the number of months in the data set, it is not interpreted as it was used to help control for serial correlation. All data is on a monthly basis and starts in 2003 and stops in the 9th month of 2021. The data is then split based on the period before and after 2007. This is due to the nature of Quantitative Easing hitting unprecedented levels during and following the great recession. While

there was some asset purchasing in previous years, the extent the Federal Reserve did post-2007 is substantial.

VI. Results

Table 1

SUMMARY OUTPUT -- Post Financial Crisis								
Regression Statistics								
Multiple R	0.98804482							
R Square	0.97623256							
Adjusted R Square	0.97544556							
Standard Error	13.4420913							
Observations	157							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	5	1120679.59	224135.918	1240.44575	1.189E-120			
Residual	151	27284.1626	180.689819					
Total	156	1147963.75						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-389.45944	31.9800369	-12.178205	3.366E-24	-452.64556	-326.27332	-452.64556	-326.27332
QE	0.02051947	0.00153197	13.3941976	1.8483E-27	0.01749261	0.02354633	0.01749261	0.02354633
PCE	0.04189213	0.00353272	11.8583232	2.4333E-23	0.03491219	0.04887208	0.03491219	0.04887208
VIX	0.18813882	0.12334714	1.52527911	0.12928126	-0.0555703	0.43184797	-0.0555703	0.43184797
10-Year Yield	6.14066661	2.20413564	2.78597492	0.00602155	1.78573779	10.4955954	1.78573779	10.4955954
Months	-0.2022797	0.14748845	-1.3714951	0.17225521	-0.4936872	0.08912783	-0.4936872	0.08912783

Durbin Watson: 0.338 (1.123 lower bound, 1.639 upper bound)

Table 2

Multicollinearity -- Pre Financial Crisis				
	PCE	VIX	10 Year	Months
QE	0.99365366	-0.1186547	0.28824656	0.99167742
PCE		-0.0582508	0.27423674	0.99907311
VIX			-0.5872747	-0.3894781
10-Year Yield				0.76503582

Prior to the Financial Crisis in 2007, QE had a negative relationship with the stock market but the data failed to reject the null hypothesis because of a p-value of 0.593. With a coefficient of -0.076, there would have been a small inverse effect on stock prices had the p-value been significant. Similarly, the months and PCE variables failed to reject the null hypothesis with p-values greater than 0.05. The coefficients of these two variables, had they been significant, would've suggested an inverse effect on stock prices for PCE and a positive effect for months. For the VIX and PCE, each had p-values less than 0.05, with values of 0.001 and 0.015 respectively. This suggests the variables may reject the null hypothesis and the values are statistically significant. However, the 10-year yield likely has stronger effects with a coefficient of 5.811. This was against the overall prediction of the model and the relationship between variables. The equation presented above suggested that bond yields would move inversely to stock prices.

The multicollinearity table shows QE having high amounts of correlation with PCE (inflation) and the month's variables, with correlation values of 0.994 for QE and PCE and 0.992 for QE and months. Additionally, the months and PCE are closely correlated with values of 0.995. This is not surprising because the very idea of inflation is that time will erode purchasing power and a dollar today is worth more than a dollar tomorrow. The Durbin-Watson test for serial correlation had a value of 0.338. The lower bound for the test was 1.123 and the upper bound was 1.639. All test statistics below the lower bound suggest serial correlation in the model, implying that there was a significant serial correlation in the regression pre-financial crisis. The serial correlation suggests that there were timing issues not accounted for, which can affect interpretations of the model. With a score of 0.61, there is evidence suggesting a

significant serial correlation. This would be expected, as many of these variables have overlaps in the financial system and will move in tandem as time progresses.

When measuring the overall model and all variables, the adjusted R-squared value will measure the correlation between the variables. R-squared measures how well the data fit the model, or how much of it can be explained by the data. In the pre-Great Recession period, this value was 0.891. This suggests that the correlation between the stock market and chosen independent variables may be correlated for the period. Due to this period lacking the volume of QE post-2007, the data matters less for this paper. However, it was important to see how these variables impacted stock performance before QE to see if QE may have also altered the effects the other variables had on stock performance.

The second regression, post-Great Recession, is shown below:

Table 3

SUMMARY OUTPUT -- Pre Financial Crisis								
Regression Statistics								
Multiple R	0.948395645							
R Square	0.8994543							
Adjusted R Square	0.89121285							
Standard Error	5.735888563							
Observations	67							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	5	17953.40579	3590.681159	109.1378597	4.30835E-29			
Residual	61	2006.925474	32.9004176					
Total	66	19960.33127						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	162.0781487	178.6366625	0.907306185	0.367815294	-195.1279348	519.2842322	-195.1279348	519.2842322
QE	-0.076364279	0.142296661	-0.536655453	0.593457577	-0.360904039	0.20817548	-0.360904039	0.20817548
PCE	-0.003158147	0.026152741	-0.12075778	0.90427978	-0.055453785	0.049137491	-0.055453785	0.049137491
VIX	-0.654819045	0.196173439	-3.337959764	0.001442127	-1.04709208	-0.26254601	-1.04709208	-0.26254601
10-Year Yield	5.811349027	2.323275084	2.501360716	0.015071575	1.165673374	10.45702468	1.165673374	10.45702468
Months	1.112880434	0.987285798	1.127212036	0.264067402	-0.861319532	3.0870804	-0.861319532	3.0870804

Durbin Watson: 0.793 (1.172 lower bound, 1.638 upper bound)

Table 4

Multicollinearity -- Post Financial Crisis				
	PCE	VIX	10-Year Yield	Months
QE	0.82437439	-0.2080139	-0.7033691	0.86414223
PCE		-0.3389121	-0.5659411	0.97927406
VIX			0.05582452	-0.3276776
10-Year Yield				-0.6173934

Analyzing the regression post-financial crisis, the model may reject the null hypothesis for QE, with a p-value of $2.433x10^{23}$ being less than .05. This implies that QE does have an impact on the performance of the U.S. stock market. Additionally, its coefficient of 0.021 suggested a positive relationship between the two. This implies that for a 1 billion dollar increase in QE purchases, the stock price would increase by 0.021 dollars. Since the Federal Reserve was purchasing over 100 billion in bonds a month, this coefficient is rather large. This supports the prediction in the model as well as what the literature suggested on the topic. The bond market index, LBUSTRUU, and the M3 money supply were taken out for this regression as well, again due to high multicollinearity values and to help with serial correlation. Only two variables were not significant to stock market performance in the second regression, with only the months and VIX having p-values greater than 0.05. This leads to the suggestion that QE, the PCE, and the 10-Year yield are significant in impacting stock market prices. The effects of both the 10-Year yield and PCE are based on the coefficients of 6.141 and 0.042 respectively. This implies for a 1-point increase in the 10-year, the SPY would increase by 6.141 dollars, while a 1-point increase in PCE would increase the SPY price by 0.042 dollars. The PCE was predicted to have a positive relationship with the stock market, and its coefficients supported that claim. Interestingly, the 10-year yield, which was significant, had a positive coefficient with the stock

market. This may imply an inversion of previous thought, that increases in yields and rates lead to a decrease in stocks.

The overall model of the period post-Great Recession, with an adjusted R-square value of 0.975, indicates there is a strong correlation between the explanatory variables and the stock market. This suggests that QE, inflation, VIX, 10-year yield, and time explain a large proportion of stock market performance in the US. Additionally, other statistical overlaps may not have been accounted for within the regression analysis. Limited data sets before the financial crisis, as well as serial correlation and other overlaps in the data, may skew results.

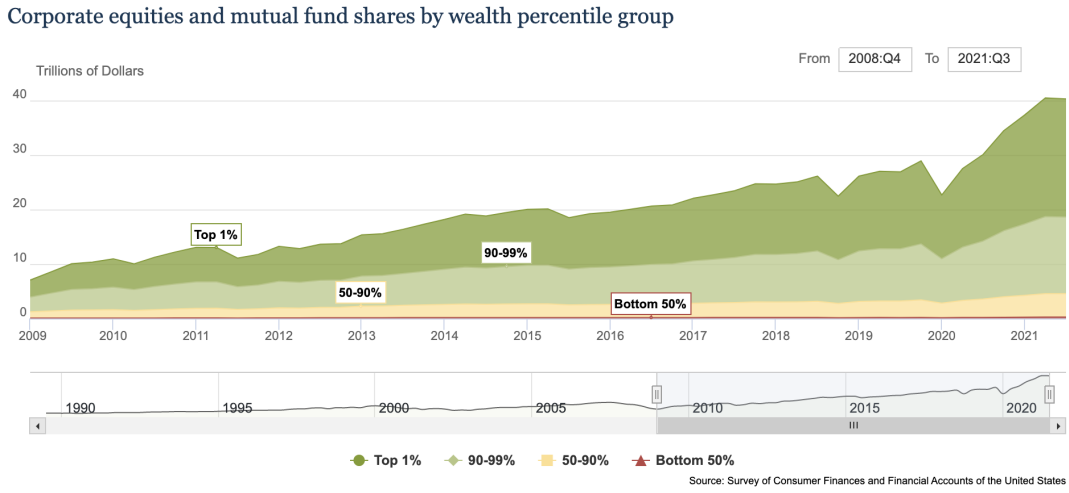
VII. Further Implications

The next step of analysis is to see how inflating stock prices might disproportionately benefit the wealthy, thus creating wealth inequality. This has been a large concern since the COVID-19 pandemic, as the stock market had returns well above the historical average of roughly 10%. The Federal Reserve's Distributional Financial Accounts (DFAs) report wealth distribution across the United States. They divide wealth into four groups, which are the top 1%, the next 9%, the next 40%, and the bottom 50%. The data also will show the dollar amount or the percentage of wealth each group owns. For instance, assume there is 1 trillion dollars worth of real estate in the United States. The top 1% may own 750 billion of that or 75%. The next 9% may have 100 billion, or 10%, the next 40 with 100 billion (10%), and the last 50% with 50 billion (5%). This paper will focus on corporate equities and mutual fund shares as that is the measurement closest to the stock market.

In the first year of data, 2003 quarter 1, the top 1% had 40.9% of the wealth in equities and mutual funds, the most of the four groups. By 2021, this number had grown to 53.8%. In dollar amounts, Americans in 2003 had 5.98 trillion dollars of wealth in the U.S. stock market

and 2.45 trillion of that belonged to the top 1%. By 2021 quarter 3, the dollar amounts were 21.64 trillion for the top 1% out of 40.23 trillion. Even visually, just looking at the years since COVID the top 1%'s wealth and concentration in stocks is alarming. The COVID-19 pandemic saw an increase that is visibly larger than the other groups previously mentioned, as seen in Chart 1 below. The chart represents wealth growth in equities and mutual funds as a group since the financial crisis.

Chart 1



To find how much of this increase was due to QE, the magnitude of increases needs to be found using the QE coefficient from the regression model. Based on the model, for every 1 billion dollars in QE purchases, the stock market or SPY ETF would increase by 0.021 dollars. Thus, from the post-financial crisis until the final data point, there was 7.385 trillion worth of assets purchased by the Federal Reserve. This was found by subtracting the first value of the post-financial crisis period, 906.234 billion, from the last value of the data set, 8,291.893 billion. Multiplied by the coefficient from the regression (0.021), these purchases led to $155.099 points being added to the SPY ETF. Over this period, the SPY ETF increased from 128.79 to 451.56. This represents an increase of 322.77, or 250.617%, which means that QE accounted for

48.052% of the increase according to the models (155.099/322.77). Since the top 1% and top 10% own disproportionately more wealth in stocks, they will benefit more than lower wealth classes who do not own as much wealth in stock.

With proportionately more wealthy households seeing faster growth, this increase in wealth inequality can lead to broader economic issues. Birdsong, citing Thorbecke and Charmulinid, states that wealth inequality could lead to a reduction of 0.5-0.8 percentage points in long-term GDP growth (2015, 2002). This stems from a longer domino effect of economics on other country measurements. When wealth inequality increases, fewer households hold more wealth, while a greater number of households simultaneously become less wealthy. Over time this can lead to higher population percentages in the lower class, thus increasing the number of households in poverty. Birdsong also writes that with higher poverty comes less education, worse overall health, and more crime (2015). Health is hurt due to the broader effects of poverty in that there is less access to necessary medicines or the means to support a healthy lifestyle. According to the American Psychological Association (APA), the U.S. struggles in overall health metrics more than other "wealthy" countries because of overall wealth inequality (2013).

Another issue resulting from large amounts of poverty and wealth inequality is the ineffectiveness of fiscal policy measures. The U.S. government has programs to help those in poverty such as food stamps. However, because of wealth inequality, lower-class citizens may not trust the programs or rebel against policies. This is often because those in political power are wealthy or affiliated with and supported by the wealthy (International Institute for Labour Studies, 2008). This can also contribute to less trust in the government and more retaliation against it, which can also raise crime (Birdsong, 2015). Higher poverty decreases economic growth and investment and increases crime in a country.

Aside from wealth inequality, Quantitative Easing's artificial inflation of financial market prices will also hurt the economy and households in the long run. At some point in the market and economic cycle, the "bubble" will burst and it will cause deep harm to the economy. Retirement accounts, 401ks, and pension plans will see decreases in value. Business and economic cycles are cycles for a reason, in that there will have to be turnover and companies that fail to move forward. If the Federal Reserve keeps artificially involving itself, then a moral hazard could be created where corporations and individuals believe there is less risk to invest because how the Federal Reserve will just print more money and save the day if things go wrong. The more this is done, the harder the drop will be when that time comes.

VIII. Policy Implications

This paper suggests that the Federal Reserve's QE stimulus is exacerbating wealth inequality in the United States by artificially increasing equity prices. When making future policy decisions regarding bond purchases, the Federal Reserve should thus take this into account or provide more information on equalizing effects. In terms of their current policy, the Federal Reserve could've bought at a lower overall volume or looked to other forms of monetary policy to help aid the economy. While it is not within the Federal Reserve's mandate to be directly involved in an issue like wealth inequality, the Federal Reserve could perhaps create new tools that help lower wealth households. This could include special lending programs through other financial institutions that indirectly aid lower-wealth households. However, many of the effects of wealth inequality as outlined by Birdsong and Ingraham are more directly impacted by fiscal policy, outside the dual mandate of unemployment and inflation for the Federal Reserve. It could be that the Federal Reserve believes that the current wealth inequality is sustainable and not detrimental to the overall economy, or that it will diminish over time. However, as the DFA

data shows, the gap has been growing since the first data points of this paper and likely before that. In 2003 quarter 1, the top 10% held 26.53 trillion in wealth, which represented 60% of the total U.S. wealth. In the last quarter of data, this number increased to 95.33 trillion, or 69%. At a minimum, the Federal Reserve should account for this growing problem as corporate equities and mutual fund ownership is a large cause of the issue.

Being more specific in its addressing of wealth inequality in congressional or federal reserve meetings could also provide more insight and help on the issue. If this is disclosed, then maybe more specific and counterbalancing effects of QE on housing prices and unemployment could be released to show that QE is not at the heart of wealth inequality. Such low rates may benefit the more wealthy because they will have an easier time borrowing than lower-wealth households. This is a product of Federal Reserve policy, but not of QE directly. It seems unlikely that housing prices and unemployment (thus wages) can counter-balance the immense increase in equity prices. Additionally, homes are less liquid than stock, and wages are more likely to be used for a household. It is unlikely there are high enough wages to see investment in the stock market. In general, the Federal Reserve could use tools such as its Federal Funds Rate, Repurchase Agreements, etc. to spur the economy in times of recession. The adverse and longer-term effects of QE are not worth the short-term stimulus it brings. The Federal Reserve could also create other tools, as evidenced by COVID-19 and the new loan facilities they created.

IX. Conclusion & Discussion

The null hypothesis that QE has no impact on stock market performance may be rejected for a post-recessionary period with p-values significant for QE. In the pre-recessionary period, the null hypothesis fails to be rejected based on the p-value. Financial markets were likely not impacted by QE before 2007 due to the lack of the Federal Reserve's use of the policy. This

conclusion supports the extensive literature and secondary sources that support the idea of QE impacting stock prices. With QE falsely-inflating equity prices, investors can become over-exposed to risky assets giving them a false sense of security. Additionally, in the event of a broader economic downturn in which the Federal Reserve's QE does not stimulate the economy, then the recession could be more severe. This can create broader economic problems including wealth inequality. Furthermore, wealth inequality has grown in the U.S. over major decades, particularly when it comes to ownership in the stock market/corporate equities. Because of QE's effects on the stock market, the Federal Reserve should perhaps change current policies to try and slow, hold, or reverse the growing trends in inequality.

Overall, the Federal Reserve should change policies to reduce the exacerbation of wealth inequality. This could be done by altering their QE policies and focusing on other tools such as interest rates or lending facilities. While QE may have increased housing prices as well, it seems unlikely it has balanced out the strong growth inequities. Even if it did, the wealthy also owns houses, in some cases multiple, in which case all classes would benefit and it wouldn't equalize the wealthier class's gain from stock market increases. Other monetary policies could be created to help with wealth inequality, but getting rid of the problem is perhaps a better solution than "solving" it. Additionally, the creation of these monetary policies likely steps outside of what the Federal Reserve's purpose is, in that it is not their function to affect wealth inequality directly. Thus it should focus on not creating problems, but rather than having to go back and fix them.

However, there are some issues within the model for this paper. There were high values of serial correlation and multicollinearity. As previously mentioned, this could suggest less significance in the data as well as altered coefficients. Furthermore, hypothesis testing is altered and may be biased, indicating that conclusions drawn from the data may be inaccurate. An

alternative to help this issue may have been choosing independent variables, for instance choosing a different yield to measure the bond market. However, QE's relative novelty as a monetary policy tool could hinder understanding of its full effects. The broader economic and social impacts will have to be reviewed when it becomes relatively more "historic" and the long-run effects can be accurately measured. To gain a grasp of the broader effects of QE, other economic indicators such as GDP, housing prices, and unemployment should be tested as dependent variables. The rate at which QE may impact those will give more insight into any offsetting/increasing effects of wealth inequality and the economy in general.

Further research on this topic should include more observations from the pre-financial crisis period, exploring other variables to measure, and QE's effects on other economic indicators. Additionally, a lag could be put in to see if the effects of QE take time to enter the market. Months may be too large a time period to accurately represent many of the variables, and these values are not fair representations of changes across time. While all serial correlation and multicollinearity cannot be adjusted for, these effects should continue to be accounted for. Serial correlation was very apparent in both periods and trying to account for this across different financial variables can be challenging. There is also a large human effect, in that many investors, citizens, and financial professionals can act "irrationally" or against statistical suggestions. From the qualitative side, discussing in-depth differences within wealth inequality, for instance between gender and race. Another area not explored is the passing of wealth from generation to generation. Assuming sound financial management, there may be a higher chance for families/individuals born into wealth to keep it. Sorting through the different types of wealth inequality might present more insight into the problem it creates and possible solutions.

To find other effects of QE, it may be more accurate to measure the effect of QE on consumption, investment rates, or specific bank lending, or look more directly at the effect of purchases of assets from commercial banks by the Federal Reserve. Additionally, adding more historic open market operations may provide some background or statistically relevant information. The overall model, in a post-recessionary period, was well explained by the variables chosen with an adjusted R-squared value of 0.975. More variables were found to be significant in a post-recessionary period, as well, with QE, PCE, and the 10-year yield statistically significant. Given the strong increase of QE due to the great recession, perhaps its inclusion has raised the importance of other variables in the stock market.

The effect of these variables on the stock market could be delved into further, perhaps looking at the after-effects of changes in the stock market. Other research could include looking at how QE may correlate with other economic factors. This could include measurements such as unemployment or GDP, which would give more insight into why theFederal Reserve enacts policies, and measure if their goals in stimulating the economy are achieved. If these two additions were added or focused on, then any information from this paper and the new research could be used for policy implications for the Federal Reserve. Understanding the full effects of QE allows the Federal Reserve to possibly re-allocate the types of assets bought, or use other tools to try and balance any adverse effects.

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