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The Federal Reserve's QE Practices Impact on Inflation: A Comparative Analysis of the GFC and Covid-Eras

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Abstract

This paper investigates and compares the effects of the Fed's quantitative easing policies on US inflation during the Global Financial Crisis and the Covid-era up to February of 2022. As inflation continues to rise, a quantitative measurement of the Fed's monetary policy response to recessions and its resulting effect on the price level is becoming increasingly relevant. Supporting the quantity monetary theory, I test the impact of the Fed's increasing their total assets and securities on their balance sheet on CPI and core CPI. Using multiple time series regressions and a single lag component on the analyzed variables. The model best fit the GFC-era data; however, the model saw greater impact of the predictor variables on CPI in the Covid-era data. The model showed that the lag variables were less significant. To determine statistically significant lead times and the quantitative effects of an increase of the money supply, a data set that contains the entire inflationary cycle associated with the Coronavirus pandemic must be used. Future models between an increase in the money supply and inflation are expected to yield greater significance.

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1. Introduction

From 2007 to 2009 the United States experienced the worst economic crisis in recent memory, the Great Recession. Subsequently the world felt the effects in the Global Financial Crisis (GFC) of 2009. When the US housing market bubble started to burst the value of Mortgage-Backed Securities (MBS) went into a free fall. Leduc (2008) summarizes that the derivative market of Collateralized Debt Obligations (CDOs) worth $400 billion had been insured with Credit Default Swaps (CDS) that were worth almost 20 times that amount. With the CDOs becoming increasingly less valuable and credit default swaps being cashed in, the banks holding these MBS ran into solvency issues. With the largest banks in the US being holders of a large quantity of these over insured and tanking securities, the “Too Big to Let Fail” doctrine was brought back into the political and financial conversation.

The Fed, stymied by the failings of conventional monetary policy tactics, took a new radical approach to combat the recession. Led by the 14th Chair of the Federal Reserve, Ben Bernanke, the Fed attempted quantitative easing (QE) or unconventional monetary policy (UMP) in the latter part of November 2008. Backed by the Modern Monetary Theory, the members of the Federal Reserve Board of Governors decided to purchase hundreds of billions of dollars’ worth of mortgage-backed securities. These policies of the Fed were known as the Troubled Asset Relief Program (TARP) and the Commercial Paper Funding Facility (CPFF). These policies increased the Fed’s treasury notes from $700

billion to over $2 trillion by June 2010. The second round of QE was closely followed by the Federal Reserve announcement that there would be another purchase of $600 billion in treasury securities and that this would be done by the end of June 2011. These purchases helped stabilize the economy and provided a much-needed boost in market confidence according to the International Monetary Fund (IMF).

Sims (2008) states that Ben Bernanke insisted that these measures that the Fed were undertaking, purchasing extremely risky assets should be done outside of their own balance sheet and should have explicit Congressional approval. However, even with the purchases that were not approved by Congress, as they did not need to be, have huge potential risk to the fiscal health of the United States economy.

The coronavirus pandemic is the next major economic crisis that the US is facing and with the success of QE during the great recession the Fed decided to pursue similar policy measures. For the past 20 years before the pandemic the money supply has increased by a little over 6% per year with the consumer price index increasing by an average of 2.2% per year. In 2020 alone the money supply increased by over 25% and inflation is on the rise. From December of 2020 to December of 2021 inflation rose by 6.9% according to US Bureau of Labor Statistics. With such increases in the money supply and inflation continuing to rise there is a worry that these unconventional monetary policies may have dramatic repercussions. Which begs the questions, what exactly is the impact of QE on inflation and how does the affect change in different economic crises? Considering

Irving Fisher (1911) and the quantity theory of money:

$$MV=PT \quad (1)$$

there is a direct relationship with money supply and prices. Therefore, an increase in the money supply would have a positive effect on the rate of inflation.

I aim to understand the impact that the Fed has on inflation in the long run by understanding the times that the Fed has undergone monumental increases in their balance sheet. In this paper I use existing literature to conduct a systematic review of the implications that the policies implemented by the Fed have on inflation and inflation dynamics during recessions and shocks. I condensed the relevant research into a streamlined summary of the available data to represent the current community understanding of the relationship at play.

I use regression model testing to analyze the relationship that Fed asset purchases have on inflation levels by creating a time series using monthly data on Consumer Price Index (CPI) and a controlled CPI, the Fed's balance sheet value of total assets as well as their security holdings. Two time periods' policies are analyzed. One being the GFC from 2007 to 2011 and the other being the Covid-era from December of 2019 to February of 2022. The results show that the model fits better within the GFC-era than the Covid-era due to problems with significance. Within the data there are also opposing effects in the different periods as well as the impact of the Fed's increase in total assets and their security purchases. Furthermore, I discuss how these results came to be and the limitations of the data

due to the methods used and time framing issues. I write about the implications for policy makers and financial markets and elaborate on how to enact further research on the subject and its importance.

2. Literature Review

This paper is a comparative analysis on quantitative easing's effect on inflation during the GFC and the Covid-era up to February 2022. First, I will assess the literature of the topic in a broad scope of the relationship between money supply and inflation. Then will defend the control variables chosen for their impact on inflation by assessing their strengths and weaknesses against the Fed's monetary policy impact. The foundational theory of this relationship is the quantity theory of money. With a change in the money supply a similar change to inflation will follow. This understanding is supported by studies done by Lucas (1986), Barro (1993), McCandless and Weber (1995) among others. However, the strength of the relationship between nominal changes in the quantity of money and their subsequent effect on inflation have not been agreed on. Brillembourg and Khan (1979) analyzed the relationship with data from 1870 to 1975 and found that impact varied throughout the period. Sims (1994) would go further to argue that monetary policy has little effect on the price level and has more to do with fiscal policy. Which is more in line with how the Fed previously operated when controlling for inflation by means of adjusting interest rates.

This is contradicted with Nelson (2008) by explaining that in the long run constant increases in the money supply will inevitably lead to increases in inflation. For the short-term effects inflation can largely be controlled by coordinating interest rates, however the consequence of nominal increases in the money supply will inevitably be seen in inflation. Lead times are difficult to measure as there is much deviation historically as pointed out by Brillembourg and Khan (1979). This conundrum is later analyzed within the scopes of inflation dynamics through financial shocks in Abbate, Eickmeier, and Prieto (2021).

Abbate et al. (2021) concludes that the "only modest disinflation" experienced by the US in the GFC was due to the decrease in demand and the contemporary financial shock. And according to Yue and Leung (2011) the QE that was implemented by the Fed between late 2008 and June of 2011 had no relationship between the inflation that was observed during that period. Yue and Leung used a paired t-test and ANOVA when analyzing the money supply (M2) and inflation (CPI^2) which yielded no significant result in the causality of inflation due to increasing the money supply. In fact, inflation dipped lower during QE than what it had been at the beginning of QE. Reasoning for this has not reached a conclusion within the literature however Yue and Leung (2011) speculate that this could be due to the decreasing trend of loans. While Abbate et al. (2021) would sympathize with that speculation, they assert that "they [and the community] remain fully agnostic about the effects of financial shocks on inflation dynamics".

Ball and Mazumder (2011) further stipulates that inflation did not fall as expected when using the Phillips curve to predict inflation over the time period of

the Great Recession. Furthermore, Ball and Mazumder (2011) discovered that expected inflation has been fully “shock-anchored” for decades and that “level anchoring” has been limited but significant. Therefore, while a key factor in real inflation dynamics, expected inflation anchors inflation in its predictions. Which helps control for large upticks in inflation during financial shocks such as the one in the GFC and the Covid-era. The Phillips curve in this study also has its own constraints as it does not factor in aggregate demand which has a bearing on inflation and unemployment independently.

The Covid-era inflation has seen a dramatic increase with the CPI increasing by 6 percent from February to November of 2021 with the number only increasing since. Studies are few and far between when analyzing inflation in relation to Fed’s quantitative easing due to the contemporary nature of this phenomenon. Which allows this paper to attempt to dig into the causal relationship myself.

The understanding I wish to acquire within this study is how the Fed’s grand actions in the short run may affect inflation in times of crisis. Sims (2008) addresses the US central bank’s balance sheet impact on inflation by spelling out the specific job, limitations, and oversight that the Fed has over the business cycle. The Fed’s objective is to maintain homeostasis and growth of the economy and provide the country with every measure it can to enable those. While inflation may be affected by a variety of factors I wish to control for as much as possible within the monetary policy scope.

3. Data

The investigative goal of this analysis is to better understand the effect that the Fed's policy of quantitative easing has on inflation. More specifically in the two-time frames of the Global Financial Crisis and during the ongoing coronavirus pandemic. Dewald (1998) states that inflation has been heavily linked to the quantity theory of money, the research process continues with determining the measure of impact that increasing the Fed's Balance Sheet has on inflation during large financial shocks and subsequent recessions. One being the determining factor for the unconventional monetary policies' inception and the other a contemporary reminder of the Fed's ongoing analysis of said theory. This paper uses countrywide data from the Great Recession and the Covid-19 era, up until February of 2022, to better interpret how the Fed's UMP practices affected inflation during the greatest financial crisis since the Great Depression and the next recession fourteen years later.

All the data that is used is provided by the FRED (Federal Reserve Economic Data) and the BLS (Bureau of Labor Statistics). More specifically from the Federal Reserve Bank of St. Louis and Federal Reserve Bank of Cleveland, which posts aggregate economic data from U.S. government credited economic sources in this consolidated site. Table 1 provides the variables used and their broad definitions.

Table 1. Variable Descriptions	
Base Variable	Definition
Inflation (CPI & Core CPI)	Monthly CPI and CPI less food and energy as measured by an index of an aggregate of prices paid by urban consumers, seasonally adjusted.
Fed's Total Assets	Monthly monetary value of total assets held in Fed's balance sheet.
Fed's Held Securities	Monthly monetary value of all securities held outright in Fed's balance sheet
M2 Money Supply	Monthly measure of the volume of money including M1 and highly liquid assets held by the public.
Expected Inflation	Monthly 10-year anticipated inflation by modeling with treasury yields, inflation swaps, and expectations of survey-based measures.
Federal Funds Rate	Monthly interest rates that depositing firms can trade federal funds.
Unemployment Rate	Monthly percentage of those unemployed in the labor force.

The object of this paper is to compare how QE has affected inflation during the Covid era up until February of 2022 and the GFC. This precipitates the need for two or more measures to be taken of the same base characteristics in two time periods to study the differences. Thus, the two measures require two tables of summary statistics.

Table 2 provides summary statistics of the monthly values for each variable less the lagged total assets and securities for the GFC period after modification, illustrated in Section 4. Lagged variables are excluded as with a single period lag the summarization of the data would be the same minus a single observation. The same will be observed for table 3.

Table 2. Summary Statistics of GFC-era Variables

	count	mean	sd	min	max
CCPI	50	218.4536	3.990251	210.392	225.218
CPI	50	216.0498	4.542154	207.234	225.395
M2	50	15.92337	.0677693	15.80072	16.03858
Exp	50	2.020321	.2735035	1.546064	2.67182
FFR	50	1.238362	1.729107	.0709677	5.258387
UR	50	7.852	2.038731	4.6	10
Total Assets	50	14.33598	.4480975	13.67398	14.87015
Securities	50	13.51022	.3275866	13.0704	14.30519

Table 3 provides summary statistics of the monthly values for each variable for the Covid period after modification, illustrated in Section 4.

Table 3. Summary Statistics of Covid-era Variables

	count	mean	sd	min	max
CCPI	27	273.3145	7.091562	265.606	287.878
CPI	27	266.0008	8.712021	255.944	284.182
M2	27	16.7626	.1083964	16.54855	16.89402
Exp	27	1.511119	.2026956	1.15835	1.902745
FFR	27	.2659259	.4790717	.05	1.58
UR	27	6.4	2.903711	3.5	14.7
Total Assets	27	15.76835	.231747	15.23038	16.00129
Securities	27	15.29308	.2732163	14.64533	15.56211

4. Empirical Analysis

I run a time series regression to test the relationship between QE and inflation with both the GFC data set and the Covid era data set with the model:

$$Y(t) = B_0 + B_1X_1(t) + B_2X_2(t) + B_3Z(t) + e(t) \quad (2)$$

Where Y is two different measures of CPI(CPI and CPI less food and energy), 1 is natural log of the total assets of the Fed balance sheet, 2 is the natural log of the value of securities on the Fed balance sheet and Z are the control variables being: the natural log of the M2 money supply, expected inflation, federal funds rate and the unemployment rate. Taking the natural log of the variables money supply, total assets and securities converts the variables from a unit set in terms of dollars to percentage change when reviewing the results. This also creates better behaved distribution and helps rein in outliers in the data set.

To effectively understand the specific effect of UMP's direct impact on inflation control variables needs to be within the regression as multiple factors affect inflation dynamics as Ball and Mazumder (2011) assert. As per the quantity monetary theory seen in Equation 1, an increase in the money supply should have a direct and somewhat proportional effect on inflation. Unemployment has an inverse relationship with inflation as seen in the Phillips curve outlined in Ball and Mazumder (2011). Interest rates also have a causal effect on inflation as well as expected inflation which is portrayed by the federal funds rate and the 10-year

expected inflation respectively in this study. Thus, including them in the regression helps control their effects on the underlying topic for analysis.

To maximize the number of observations in this study all data is collected with monthly data points. Per the Federal Reserve History: The Great Recession (2013), the GFC started in December 2007 and ended in June 2009. Allowing for precipitating economic data, I collected data starting from June 2007 to July 2011 which is when the QE efforts to subvert the negative financial effects GFC ended. The Covid pandemic is widely considered to have started in the early months of 2020, to account for any preliminary findings of the virus that could have affected the financial status of the economy, I elected to collect the data starting from December 2019 to February of 2022.

I run a time series regression to test the effect between QE and inflation a time period later with both the GFC data set and the Covid era data set with the model:

$$Y(t) = B_0 + B\,\Phi_1 X_1(t-1) + B_2\,\Phi X_2(t-1) + B_3 Z(t) + e(t) \qquad (3)$$

In this secondary regression I replaced the natural logged variables of total assets and securities with a lagged version of them both. This along with the standard controls outlined previously, creates an interpretative result of the effect that each of those modified variables have on CPI the following period, in this case 1 month. It is understood that increasing the money supply will increase inflation however in this model I attempt to understand the relationship between the cause and effect along with the time frame presented. All else remaining the same, the

output should reflect inflation's reaction from purchasing by the Fed the month previous.

5. Results

Table 4 in the left column shows the regression output for Equation 2 using the GFC data set complete with the 50 observations, monthly, from June 2007 to July 2011. I used a time series regression to make each month a data point individual from all others. As seen, the natural log of total assets shows that for every percentage increase of total assets in the Fed's balance sheet there is a decrease of 2.21 units of the core Consumer Price Index. Converse to what is commonly accepted about how the money supply impacts inflation per the quantity theory of money. As a positive correlation would fit more closely to what is accepted throughout the literature on the subject. With a p-value of .002 this appears to be highly significant which corroborates with previous findings and community understanding of the Fed's balance sheet in relation to the CPI less food and energy. The log of securities held outright by the Fed has an even more significance with a p-value of .001 and a positive correlation of every 1% increase in securities there is a change of 2.82 units in the inflation index. With a R-squared value of .98 the data accounts for a large percentage of the core CPI change.

The right column of table 4 shows a similar regression output to left with the same data inputs but replacing the logged total assets and securities with a lag of the same thus using Equation 4. The Total Assets on the right side illustrates the

lag on total assets has a coefficient of -2.94 which is greater than the non-lagged estimate showing a larger effect on inflation the month succeeding than in the same month. A p-value of 0.000 is perfectly significant which indicates there may be an error in the data as that level of mirroring is seldom seen. Likely caused by insufficient data to control for unregistered effects on inflation dynamics. Securities in the lagged column holds the same p-value to that of the value in the non-lagged column but with less effect on inflation following that time stamp. This lessening effect may be caused by the time series format set to monthly and closer examination of when the effects of purchasing securities are most impactful may be prudent. There is also a marginal increase in the R-squared illustrating that this better explains the variance in the core CPI.

Table 4: Regressions Run with GFC-era Data and Core CPI

Non-Lagged	Lagged
Variables: Coefficients	Variables: Coefficients
Total Assets: -2.210**	Total Assets: -2.940***
(0.834)	(0.803)
Securities: 2.821***	Securities: 2.355***
(0.818)	(0.757)
M2: 37.209***	M2: 46.527***
(8.653)	(7.769)
Exp: 0.532	Exp: 0.427
(0.599)	(0.576)
FFR: -1.128***	FFR: -0.763***
(0.257)	(0.238)
UR: 0.116	UR: 0.314***
(0.119)	(0.106)
Constant: -381.051***	Constant: -514.480***
(125.434)	(110.663)
Observations: 50	Observations: 49
R-squared: 0.984	R-squared: 0.986

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 represents the same regression run in table 4 with GFC-era data however the dependent variable is switch from core CPI to just CPI to achieve a more robust result. The left column (non-lagged) shows a -10.2 coefficient of total assets to CPI. Which indicates that for every percent increase of total assets CPI should lower by 10 points. This has strong significant results and a standard deviation of only 1.8. Securities has the opposite effect on CPI of all items as the coefficient has a positive value of 5. According to the model for every single percent increase of the Fed's security holdings it would increase the CPI 5 index points. All

the control variables besides unemployment rate and securities have p values under .01 however the R-squared has the lowest value of all regressions within the model with .9. Still a strong R-squared however it shows that this regression's variables account for the least amount of deviation of CPI.

The right side (lagged) of table 5 reflects the same regression on the left side of table 5 but with the two predictor variables of the natural logs of total assets and securities lagged with a lead time of one. This regression uses GFC-era data and CPI. The lagged regression has similar variable significance with a slight difference in the constant variables significant. The constant for the lagged variable regression less significant than its twin on the left side. Lagged total assets coefficient indicates that for every percentage increase of total assets the month before there will be a drop of the CPI by 13 index points in the current month. Conversely securities which has a similar significance to its not lagged counterpart on the other side of the table has a coefficient of 4.27 indicating a rise of 4.27 index points in the CPI for a percent increase of securities in the month prior.

Table 5. Regressions Run with GFC-era Data and CPI of All Items

Non-Lagged	Lagged
Variables: Coefficients	Variables: Coefficients
Total Assets: -10.221***	Total Assets: -13.231***
(1.847)	(1.786)
Securities: 5.07**	Securities: 4.274**
(2.245)	(1.663)
M2: 82.939***	M2: 107.003***
(24.503)	(18.467)
Exp: 5.019***	Exp: 3.829***
(1.414)	(1.209)
FFR: -2.918***	FFR: -1.859***
(0.762)	(0.565)
UR: -1.141	UR: -0.407
(0.334)	(0.323)
Constant: -1024.152***	Constant: -1358.332**
(361.698)	(269.061)
Observations: 50	Observations: 49
R-squared: 0.9	R-squared: 0.924

standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The left column (non-lagged) of table 6 shows the regression of Equation 3 using the Covid era data set. Total assets are seen to have the opposite effect shown in table 4 and 5 has a positive relation with the dependent variable, inflation. With a coefficient of 48.47, for every 1% increase in total assets there is a momentum shift of CPI increasing. Though coupled with the p-value of .197, larger than .05, it is statistically insignificant. Therefore, the effect of total assets cannot be seen in this output with confidence. However, securities have a negative effect

of 56.36 for every percentage increase in the value of securities held in the Fed balance sheet. With a p-value of .05 it can be concluded that this is significant. The R-squared values are less than that of the previous data sets regression outputs and do a poorer job of expressing the components of the variance in core CPI.

The lagged column (right side) of table 6 shows the results of the Equation 4 regression model using the 26 observations between December 2019 and February of 2022. Both the lag of logged total assets and securities are seen to have significance with a p-value of .03 and .009 respectively. Total assets in this format are seen to have the greatest impact on core consumer price index with a coefficient of 70.13. This is to say for every percentage increase of total assets the CPI increases 70.13 units. While securities again have a negative effect of 88.08 units per every 1% increase on CPI.

Table 6. Regressions Run with Data from Covid-era and Core CPI

Non-Lagged	Lagged
Variables: Coefficients	Variables: Coefficients
Total Assets: 48.467	Total Assets: 70.129**
(36.349)	(29.312)
Securities: -56.355**	Securities: -88.081***
(26.956)	(28.469)
M2: 56.678	M2: 101.812***
(60.221)	(27.640)
Exp: 19.808	Exp: 11.455
(8.980)	(8.291)
FFR: -6.093	FFR: -4.865
(5.960)	(5.329)
UR: -0.293	UR: -0.792**
(0.499)	(0.354)
Constant: -605.598	Constant: -1,203.953**
(695.607)	(423.947)
Observations: 27	Observations: 26
R-squared: 0.932	R-squared: 0.954

standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 represents the regressions run in the Covid-era with CPI. The left side (non-lagged) has a R-squared of .94. Which is the middle ground of the R-squared results found within the model. Total assets have a coefficient of 60.43 which indicates that for every percent increase of the Fed's total assets inflation goes up 60 index points during this contemporary Covid-era data. Unfortunately, this statistic is not statistically significant. Furthermore, the natural log of securities has a coefficient of -74.85. Which contrasts the effects that total assets has on inflation within the same data. Increasing securities by a percentage point

decreases the CPI index by almost 75 points and is statically significant. Besides expected inflation that is the only significant result within this regression.

The right column of table 7 (lagged) has an R-square of .96 which is relatively high for this model and illustrates that 96.5% of the variance in the CPI within the data period is accounted for in these variables. All variables less expected inflation show significance. The value of lagged total assets has a coefficient of 87.15 which is the highest coefficient of total assets in this study. According to the model the CPI will rise 87 index points for a 1 percent rise in total assets a month before. On the other hand, a percent rise in securities a month before will decrease the CPI by 109.9 index points.

Table 7. Regressions Run with Covid-era Data and CPI of All Items

Non-Lagged	Lagged
Variables: Coefficients	Variables: Coefficients
Total Assets: 60.433	Total Assets: 87.155**
(40.512)	(32.489)
Securities: -74.859**	Securities: -109.970***
(30.043)	(32.92)
M2: 85.871	M2: 131.99***
(67.119)	(34.874)
Exp: 23.288**	Exp: 13.212
(10.008)	(8.796)
FFR: -6.054	FFR: -4.499
(6.643)	(5.376)
UR: -0.316	UR: -0.992**
(0.556)	(0.392)
Constant: -1013.086	Constant: -1652.561***
(775.614)	(527.242)
Observations: 27	Observations: 26
R-squared: 0.944	R-squared: 0.965

standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Discussion

The results in tables 4 through 7 show that over 90% of the variance and in some cases 98% of the variance in the consumer price index is accounted for within the model. The observed variables of the Fed's total assets and securities held outright are shown to be more significant during the GFC than during the Covid-era in this model. However, the coefficients of these variables are much higher, almost 20 times higher in the Covid-era. This shows that the Fed's QE policies did have a positive effect on inflation, parallel with the quantity money

theory. Though the factors that influenced the rise in inflation are explained less in the model during the Covid-era than that of the Great Recession era. Inflation rose higher during the Covid-era than the GFC but the policies direct impact on the inflation seen in the former period had a larger impact.

This supports the previous works of Yue and Leung (2011), Abbate et al. (2021) and Gilchrest et al. (2015) that concluded that inflation was kept down by other disinflation or contradictory inflation factors. The significance of the causal relationship of the UMP contradicts Yue and Leung (2011) as inflation was impacted by the Fed's actions of increasing their assets and securities.

A possible explanation for the higher coefficients in the Covid-era model may be due to the supply shocks during this time period. The surge in the consumer price index may be exacerbated by the bottleneck of access to goods and demand only being pent up in this time. Abbate et al. (2021) and Lim and Sek (2015) also argue that with the interest rates being dropped even lower made borrowing cost less expensive during a financial shock and thus propagated a steep rise in inflation.

The results do show that the Fed's quantitative easing implementation to combat the Covid-era recession are overwhelmingly more impactful on the core CPI. Which illustrates that the policy while helpful in the short run combatting an economic shock can have drastic negative economic effects later. The Fed has now been using quantitative easing to shock the overall financial markets for over 10 years. The results indicate that since the inception of the policy, inflation has

continued to rise during periods of recessions. These effects have been building with a greater impact in the latter period as the indication of the data stipulates.

Inflation is determined through a variety of factors most notably GDP and the money supply growth per the Kim and Sek (2015) study. Unfortunately for this paper, using monthly data points caused me to leave out GDP as another control variable and thus could limit the study with more statistically significant results as well as better insights into the relationships observed. Other limitations are unknown inflation dynamics with a lot of components being unknown.

The lagged variables have mixed but lower significance than the non-lagged variables. Which means that the lead time of the lag used may not be appropriate in the model as it is not enough time to show the causal effect on inflation. Which is congruent with the study done by Brillembourg and Khan (1979) that found lead times to be about two years at times. During the time of this study, the Covid-era is still ongoing, so I was not able to lag to an appropriate degree or at least attempt to find evidence to suggest a time frame of the effect. For future investigations it may be beneficial to have lags at longer intervals and be able to use the data available at that junction. Since the community understanding of financial shocks on inflation dynamics are “agnostic” per the Abbate et al. (2021) study it is difficult to assert when and exactly how the QE impacts inflation. There has been success in using sign restrictions to assert times in which inflation has external factors affecting its overall level as Uhlig (2017) and Abbate et al. (2021) suggests.

Another issue of this study is the nature of the data which is largely limited as shown with how the total assets of the Fed’s balance sheet and their securities

held outright had contradictory results. These two confounding results for the most part do not coincide with one another as an increase in the securities is also an increase in the total assets. As for the issue of the reverse of positive and negative correlations in the next time this proves further that the nature of the data is difficult to analyze with clear understandings of the relationship at play.

7. Conclusion

This study investigates the causal relationship between the Fed's QE policies and inflation during the last two major recessions of the US. I examine the influence that the Fed has per the quantity monetary theory with CPI less food and energy, the Fed's total assets on their balance sheet, the Fed's securities held outright, money supply, the federal funds rate, expected inflation, and the unemployment rate. Most of the previous literature on the subject would concur that the increase of the Fed spending into the economy would in fact have a positive effect on inflation. With others stipulating that inflation is more dependent on interest rates and other fiscal policies. Literature is sparse on exactly how impactful QE has been on inflation between the GFC and during the Covid-era.

The results of this study did show a positive correlation between inflation and increasing the Fed's securities in the GFC era and increasing the Fed's total assets in the Covid-era. The data does prove a close relationship between the dependent variable of inflation and the other determining variables as the R-squared of each regression would indicate. The regression model fits more closely

with the non-lagged variables as the lead times may vary during different time periods. The model however did not behave as initially intended. With two time periods having their total assets and securities coefficients having different integer signs. And these signs switch between the two time periods. This would show that the model shows an incomplete explanation of the quantity monetary theory phenomenon.

What was seen was an increase in the total impact of the two activating variables of total assets and securities during the Covid-era. A sharp rise in fact to almost a 20 times multiplier. With too many convoluted external and internal stressors during these two periods the data cannot support a streamlined summarization or predictor of the effect. As in the case of the GFC, there was a demand shock that helped anchor inflation while the supply shock of the Covid-era boosted inflation perhaps independent of the Fed's QE.

I feel confident in the interpretation of the data that supports the quantity monetary theory. Increasing the Fed's balance sheet, namely securities held outright, will cause a direct increase in the nation's inflation. However, this model does prove to be incomplete and an ignorance of inflation dynamics during financial shocks are limiting to understanding the relationship further.

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