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The Effects of Unconventional Monetary Policy on Asset Prices Across Markets

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Abstract:

With interest rates stuck near zero for the foreseeable future, the Federal Reserve has had to employ numerous unconventional monetary policy measures in an attempt to stimulate an economy in the aftermath of the worst economic downturn since the Great Depression. I assess the usefulness of market-based measures of expectations in gauging the effects of these seemingly extreme policy actions undertaken in an environment of unprecedented fear and uncertainty. I use a principal component analysis to combine a number of asset prices that indicate different types of market expectations; by combining these variables into one single variable indicator, this principal component variable filters out the variance among these similar variables and focuses on the common movements among the variables that can be attributed to a specific market force such as investors’ inflation expectations, overall market risk appetite, and economic growth expectations.
1. Introduction

When the Federal Open Market Committee (FOMC) lowered its target federal funds rate to a range of 0 to 25, the Fed was left with no room for further conventional monetary policy easing at a time when they desperately needed to stimulate borrowing and consumption in an attempt to avoid severe economic contraction. With the federal funds rate stuck at this zero-lower-bound, the Federal Reserve has had to employ unconventional monetary policies in an attempt to facilitate economic growth and recovery in the wake of the worst financial crisis since the Great Depression. These unconventional policies have been the subject of much debate among politicians and market participants.

A number of economists have conducted studies on the effects of these unconventional easing policies on different assets, overall market conditions, and the pace of economic recovery in the U.S. Many believe quantitative easing had the effect of inflating asset prices across markets and affected the value of securities through a few channels—future policy expectations, a portfolio rebalancing effect, and improving market functionality during a period of chaos and uncertainty, which effectively reduced risk premiums across a variety of markets. Critics of quantitative easing claim that by removing supply of certain long-term assets, the Fed simply manipulated the equilibrium risk premia to reduce longer-term rates in order to boost consumption and investment. However, some suggest this was a market distortion that led to artificial inflation of asset prices without stimulating the overall economy. Other critics point to the unemployment
rate that remained elevated and US GDP growth that remained slower than anticipated. Still others claim that quantitative easing was a temporary solution and did not have any lasting effects on the US economy.

I chose to expand on a few of these studies in order to better evaluate the spillover effect of these unconventional policies on assets other than the assets that the Fed was directly purchasing. I looked at numerous asset prices across different securities markets and used a principal components analysis in an attempt to find a better variable indicator of investors’ inflation expectations, economic growth expectations, and market risk appetite. Using this type of analysis, I was looking for the best combination of high-frequency variables that would result in an improved ability to measure the implications of unconventional monetary policy. For example, there are many different types of variables that indicate investors’ inflation expectations—TIPS breakevens, inflation swaps, and even certain commodity prices such as gold and oil. Though some of these assets are highly correlated in their responses to quantitative easing and other monetary policy actions, they don’t react identically. By accounting for some of the variability across these individual assets that indicate similar expectations or market conditions, a principal component variable can be used to find the best combination of variables to predict the effects of future monetary policy and to measure the effects of past unconventional policy.

2. Literature Review:
Numerous articles have been written in an attempt to assess the impact of U.S. government policy responses to the US financial crisis. Most of these articles assess the impact of monetary or fiscal stimulus in the wake of the financial crisis; a few others propose ideas for the next step US policymakers should take in their struggle to stimulate a stagnant and sluggish economic recovery from what most now call the worst downturn since the great depression.

Traditional monetary policy in the US consists of the Federal Reserve setting the target Federal Funds rate that determines the interest rate at which banks will loan to each other on an overnight basis. However, as a result of the financial crisis, this key short-term interest rate has been stuck at nearly zero since December 2008. Most macroeconomists reason that because the “U.S. currency carries an interest rate of zero, it is virtually impossible for the FOMC to target a value for the federal funds rate that is substantially below zero.” (Swanson, 2001) Faced with a zero lower bound, policymakers have had to come up with alternative ways to ease monetary policy given the stagnant rate of recovery the US economy currently faces. Prior to the financial crisis, Bernanke, Reinhart, and Sack (2004) wrote an article discussing potential monetary policy options when the Federal Funds rate reaches this zero-lower-bound, and found three options they believed would be effective: 1) communication from the Fed to shape public expectations for future policy and the future level of interest rates, 2) increasing the size of the Fed’s balance sheet through “quantitative easing”, and 3) changing the composition of the central bank’s balance sheet by selling shorter-dated securities and
buying longer-term securities. Since 2008, the Federal Reserve has employed all three of these strategies.

Over the past few years, a number of empirical studies have been conducted to assess the impact of these unconventional policies, and economists have reached a variety of conclusions. In this study, I aim to expand on the findings of a few researchers by focusing specifically on announcements and actions relating to quantitative easing policies a principal components analysis and an event-study technique. Annette Vissing-Jorgensen and Arvind Krishnamurthy (2011) use an event-study technique to evaluate the effects of large-scale asset purchases by the Federal Reserve on different types of risk premiums. They begin with the hypothesis that quantitative easing policies can potentially reduce long-term interest rates through seven channels: duration risk premium, liquidity premium, safety premium, prepayment risk premium, default risk premium, inflation risk premium, and a signaling channel. Using daily and intra-day data, Krishnamurthy and Vissing-Jorgensen conduct an event-study to evaluate through which of these channels quantitative easing had the most significant impact on the level of longer-term nominal rates. They conclude that the most significant driver of the reduction in long-term rates was through the safety premium channel, as rate declines were most significant on long-term safe assets such as U.S. Treasuries, Agency debt, and highly rated corporate bonds. They also conclude that the Fed’s large-scale asset purchases had a significant impact on agency MBS yields only when direct purchases of agency MBS securities occurred. This led them to believe that quantitative easing
involving agency MBS purchases reduces the equilibrium prepayment risk premium specific to mortgage-related securities, but that quantitative easing involving only U.S. Treasury securities did not have a significant impact on prepayment risk premium in the current low-for-long rate environment. Finally, they conclude that quantitative easing raised investors’ inflation expectations and the overall level of inflation, as reflected in TIPS breakeven yields and inflation swap rates on the key dates of their event study. However, it is important to note that during the second round of quantitative easing, Vissing-Jorgenson and Krishnamurthy find that measures of inflation expectations derived from TIPS versus inflation expectations derived from inflation swaps deviate from each other and display some marked differences; they conclude that “while inflation swaps and TIPS both point to a rise in inflation expectations, there is a dramatic difference in the numbers from each asset market.” Krishnamurthy and Vissing-Jorgensen do not address this further, but instead simply assert they are unsure as to why this happens. One way in which this could happen is if the TIPS and inflation swaps markets attract different types of clients, and these different clients hold different inflation expectations and have divergent concerns about the magnitude and direction of inflation risk. With this in mind, I thought a principal component analysis using different types of inflation indicators would be an interesting and potentially more reliable way to gauge the impact of monetary policy on inflation expectations going forward.

Gagnon, Raskin, Remache, and Sack (2010) reach a similar conclusion as Krishnamurthy and Vissing-Jorgensen and find a significant reduction in the safety
premium due to quantitative easing; they attribute this to a “portfolio balance” effect. By purchasing a specified amount of an asset, the Fed reduces the amount of this asset held by the private sector; for this to occur, investors must reduce their holding of the asset. For investors to be willing to make this adjustment, the yield on the security must fall, which thereby raises its price. However, unlike Vissing-Jorgensen and Krishnamurthy, Gagnon et al. found this portfolio balance effect spilled over into other assets insofar as they were close enough substitutes for the securities the Fed was purchasing. For example, they found that as yields on US Treasuries fell, investors are likely to bid up the prices of other assets such as Agency debt and highly rated corporate bonds, and even equities in a search for potential yield. With these results in mind, I reasoned that, similar to Krishnamurthy and Vissing-Jorgensen’s findings that inflation-indicating securities show divergent inflation expectations, there are likely similar divergences among assets that indicate growth expectations or overall market risk appetite. Therefore, a principal component analysis could also be used to find reliable variable indicators for risk appetite as well as economic growth.

Vayanos and Vila (2009) also assess the effectiveness of unconventional monetary policy in a zero rate environment. They find the same portfolio balancing effect but offer further explanation of why exactly it occurs. Vayanos and Vila assume the existence of two types of investors: one group, the “preferred-habit” investors, who have specific bond maturity and risk preference and are willing to pay despite increased prices, and the arbitrageurs who are willing to hold any asset depending on its risk and expected
return profile. They conclude that because of the existence of this second group, the Fed has the potential to flatten the yield curve by buying longer-securities and selling shorter-dated securities such as short-term treasuries or bank reserves, but not to significantly reduce the overall level of interest rates using a quantitative easing policy. This is consistent with other economists who conclude that once short-term rates reach zero, they cannot be reduced further because the yield on U.S. currency is effectively zero.

By conducting a principal component analysis of different types of market indicators— inflation expectations, growth expectations, and overall market risk—I am looking to expand Vayanos and Villa's conception of segmented markets, Krishnamurthy and Vissing-Jorgensen’s inflation expectations results, as well as Gagnon, Raskin, Remache, and Sack’s conclusion that the Fed’s unconventional monetary policy resulted in spillover effects of price inflation across markets.

3. Methodology

When looking at historical data prices across markets, the options for inflation indicators, economic growth indicators, and market risk indicators are vast. To account for the variation among these different inflation indicators, market risk indicators, and economic growth indicators, I used a principal component analysis. A principal component analysis is a mathematical procedure used to reduce the number of similar variables in order to develop a smaller number of artificial variables; these artificial variables are called principal components. This variable-reduction procedure is similar to
factor-analysis and is used when a number of observed variables indicate a similar result, but with some variation. I looked at a number of asset price variables, and categorized the securities into three types of market indicators: inflation expectations, market risk, and economic growth.

After finding these principal component variables, I put the results on a graphical timeline and focused on three questions; first, were there any noticeably large price or yield movements that coincided with macroeconomic and policy events, such as the Lehman Brother collapse or the Federal Reserve’s quantitative easing announcements? Second, were these large movements consistent with macroeconomic theory expectations? For example, did inflation expectations rise on the days that the Fed announced quantitative easing policies? And finally, in cases where similar individual variable indicators (for example, TIPS breakevens and inflation swaps) diverge from each other, does the principal component variable show more consistency with macroeconomic theory expectations?

4. Data

Most of the security price data was accumulated from Bloomberg and from J.P. Morgan’s research database, MorganMarkets. In order to be able to compare different types of securities (for example some were measured in spreads to US Treasuries, while others were simply dollar prices), I normalized the price and spread data, as well as the principal component variable, to 100. I then categorized the securities into three types of
indicators: 1) inflation indications, 2) market risk indicators, and 3) economic growth indicators.

a. Inflation Indicators

To gauge the impact of unconventional monetary policy on investors’ inflation expectations, I looked at the five-year TIPS breakeven yield, one-year inflation swap rate, five-year inflation swap rate, and commodities prices.

i. Five-year TIPS Breakeven Yield

The TIPS breakeven yield measures the difference in yield between Treasury Inflation Protected Securities and nominal Treasury yields of the same maturity. An increase in the breakeven rate is often viewed as a sign of rising inflation expectations in the market. Although the U.S. Treasury issues 5-year, 10-year, and 30-year TIPS, I opted for the 5-year TIPS breakeven yield as these most closely mirror investors’ short- and medium-term inflation expectations which most were affected most significantly by unconventional monetary policy.

ii. Inflation Swaps (one-year, five-year)

Two cash flows are exchanged at the end of a given period of time; one party pays the expected inflation rate that is determined the day of the swap agreement (the fixed cash flow) while the other party pays the actual inflation rate that is realized over the specific period of time. Generally, inflation swap rates rise as investors’ inflation
expectations rise. I chose to look at the one-year inflation swap rate as an indicator of investors’ inflation expectations in the short-term, and the five-year inflation swap rate as reflective of their medium-term expectations.

iii. Commodities Prices—Oil, Gold, Cotton

Commodity prices often reflect inflation expectations far more quickly than consumer prices indicate, as consumer prices exhibit a time lag in response to inflation. Frank Browne and David Cronin (2007) conducted a study on the relationship between commodity prices and the expansion of the monetary base and found that commodity prices and consumer prices are both proportional to the monetary supply over the long-term, but that commodity prices often overshoot their new equilibrium values in response to an expansion of the monetary base. For this reason, I thought commodity prices would be a good measure of investors’ inflation expectations due to significant macroeconomic or policy events, as the changes may be exaggerated relative to CPI changes. Also, commodity prices can be recorded on a daily and intra-day basis, where as the CPI is reported only quarterly. However, one caveat to using commodity prices to evaluate changes in inflation expectations is that commodity prices are affected by a number of other market factors. For example, gold became a main flight-to-quality investment from late-April until September 2011; gold prices rose sharply due to the escalation of the sovereign debt crisis and the debt ceiling crisis in the US. Similarly, oil prices are often linked to investors’ economic growth projections; they will invest in oil futures in times of projected economic growth, and the price of oil will fall as economic growth, as
indicated by production and consumption, is expected to fall.

b. Economic Growth Indicators

To measure the impact of monetary policy events on investors’ economic growth expectations, I looked at a few types of assets: stock market indices such as the S&P 500 and Dow Jones Industrial Average, dividend swap indices, and a commercial mortgage-backed securities index.

i. Dow Jones Industrial Average

The DJIA is a price-weighted index of 30 major publically held U.S. companies. The performance of the index overall reflects conditions in the economy as a whole and is frequently bought and sold by investors to increase their exposure to equities (a riskier investment) without taking on individual firm-specific risk by investing in an individual corporation.

ii. S&P 500

The S&P 500 is a market value weighted index of 500 stock prices of the largest publically held U.S. companies. Like the Dow, the performance of the S&P 500 can be used to gauge conditions in the overall market, as well as investors’ future expectations for economic growth. It is an extremely liquid index and therefore it is traded frequently and often on a short-term, speculative basis.

iii. S&P 500 Dividend Swap Index, 2012 and 2014

Two cash flows are exchanged at the end of a given period of time: one party, the buyer, agrees to pay a future fixed cash amount based on S&P dividend expectations,
while the other party, the seller, agrees to pay the actual dividends realized after the specified time period. Investors use dividend swaps to express their views on consumption growth, a main driver of GDP growth in the U.S. They will pay the fixed cash amount if they expect the economy to expand and dividends to increase with economic growth.

iv. CMBX Index—CMBX Series 3, AM tranche

The CMBX indices are synthetic, tradable indices that reference a specific group of 25 commercial mortgage-backed securities (CMBS). The CMBS market often moves in tandem with investors’ growth expectations, as the market for commercial real estate is expected to grow during periods of overall economic growth. I chose the third series and AM tranche because the CMBX AM 3 tends to be fairly volatile; the holders of the underlying AM bonds are likely to receive payments in times of economic growth, but unlikely to receive payments should the economy contract and companies default on their commercial real-estate payments. Tranches such as the AAA are less volatile as payments are more stable and less contingent on economic conditions, while tranches such as BBB and below are less volatile for the opposite reason that repayment is highly unlikely regardless of overall economic conditions.

c. Market Risk Indicators

i. Agency Debt Spread to Treasuries

Agency and Treasury securities of the same maturity have very similar risk characteristics – they have the same minimal risk of default, inflation risk, and maturity
risk. However, they differ in their liquidity premium, as Treasury securities are far more liquid than agency debt. Agency-Treasury spread widening often reflects investor flight-to-quality, which results from increased market risk.

**ii. Credit Default Swap Indices (CDX.NA.HY, CDX.NA.IG)**

A credit default swap can be thought of as an insurance policy on any financial asset. The seller of the CDS agrees to compensate the buyer in the event that a payment obligation on a debt security (such as a corporate bond or loan) fails to be paid by the entity that issues the debt. However, there is a significant difference between a traditional insurance policy and a credit default swap in that the buyer of CDS protection does not have to own the asset it believes will default. The price of a credit default swap rises as the credit risk of the underlying asset derivative rises; therefore, credit default swaps can be used as a measure of the credit risk of a financial asset. I used two credit default swap indices, one that reflects a number of high-yield bonds (CDX.NA.HY) and another for investment grade bonds (CDX.NA.IG), to gauge the impact of monetary policy and other significant macroeconomic events on default risk premium.

**iii. Chicago Board Options Exchange Market Volatility Index (VIX)**

The VIX is a popular measure of the implied volatility of S&P option prices; it essentially acts as an indicator of investors’ near-term volatility expectations. The VIX tends to rise as a result of increased investor uncertainty and is known to move with positive or negative news headlines.

**iv. J.P. Morgan US Liquid Index (JULI), 1-3 years, AAA and BBB tranches**
The J.P. Morgan US Liquid Index (JULI) encompasses high-grade fixed-rate corporate bonds into a measurable index. Like the bonds themselves, these indices have different tranches depending on the credit risk of the investment. I will use the AAA and BBB tranche, both investment grade but at opposite ends of the risk spectrum, to measure different levels of credit risk, and will look at the spread to U.S. Treasuries of the same maturity in an attempt to isolate a default risk premium. This default risk premium is reflected by the difference between yields on Treasuries and on these corporate bonds.

v. Agency MBS Spread to U.S. Treasuries, FNMA 4.5 and FNMA 5.0

This metric is more complicated, as there is no perfect way to measure the exact return that an agency mortgage-backed security will generate; its realized yield depends on borrower defaults and prepayments, which depends on the overall level of rates, the housing market, and economic conditions in general. There are many ways to quantify the predicted yield of an agency MBS security; the simplest way being its static (estimated) yield spread over a single point on the Treasury curve, determined by the MBS bond’s estimated duration. This static MBS-Treasury spread reflects the estimated prepayment and default risk, and therefore reinvestment risk associated with an agency MBS security. The difference in the estimated MBS yield and its interpolated US Treasury yield reflects the prepayment risk premium as well as liquidity risk premium associated with an agency MBS bond.

5. Important Macroeconomic or Policy Event Dates

ii. September 15, 2008: Lehman Brothers bankruptcy
On September 15, 2008, after days of merger talks and attempts to sell the company, Lehman Brothers filed for chapter 11 bankruptcy protection. To date, it is the largest bankruptcy filing in US history, with Lehman holding over $600 billion in assets. Because of Lehman’s significant involvement in the commercial paper market, the commercial paper market effectively froze, and turmoil quickly spread to other private credit markets.

i. November 25, 2008: First QE1 announcement

In the wake of the Lehman bankruptcy, and with other major US corporations such as AIG, Fannie Mae and Freddie Mac proving insolvent, the Fed announced its first round of its quantitative easing (QE1) on November 25, 2008, amidst rising uncertainty and fear in the US economy. Quantitative easing would consist of purchases of up to $100 billion of agency debt and up to $500 billion of agency MBS. In their press release, the Federal Reserve announced that it initiated the program because of the excessive spread widening in credit markets. With this unconventional monetary policy, the Fed intended to reduce the cost of mortgage financing and increase the availability of credit for the purchase of homes. The committee believed that reducing the cost of mortgages would facilitate a recovery in the housing market, which would improve conditions across financial markets in general.

iii. December 16, 2008: Target Fed Funds Rate hits 0
In its last attempt at conventional monetary policy, the Fed lowers its target Federal Funds rate to 0–25 basis points, where it remains today and is expected to remain for the foreseeable future.

iv. January 5, 2009: First quantitative easing purchases by the Fed

v. March 18, 2009: Fed increases QE1 purchases

The Fed announces additional purchases of up to $750 billion agency MBS as well as up to $300 billion of longer-term Treasury securities (2-10 year maturities) with the intention of stimulating private borrowing by improving conditions in private credit markets. The committee saw a lackluster pace of recovery with the economy continuing to contract: job losses continued at a steady pace, tight credit conditions remained, and business investment, equity value, and consumer wealth continued to decline. The FOMC believed an expansion of QE1 would provide greater support to mortgage lending and housing markets.

vi. March 25, 2009: First US Treasuries purchased under QE1

vii. May 27, 2009: Significant selloff in long-term rates and MBS yields

Hancock and Passmore (2011) note the importance of May 27, 2009 in their analysis of the effect the Federal Reserve’s MBS purchase program on a variety of mortgage rates. They found that mortgage rates increased an average of 38 basis points during the week of May 27, 2009 in tandem with a significant rise in agency MBS yields. The researchers believe that an increase in longer-term Treasury yields combined with expectations of higher long-term yields in the future caused agency MBS investors to sell
in large quantities. These higher rates prompted holders of higher-coupon MBS to sell their holdings and lock in capital gains created by the decline in yields caused by QE1. Hancock and Passmore (2011) find this market reaction significant in that it showed investors questioning the Fed’s commitment to maintaining lower rates in the future; until this point, most had left their positions relatively unhedged in their confidence that the Fed would maintain a low rate policy for a significant period of time.

viii. September 23, 2009: QE1 end date is announced

ix. March 31, 2010: QE1 ends

x. August 10, 2010: FOMC announces no further quantitative easing

FOMC announces they will keep asset holdings at current level; however, they will reinvest Agency debt and MBS paydowns into longer-term Treasuries.

xi. August 23, 2010: Bernanke’s first hint of QE2 (Jackson Hole speech)

In a time of rising market volatility and policy uncertainty, Bernanke announces that the Federal Reserve “will do all that it can” to ensure continued recovery of the U.S. economy. In his opening remarks, he states “the committee is prepared to provide additional monetary accommodation through unconventional measures if it proves necessary, especially if the outlook were to deteriorate significantly.” He voices the view that economic growth over the previous year had been far too slow, that unemployment had remained far too high, and most importantly that the risk of “undesirable rise in inflation” seemed also very low. Most importantly, he states “additional purchases of longer-term securities, should the FOMC choose to undertake them, would be effective
in further easing financial conditions.” Investors, many of whom already expected further stagnant growth and deteriorating market conditions, took Bernanke’s words as a signal that the FOMC would likely announce a second round of quantitative easing in the near future.

xii. November 3, 2010: QE2 is formally announced

The FOMC announces it will purchase an additional $600 billion of longer-term Treasury securities by the second quarter of 2011, at a pace of $75 billion per month. The committee does this with the intent to facilitate a stronger pace of recovery and to ensure inflation remains at levels consistent with the Fed’s mandate, as many committee members were beginning to worry about the risk of deflation.

xiii. November 12, 2010: QE2 purchases begin

xiv. Late-April 2011: Rates begin sustained drop

In the aftermath of the tsunami in Japan, which caused a disruption to the global economic recovery, weaker U.S. housing and employment data, and a remerging sovereign debt crisis that looked poised for contagion, interest rates in the US began a sharp and steady decline leading up to the end of QE2.

xv. June 30, 2011: QE2 ends


The FOMC announces they will extend the average maturity of the securities on its balance sheet by purchasing $400 billion of Treasury securities with remaining maturities of 6 to 30 years, and selling an equal amount of Treasury securities with
remaining maturities of 3 years or less. Although the committee expresses the view that they expect the pace of recovery to continue to pick up, they highlight significant downside risks to a positive economic outlook and anticipate the unemployment rate to remain uncharacteristically high.

6. Results

a. Inflation Expectations (see Figure 1, 2, 3)

I used a few types of variables, TIPS breakevens, inflation swap rates, and commodities prices in an attempt to find a principal component variable that would indicate the effects of policy and macroeconomic events on investors’ inflation expectations. In the first analysis, I used the five-year TIPS breakeven and five-year inflation swap to indicate investors’ medium-term inflation expectations, and the one-year inflation swap rate to indicate investors’ short-term expectations. In this analysis, the fluctuations of the Z variable, inflation swaps and TIPS breakeven were all consistent with my expectations, but each moved at different magnitudes (see figure 1): the Z variable for inflation expectations sharply declined after the Lehman crisis (9/15/09), rose shortly after QE1 announcement (11/25/08), and rose steadily after QE1 was expanded (3/13/09). As expected, the Z variable, as well as each individual inflation-indicating asset showed sharp declines when QE1 purchases ended (3/31/10), and began to rise again after Bernanke’s infamous Jackson Hole speech (8/23/10), where he indicted a willingness to employ a second round of quantitative easing should economic conditions
warrant further easing policy. Inflation expectations began to fall around the end of April 2011, for a number of reasons. The most likely reason was the reemerging sovereign debt crisis in Europe, and the rising risk of contagion into Europe’s largest banks, governments, and economies. Another likely factor was the increasingly negative economic data out of the U.S. that signaled the recovery had less momentum than most investors were expecting. QE2 was set to end in June with no further monetary easing policies expected, which only added to investor uncertainty at this time. In this analysis, the principal component variable, Z, was heavily weighted to the one-year inflation swap, the most volatile of the three inflation indicators. This may have skewed the results, so I ran a subsequent principal component analysis using only the five-year inflation swap and five-year TIPS breakeven.

In my second inflation expectations principal component analysis, the Z variable, as well as the individual inflation indicating variables moved in line with my expectations, as they did in the first principal component analysis (see figure 2). One interesting difference between the Z variable in the first and second analysis was that that in the first analysis, which included the one-year inflation swap, the Z variable did not show the expected decline in inflation expectations when QE2 ended on June 30, 2011. However, the Z variable that excluded the one-year inflation swap and focused only on the 5-year TIPS and 5-year inflation swap showed a significant decline in inflation expectations following the end of QE2. This may show divergent expectations between
investors that focus on short-term assets, indicated by the one-year inflation rate, versus those who invest in medium term assets, indicated by the five-year assets.

I also looked at a range of commodities data to see whether an artificial variable of commodity prices could show price movements based on inflation expectations. Interestingly, the Z variable moved in line with my expectations for the most part, while the commodities themselves individually varied and did not reflect the expected inflation expectations patterns over this time period (see figure 3). Though some volatility was evident, the Z variable moved in line with the inflation expectations I had for the significant policy event dates: on August 23, 2010, the Z variable began to rise significantly, indicating increased inflation expectations. It continued to rise through the official QE2 announcement on November 2, 2010 until late-April, in a similar fashion as the previous Z variables. However, with the significant increase in gold prices from late-April until the end of the third quarter of 2011, the Z variable was inconsistent with the expectation that inflation expectations should fall at the end of QE2. There were a few limitations to this analysis using commodities data as inflation indicators. Commodities prices are very volatile, and reflect market pressures other than inflation expectations. Gold, for example, was used as a flight-to-safety asset over the summer of 2011, which was a period of significant market uncertainty with the increasing intensity of the U.S. debt ceiling debate as well as the sovereign debt crisis in Europe. Oil prices are also indicative of overall economic and production growth; oil prices rise in times of expected
growth and fall in times of expected economic contraction or stagnation. However, using the covariance’s of these commodities, rather than their individual prices, the artificial Z variable moved in line with inflation expectations. With better access to data—the data I was able to find was extremely limited—and more individual commodity variables, this Z variable for inflation expectations could in fact be useful.

b. Market Risk (Figures 4, 5, 6, 7, and 8)

To look at the impact of macroeconomic and policy events on investors’ appetite for risk, I used a number of different assets to measure various types of risk. Agency MBS securities indicate both prepayment risk and liquidity risk, agency debt indicates liquidity risk, and credit default swap indices and corporate bond index tranches indicate credit risk. I ran my first market risk principal component analysis using various different risk-indicating variables (see figure 4), and then narrowed down by including only one variable with each risk category (see figure 5). In figures 4 and 5, both Z variables show a number of expected trends: risk premium noticeably rises during the Bear Stearns crisis, and peaks on March 14th, the day the of the infamous government bailout, then rises substantially again after the Lehman bankruptcy (9/15/2008). The Z variables reach a peak around November 25th, the day FOMC announces the first round of asset purchases. Risk premiums as evidenced by the Z variables fall slightly shortly after QE1 is announced, but are still very volatile until QE1 is expanded on March 13, 2009. From there, the risk premium Z variable steadily declines to almost the exact date that QE1
ended, March 31, 2010. From there, on both graphs it seems the Z variable for risk premium is less affected by QE2 announcements and purchases; the overall market risk premium remains relatively low until it rises slightly leading up to the end of QE2 and in the midst of a pretty rocky summer for the global economy. For my third market risk principal component analysis, I substituted the VIX, high-yield, and investment grade credit default swap indices for the corporate bond index tranches I used in the previous analyses (see figure 6). Credit default swap indices and the corporate bond index tranches all reflect different levels of credit risk and they react to significant macroeconomic and policy events in a similar pattern but at different magnitudes. The Z variable in figure 6 reflects the same trend as the previous market risk analyses. However, one interesting difference was that when credit default swap indices were used to indicate the default risk aspect of the risk premium, the risk premium Z variable exhibited a steeper rise after the end of QE2. This shows a divergence between corporate bonds and credit default swaps as indicators of credit risk.

Finally, I categorized the variables further into their specific risk types. I used a number of variables that indicate liquidity risk in one principal component analysis, and a number of credit risk variables in another principal component analysis (see figures 7 and 8). In figure 7, you can see the liquidity risk Z variable rises up to the Bear Stearns rescue, and then falls after the firm narrowly dodges bankruptcy. The liquidity risk premium rises sharply after the Lehman bankruptcy, which is expected given that the bankruptcy caused the commercial paper market to freeze temporarily; this severely
disrupted all private credit markets. The Z variable, as well as the other liquidity risk variables, all rose from September 15 until the announcement of QE1 on November 25, 2008. Following the expansion of QE1 on March 13, 2009, the Z variable fell relatively steadily until the end of QE1 in March 2010; the individual variables were extremely volatile and did not show any real trend. There are a few issues with this analysis, perhaps most importantly that agency MBS prices and spreads are affected by factors other than their liquidity premium. They are also affected by prepayment risk and housing reform policies, which in recent years have been extremely relevant to mortgage refinancing.

The last market risk principal component analysis I ran was one that focused specifically on credit risk; I used credit default swap indices, corporate bond indices, and the VIX as individual variables. The Z variable reflected the expected trends, and again seemed less affected by the QE2 announcement than by QE1. However, all individual credit risk variables as well as the Z variable rose sharply after QE2 ended in June (see figure 8).

c. Economic Growth

I also ran two principal component analyses on economic growth expectations indicators. In the first, I attempted to use stock market indices, such as the S&P500 and the Dow Jones Industrial Average, and one of the more volatile CMBX tranches to gauge the effects of macroeconomic and policy events on investors' growth expectations.
However, the historical CMBX data is extremely limited without an expensive subscription, so I could only gauge the results as far back as April 2011. However, in this short time period, it is evident that the economic growth Z variable rose significantly with the end of QE2 on June 30, 2011, which is the opposite of what I was expecting. The Z variable showed considerable decline in the midst of the second Greek bailout (7/21/11) and during the political deadlock over the U.S. debt ceiling, which is consistent with my expectations. Unfortunately, with such little historical data to analyze, this principal component analysis should be evaluated further before drawing any conclusions.

In my second economic growth principal component analysis, I used the S&P500 index and S&P500 dividend swaps for 2012 and 2014, which yielded interesting results. The Z variable moved very much in line with my expectations. However, there was a noticeable divergence in the magnitude of individual asset movements. Both the S&P and its dividend swaps moved in near lockstep from the Lehman crisis until about midway through QE1. Interestingly, dividend swap rates began to level off around November 2009, with the S&P continuing its steady increase. All 3 individual variables, as well as the Z variable, rose after Bernanke’s Jackson Hole speech indicating a QE2, however, dividend swaps were noticeably less affected than was the S&P index. The S&P fell significantly leading up to the end QE2, with dividend swaps again much less affected. This divergence between dividend swaps, which are indicative of investors’ consumption
growth expectations, and the level of the S&P 500 is evidence that QE2 caused price appreciation on more liquid risk assets like the S&P that are frequently traded by fast-money, speculative investors.

7. Limitations

A few important limitations to my study must be noted. As a college student with limited resources, I had insufficient access to historical data for some of the more obscure securities that I was hoping to use as variables. For example, historical data on certain commodities only went back to April 2009, which is in middle of QE1, and data on CMBX indices are only freely available starting in April 2011 without a costly subscription. Also, significant factors other than monetary policy influence market risk appetite, inflation expectations, and economic growth expectations. In this time period, for example, two sovereign debt crises occurred in the European Union, the U.S. government found itself at a political deadlock with regard to the debt ceiling and deficit spending, and U.S. unemployment data, housing data, and other economic indicators fluctuated wildly across this time period, which may have caused an endogeneity effect in my analysis. Perhaps most significantly, it is extremely hard to gauge when investors begin to position themselves for monetary policy actions; in my study I expected positioning to occur as policies were announced. However, more levered and fast-money investors such as hedge funds speculate prior to the actual announcements and try to position early to generate abnormally high returns.
8. Conclusion

In running a principal component analysis on these measures of market expectations, I was looking to gauge the effects of recent unconventional policy actions that many believe to be extreme, but were undertaken in an era of unprecedented market uncertainty and volatility. Throughout the two periods of quantitative easing, assets were affected differently. For example, assets that are generally used to measure inflation expectations generally moved in line with what economists would expect; however, the individual assets varied in the magnitude that they reflected this expected rise in inflation.

The same thing occurred with different market risk appetite indicators, as well as economic growth indicators. This occurs for a few reasons; the most significant being that markets are segmented, and different types of investors may have different expectations and will therefore invest differently. Krishnamurthy and Vissing-Jorgensen found a specific case of this in their event study, when they noted that inflation swaps and TIPS breakevens reflect similar market expectations but to so at different magnitudes.

Upon expanding this to other types of market indicators, such as overall market risk appetite and economic growth, it seems this divergence among similar assets is common due to investors’ diverging expectations and investment decisions. The principal component variable, which combined a few individual inflation-indicating variables, effectively filters out the idiosyncrasies of each individual asset and acts as a convenient way to summarize the effect of these policy actions on different macroeconomic expectations more generally.
Figure 2 – 5 year TIPS Breakeven, 5 year Inflation Swap
Figure 3 – Commodities: Gold, Oil, Cotton
Figure 5 – Agency MBS, Agency Debt, Corporate Bond Index (BBB tranche)
Figure 7 – Liquidity Risk Variables

- Z Variable
- FNMA 30 4.5% Spread to UST Normalized to 100
- FNMA 30 5% Spread to UST Normalized to 100
- Agency 5yr Normalized to 100
Figure 8 – Credit Risk Variables
Figure 10 – S&P 500, S&P 500 Dividend Swap Index (2012, 2014)


References:


