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The Effects of the European Central Bank's Public Sector Purchase Program on Eurozone Unemployment Rates

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While writing this thesis, I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Skidmore College Honor Code

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Abstract

This paper assesses the impact of the European Central Bank's (ECB's) Public Sector Purchase Program (PSPP) on Eurozone unemployment rates. Using a panel dataset, I construct a series of OLS models to test the relationship in 18 Eurozone countries. Results suggest that PSPP purchases do not significantly influence Eurozone unemployment rates. However, the strength of the relationship changes depending on monetary policy lag time and the sub-regions examined. The findings contribute to the debate surrounding how the ECB conducts the PSPP as well as to the literature studying monetary policy's effect on the real economy.

1. Introduction

The financial crisis of 2008 presented central banks with their greatest challenge in decades. Having exhausted traditional methods, many, including the ECB, undertook quantitative easing (QE) programs to combat the prolonged period of low inflation. The ECB relies on various mechanisms to transmit their QE (the PSPP) to the real economy. Theory suggests that many of the same mechanisms targeted by the ECB that boost inflation, namely increased economic growth, also decrease unemployment. So, might QE affect unemployment too? The answer may provide policy makers with new tools to employ during times of recession. This paper seeks to establish whether the amount of sovereign debt that the ECB purchases from European governments affects the unemployment rates in those countries. As unemployment is often used as a proxy for economic health, the findings of this paper may be used to explain whether, and by how much, the ECB's debt purchases influenced the speed at which Eurozone countries recovered from the global financial crisis. The effects of these QE policies vary by country and, as a result, criticisms of the program abound. Given the untested nature of the new programs, it is important to study their effects as the conditions that warrant such a response from the ECB will someday return.

Many economists study the effects of QE on the real economy. However, much of researcher's interest has focused on QE's effect on financial markets. For instance, a wide body of literature, summarized nicely by Williams (2011), finds that Federal Reserve (Fed) QE significantly lowered long term treasury bonds. Gambetti and Musso (2017) finds empirical evidence that the ECB's QE boosted real GDP growth and inflation in the Eurozone, but stops short of assessing its impact on labor markets. Few papers extend their analysis to unemployment, and the ones that do, find insignificant results (see Bhar et. al, 2015).

Perhaps the authors stop short for good reason. With so many related variables, proving such a hypothesis empirically is challenging. However, there exist a series of links that, based on theory, may connect QE and unemployment. The purpose of this paper is to establish the theory behind the links and use it to explain the empirical results of the relationship. I construct a series of panel regression models controlling for various macroeconomic conditions to test the relationship in all 18 Eurozone countries. The first univariate panel regression relates ECB debt purchases and unemployment rates controlling for fixed effects and various time lags. The

second panel regression adds GDP growth, government bond yields, inflation, government expenditure and Euro/Dollar exchange rates as independent variables to ensure a more robust analysis. I experiment with monetary policy lags and section the countries by growth rate to test whether time or economic growth rates influence QE's effectiveness. I then conduct a separate analysis comparing the subgroup of Italy, Spain and Portugal to that of Germany to see how the ECB's debt purchase program affects the two blocs differently. The findings highlight a debate regarding how the ECB allocates their debt purchases.

This paper contributes to the body of literature studying the effects of QE on the real economy in a few ways. First, no study assesses the effects of the ECB's QE program on Euro area unemployment. This paper fills the void. Second, this paper's use of panel data enables the model to capture cross country heterogeneity, something lacking in papers such as Gambetti et. al (2017) which relies on European aggregate data. Panel data also allows for the various subgroup analyses performed. The choice of monetary policy lags for the analysis as well as the independent variables used follow closely from the literature.

The results from the panel regressions are as follows: The univariate model shows a negative relationship between PSPP purchases and Eurozone unemployment. The results are significant ($P < 0.1$) when unemployment is lagged 3 months, however, significance disappears when lag time increases. Upon controlling for other macroeconomic factors, the significance disappears. Results from the multivariate model suggest that the ECB's monetary policy may not play a significant role in lowering Eurozone unemployment. Findings from the subgroup analyses, though also insignificant, suggest that the ECB's debt purchases may be more effective in certain countries than in others. Certain limitations to the model as well as scarce data may taint the results of the analysis. Therefore, any conclusions reached from the findings should be taken with caution.

The remainder of the paper is structured as follows: section 2 provides background on the ECB's debt purchase program; section 3 discusses the literature surrounding monetary policy transmission mechanisms as well as the lag time associated with such transmission; section 4 describes the empirical data and the model; section 5 reports and discusses the results from the model; section 6 discusses the subgroup case study; section 7 concludes.

2. Background

At the beginning of 2015, on January 22nd, the ECB announced the expanded Asset Purchase Program (APP). The APP continued many of the bank's existing efforts such as the asset-backed securities program (ABSPP) and the covered bond purchase program (CSPP) that were meant to support the banking sector and reinvigorate financial markets. More importantly however, the APP added a new public sector purchase program (PSPP). Accounting for more than 80% of total ECB stimulative spending, the PSPP is the largest of the programs encompassed by the APP. With the policy, the ECB followed the lead of other central banks, such as the Fed and the Bank of Japan (The BOJ), who experimented to varying degrees of success, with QE.

The ECB created the PSPP as their primary tool to spur economic activity and increase inflation. PSPP purchases consist of public-sector assets, mainly Euro government bonds. The ECB set initial monthly purchases at €60 billion, raising the amount to €80 billion in March 2016, and as of January 2018, lowering it to €30 billion (ECB). Since 2015, ECB injected more than €1 trillion into the Eurozone economy. The Eurosystem, a collection of 18 member states in the Eurozone, oversees PSPP purchases. The program was originally intended to run on a monthly basis between March 2015 and September 2016. However, at the ECB's October 2017 meeting, the board decided to extend the program into 2018 after forecasts indicated persistently weak inflation.

The ECB conducts PSPP purchases in a gradual manner subject to the capital key guidelines. The capital key determines the proportion of government bonds that the ECB can purchase from each member state. The key reflects a country's share in the total population and gross domestic product (GDP) of the Eurozone. The key determines how much capital each country must contribute to the ECB - the larger the country, the larger the capital requirement. As it relates to the PSPP, the larger a country's capital key, the greater the amount of debt the ECB purchases from that country (see graph 1 for PSPP purchase distribution). Thus, the ECB has purchased more than €437 billion government debt from Germany - the Eurozone's largest economy with a capital key of 18% - and only €65 million from Estonia which has a capital key of 0.2% (ECB).

3. Literature Review

As a central bank's policy toolkit grows, so does the body of literature surrounding it. Given its recent history and unconventional means, QE has been the hot topic of late. However, much of researcher's interest has focused on QE's effect on financial markets. Less researched are the policy's effects on the job market. Bhar and Malliaris (2015) investigates the impact of the Fed's three rounds of QE on unemployment rates and find insignificant results. Gambetti et.al (2017) finds empirical evidence that the ECB's QE boosted real GDP growth and inflation in the Eurozone, but stops short of assessing its impact on labor markets. Additionally, the authors limit the paper's scope to just the first stage of the APP program. As a result, their findings do not capture the subsequent adjustments to the program made by the ECB in April 2016 and January 2018.

To date, no study assesses the effects of the ECB's QE program on euro area unemployment. And the papers that study the APP's macroeconomic effects are limited in their examined time period. This paper fills the void. It seeks to provide an explanation to trends that we see developing in European labor markets. In doing so, it also contributes to the broader discussion of the efficacy of monetary policy.

No one theory links central bank monetary policy to changes in unemployment. And with good reason. With so many related variables, proving such a hypothesis empirically is challenging. However, there exist a series of links that, based on theory, may help connect the two. The theory rests upon the belief that central bank public debt purchases lower interest rates. Lower interest rates then stimulate economic growth through various channels that each reduce unemployment in a small way. While no one channel can itself explain the reduction in unemployment, taken together, they may have a significant effect. By exploring existing literature, I hope to develop some sense of the efficiency of the channels so that I can accurately judge whether a relationship between central bank QE and unemployment exists. This paper will not test the empirical validity of the channels nor their individual power. Rather, the theory behind the channels will help to explain the empirical findings of the relationship between QE and unemployment.

Monetary Policy and Interest Rates

Different theories describe how monetary policy affects interest rates. D'Amico, English, Lopez-Salido and Nelson (2012) finds evidence for two transmission channels when looking at the effect of the Fed's large scale asset purchases (LSAPs) on United States (U.S) treasury bonds. The authors write that Fed purchases influence interest rates first by the scarcity effect. For stable governments like the U.S government, it is assumed that a permanent and consistent demand exists for treasury bonds. When the central bank purchases treasury bonds from private investors, they reduce the stock of existing bonds in the market thereby creating scarcity, driving up bond prices and lowering yields. Simple supply and demand.

The second channel is the duration risk effect. In bonds, a risk premium explains the difference between yields on long term and short securities. Investors deem long term securities more risky than short term ones, therefore a premium exists for which borrowers must pay. Hence, risk premium. When a central bank, like the Fed, purchases 10 year treasury bonds, they remove some of the longer term securities from the market. By removing these long term securities, the risk premium shrinks as the average maturity of all bonds held decreases. In response, investors increase purchases of riskier bonds, either long term assets or those that are inherently more risky (e.g., corporate bonds) in order to get back to their original risk threshold.

Other have described this phenomenon as the portfolio rebalancing effect (Tobin 1969). When the central bank purchases certain long term securities from private investors, they effectively change the maturity balance of an investor's portfolio. Suddenly, the relative amount of short term, less risky assets held by private investors increases. The change puts their holdings out of alignment. To rebalance their portfolios, private investors purchase longer term securities, raising their prices and, thus, lowers their yields. As the interest rate risk on long term securities decreases, the risk premium shrinks which may in turn lowers short term rates as well. The portfolio rebalancing channel may affect investor preferences in the near term, but they may also affect them in the medium term as investors continually rebalance their portfolios.

In the EU, different investor preferences may mute the benefits from the portfolio rebalancing effect. Unlike in the U.S and Japan, where domestic investors held the majority of government debt (~60% and 80%, respectively) at the onset of the central bank's purchases, European investors held few government bonds. As of 2014, investors owned only 40% of government debt (Nazaré, Gonçalves, and Rodrigues 2016). While 40% is the average, the percentage differs among countries too. As a result, the portfolio rebalancing towards riskier

assets that contributed to lower interest rates in the U.S may be minimal (or not materialize at all) in some Eurozone countries.

Eggertsson, Woodford (2003) attributes much of the change in bond yields to the signaling channel. The authors posit that central bank LSAP purchases do little to increase the monetary base and thus have little influence on real economic variables such as inflation. Rather, a central banks actions signal changes to investors and it's those signals that affect bond yields. The central banks purchases indicate to investors the bank's commitment to monetary stimulus. The bank's commitment provides a degree of certainty to the market, reducing the interest rate risk (and thus yield) on longer term securities. The bank's actions also provide clarity to investor's short term expectation leading to lower short term interest rates. Relying on an intertemporal equilibrium model, the authors reason that the economy only changes equilibrium paths by way of the signaling channel.

Transmission Mechanisms at Work in the Data

With the transmission mechanisms taken care of, let's ask central banker's favorite question: what does the data show? For the Fed's QE program a consistent trend emerges among papers; QE decreases long term interest rates. For example, using a time series analysis of treasury yields following FOMC announcements, D'Amico et.al find that 10 year treasury yields decreased 45 basis points in response to the Fed's second $600 billion QE program. The authors attribute 2/3rds of the decrease to the scarcity affect and 1/3rd to the duration risk effect.

Gagnon, Raskin, Remache and Sack (2011) estimates similar effects using both an event series and time series model, finding that the Fed's first QE program contributed to a 30 basis point decrease in long term treasury yields. However, the authors attribute the reduction in interest rates to the duration risk channel as opposed to the expectations channel assumed by Eggertsson et.al.

San Francisco Fed president John Williams captures the trend well by aggregating more than 10 prominent studies of the Fed's first QE program. He finds that on average, treasury yields fell 15-20 basis points in response to the Fed's $600 billion worth of asset purchases. Williams notes that while 0.15%-0.20% may not sound significant, the decrease is equivalent to the Fed reducing the Fed funds rate by .75%.

Fewer studies exist for the ECB's QE program, but preliminary findings suggest similar results. Andrade, Breckenfelder, De Fiore, Karadi, and Tristani (2016) examines the APP's effect on European government bond yields and bank profitability/stock prices. The authors use a general equilibrium model informed by the three aforementioned transmission mechanisms to assess the macroeconomic effects of the APP. Compared to a scenario without monetary stimulus, the authors find that after the APP announcement, 10 and 20 year bond yields declined an average of 13 basis points. Upon implementation, yields fell an additional 14 basis points. Their findings provide evidence for (Eggertsson et.al)'s signaling channel hypothesis as effects were visible upon the announcement. For longer term, more risky loans, the effects tend to be more significant, suggesting evidence of the duration risk channel. The observed reduction in bond yields is similar to that observed following a 1% decrease in ECB interest rates.

For banks, they find that institutions with larger sovereign debt holdings increased in value following the announcement and implementation of the APP, as the value of their bonds grew. Increased bank capital should allow banks to make portfolio adjustments towards riskier assets. This may take the form of increased lending to risky clients or lower interest rates on future loans. Both represent another possible mechanism for monetary transmission. It's not all good news though. The authors estimate that profitability declined at banks that held significant amounts of sovereign debt due to lower yields on long term bond holdings.

Monetary Transmission to the Real Economy

The idea that QE lowers long term interest rates appears well supported by the literature. For my research, it serves as the link that connects stimulative monetary policy to positive changes in the real economy. As it relates to the ECB and their bond buying program, lower government bond yields may influence the real economy through various channels that affect consumer wealth, business investment and overall confidence in the economy. Together, these effects stimulate economic growth.

The asset price channel describes how interest rates affect the stock market. As interest rates decline, investment in fixed income assets, such as government and corporate bonds, becomes less attractive. Investors seeking higher returns move their money into the stock market. Increased demand for equities leads to higher stock prices. Lower interest rates also mean lower

debt servicing costs for corporations. Corporate balance sheets improve as less money is diverted to debt payments. Reduced corporate leverage coupled with changing investor preferences will in theory raise stock prices.

While the stock market is not the economy, higher stock prices can significantly affect other real economic variables. Tobin (1969) reasons that higher stock prices may increase business investment. The author's q theory explains why corporations invest in new assets. Corporations typically finance investments through the issuance of either stocks or bonds. When stock prices rise, corporations can issue new stock at a higher price relative to previous valuations. Thus, a higher stock price allows companies to invest more while giving less ownership/stock to investors.

Higher stock prices don't just benefit corporations. Consumer wealth increases as well. In their theory on the life cycle hypothesis, Ando and Modigliani (1963) state that consumer spending is a function of total household wealth. Modigliani posits that consumers seek to maintain a balanced level of consumption throughout their lifetime. When consumers gain wealth, rather than save it, they will consume some of it in the current period so as to smooth their consumption over all periods. As a result, when household wealth increases (stocks, real estate prices, etc.) so does consumer spending. Therefore, as the stock market rises, household wealth increases causing aggregate demand to rise.

In the Eurozone, the wealth effect may differ across countries. For instance, in nations where consumers concentrate their investments in the stock market, aggregate demand should increase more than in nations where consumers hold fewer stocks. Consumer spending habits may vary too. Germans have long been accused of over-saving, evidenced by their nation's consistent current account surpluses. Therefore, when consumer wealth rises, German households may save their additional earnings rather than spend them. If true, these patterns would dull some of the broader macroeconomic effects resulting from a rising stock market.

Another mechanism is the exchange rate channel, whereby changes in interest rates affect foreign exchange markets. While the ECB never explicitly intends to depreciate the euro, Mishkin (2001) posits that expansionary monetary policy will do just that. The author reasons that as interest rates fall in response to central bank QE, assets denominated in the domestic currency, we'll say the euro, become less attractive. Investors, both foreign and domestic, seeking higher interest rates move their money out of euro denominated assets and into foreign

ones. The reduction in demand for euro denominated assets causes depreciation of the currency.

The net effect of a depreciating euro on Eurozone members is difficult to judge. On one hand, European countries tend to be large exporters; in 2016, Eurozone nations recorded a €238.1 billion trade surplus (Eurostat). A decrease in relative exchange rates (EUR/USD) would increase their export competitiveness in the world economy, boosting Eurozone economic growth. On the other hand, for euro denominated debts, the cost of servicing those debts increases as the value of the euro declines. As a result, household and business demand would decline due to higher debt payments. The size of national debts vs. total exports will determine whether the exchange rate channel contributes or detracts from a country's economic growth.

Another channel investigated is the confidence channel. Investor and consumer confidence has long been recognized as an important driver of economic growth. These seemingly sporadic "animal spirits" can tank bull markets, but also revive growth in a stagnant economy. The theory behind the confidence channel is similar to that of the expectations channel in that investor confidence derives from the central bank's commitment to stimulative monetary policy. The central bank's debt purchases signal to investors (and monetary policy loving consumers) the bank's commitment to economic stability. Changes in interest rates signal that other investors take the bank's actions seriously. Reassured of their doubts and optimistic of future economic growth, investors/consumers spend and invest more. Higher aggregate demand in turn increases economic growth.

Transmission Mechanisms at Work in the Real Economy

So what does the data show about the effectiveness of monetary transmission mechanisms on the real economy?

If the asset price channel functions as assumed, one would expect to see a rise in the stock market as result of declining interest rates. Preliminary evidence from the EuroStoxx 50, an index that follows the 50 largest blue chip corporations in the Eurozone, supports the asset price channel hypothesis. Following the announcement and implementation of the PSPP, the EuroStoxx 50 increased, gaining 13% between January 22nd and April 10th, 2015 (Yahoo finance). In the quarters that followed, the market gave back much of its initial gains. But to date, since the PSPP implementation, the index has risen roughly 14%. Subdued interest rates cannot

claim credit entirely, but the market's rise may be partially attributed to interest rate declines. Gains in the stock market, all else equal, increase consumer and business wealth. The subsequent rise in consumer spending and business investment should boost economic growth.

The depreciating euro further spurs economic growth. Following the implementation of the PSPP, the euro fell over 5% between January 22nd and April 10th, continuing its precipitous decline of the past few months. While the changing monetary policy stance of the ECB is partially to blame, changing policies of other major central banks may also have affected investor's preferences. During 2015, the Fed announced further plans to raise interest rates which may have induced capital away from Europe and into U.S markets.

Since April 2015, the Euro has rebounded as economic growth, and investors following it, returned to the region. But there is reason to believe, that the euro still retains a competitive advantage over its dollar counterpart. The Economist's Big Mac index, a "lighthearted" measure of currency over/undervaluation, rates the euro as undervalued by 8.4% (Economist). If true, research suggests that European nations would see benefits in the form of increased economic growth. It is long established that overvaluation of a currency hurts economic growth (Easterly 2005). But less research exists to prove causality in the other direction. Relying on a dynamic stochastic general equilibrium model relating the domestic price level with economic growth, Rodrik (2008) finds that currency undervaluation is associated with increased rates of economic growth. While his findings are strongest in developing countries, he notes that developed nations still see positive, albeit marginal, benefits. Relative difference in currency valuations make it more attractive to invest in undervalued countries and also make it easier for those countries to export to the world.

While the Big Mac index is hardly a perfect measure, the above research suggests that euro area economic growth could receive a boost from the cheap euro. It should be noted however, that Eurozone governments and central banks rarely intervene in currency markets. In fact, it has been the stated rule of the ECB not to comment on euro exchange rates for some time. As a result, it's difficult to prove causality, because domestic currency exchange rates and as a result, real exchange rates really are determined endogenously.

As mentioned earlier, business and consumer confidence impacts economic growth. Since the PSPP announcement, both are up. While subdued throughout much of 2014, economic sentiment among business and consumers in the euro area rose substantially in response to the

PSPP announcement (European Commission). Since that time, it has further increased, in part spurred on by reaffirmed commitment to monetary stimulus from the ECB.

But do changes in economic sentiment meaningfully affect the economy? De Bondt (2015) finds empirical evidence that suggests that, yes, they do. For confidence to be effectively transmitted to the real economy, both lenders and borrowers must feel it. The author uses the European Commission's economic sentiment indicator as a proxy for borrower confidence and data from the Bank Lending Survey to measure lender confidence. Using vector auto-regression models (VAR's), the author finds that both confidence indicators responded positively to ECB monetary policy announcements. Positive changes in lender and borrower confidence were found to both significantly increase real GDP growth in their models up to 8 quarters after the initial policy announcement. The author's findings warrant caution, however. Economic sentiment is difficult to assess empirically and changes in one survey may not reflect the feelings of the country, let alone a region like the Eurozone.

Economic Growth and GDP

The above findings suggest that the channels that direct the ECB's monetary policy towards the real economy function, at least to some degree. As consumer spending and business investment both contribute significantly to GDP growth, positive increases in the two should boost economic growth. To complete the macroeconomic puzzle, we must establish the relationship between economic growth and unemployment.

The relationship between economic growth and unemployment is so soundly accepted in economics that one might call it a law. Arthur Okun sure did when, in 1962, he stated that there exists an inverse relationship between economic growth and unemployment (Okun 1962). The law simply highlights an observed empirical relationship, however. But logically a relationship makes sense. Workers create widgets. The more workers there are working, the more widgets a society can produce. And inversely, the more widgets a society produces, the more workers it will require. However, to draw meaning/causation from Okun's law, one must establish the theory behind why increases in economic growth reduce unemployment.

The most fundamental theory derives from a standard growth model. Aggregate demand raises output which in turn reduces unemployment. Shocks to aggregate demand may be caused

by increased investment, consumer spending or fiscal policy. Demand incentivize businesses to produce more which requires them to hire more workers.

Many have formalized Okun's law through empirical analysis. Ball, Leigh and Loungani (2012) examines the short run accuracy of Okun's law. Using data from 20 OECD countries between 1980 and 2011, the authors find that Okun's law bears true over the short run in most developed nations. However, the strength of the relationship differs among countries.

Herwartza and Niebuhr (2011) agree with the theory behind Okun's law, but note that many factors influence how responsive a country's unemployment rate is to changes in economic growth. Performing a linear regression analysis, the authors look at the 192 EU15 regions between 1980 and 2002. The authors find that different institutions, labor market laws and the generosity of benefit systems affect how much unemployment responds changes in growth. For instance, the more generous a country's benefit system, the weaker the relationship between growth and unemployment. Additionally, the authors find that countries with highly coordinated unions, such as Germany, experience a .004% higher decrease in unemployment per unit of economic growth than countries with weakly coordinated unions. The authors posit that better coordination in unions reduces some of the negative effects that unions have on labor demand. The age of a country's workforce matters too. Countries with older work forces experience lower unemployment than those with younger workforces in response to economic growth.

The author's findings uphold Okun's law but suggest that European nations may respond differently to economic stimulus. A coordinated monetary policy may result in disparate effects in the different European countries. Additionally, many social structures changed following the financial crisis. Labor union's influence became weaker and governments restructured benefit systems. As a result, the author's findings may no longer apply to all European states.

Others critique the theory behind Okun's law. Citing the slow recovery from the 2008 recession, many say that policies that boosted aggregate demand did little to change unemployment. In other words, it was a "jobless recovery." Sahin, Song, Topa, Violante (2014) argue that there exist mismatches between workers and employers in the U.S that exacerbate periods of unemployment. The authors hypothesize that geographic, industry and skill mismatches prevent workers from finding employment. Using empirical data from U.S industry, they find that up to 1/3rd of the rise in unemployment following the financial crisis may be attributed to these mismatches. However, the author's model does not allow them to determine

which mismatches specifically are to blame. As it relates to the transmission mechanisms, the author's findings suggest that economic growth alone cannot explain unemployment.

Monetary Policy Lags

Before continuing, it must be mentioned that there exist lags between the time when a central bank implements monetary policy and when effects begin to appear in the real economy. When the central bank lowers interest rates or engages in asset purchases, financial markets respond quickly. The subsequent changes to the macroeconomic indicators mentioned above take longer to materialize. Additionally, unemployment often lags behind other economic indicators as firms take time to hire workers in response to changes in demand. The timing of the lags along with their causes remains a contentious subject.

Some studies find long lags between the central bank's actions and changes to the real economy. Looking at data between 1867 and 1960, Friedman (1961) finds in the U.S, peak growth national product (GNP) is only realized an average of 16 months after the culmination of stimulative monetary policy. Friedman reasons that the lag may be because firms respond slowly to changes in interest rates when deciding to invest. For many years, Friedman's findings established the doctrine that monetary lags are "long and variable." Others find shorter lag times. Tucker (1966) posits that while investment lags tend to be longer, consumption may respond to changes in monetary policy quicker. Empirical evidence suggests it may be as short as one quarter. Because financial markets respond quickly to changes in monetary policy, the asset price channel and the subsequent changes to consumer wealth may explain the quick changes in consumption. Lag time differences may be influenced by an economy's position in the economic cycle too. Using a similar framework to Friedman, Sprinkel (1959) finds that the monetary policy lag differs whether the economy is in recession or recovery. While the author find an average lag time of 19.5 months for economies in recession, during economic recoveries, lag time to peak GNP shortens to 8.5 months. Economies that are recovering may experience shorter lags because investors sense increasing demand and thus plan investments. Investors may respond to lower interest rates quicker as a result. Of the papers reviewed, none study specifically the lag time associated with QE. Although the program's end goal is the same as

traditional monetary policy, it may be that the effects of QE take longer to materialize. The subject certainly warrants further research.

No one theory explains how central bank's debt purchases affect the labor market. But the existing literature provides theories that, supported by empirical evidence, might explain it. The bank's initial debt purchases decrease interest rates as investors rebalance their portfolios and adjust their expectations. After some unknown, and perhaps considerable, time passes, lower interest rates beget stock market investment which in turn boosts consumer wealth and increases business investment. Paired with lower exchange rates and increased consumer/business confidence, economic growth increases. And after all that, unemployment declines. But is it true? Do the effects that occur in the financial markets ever seep into the real economy? Keep reading to find out!

4. Research Question

This paper investigates the varying effects of the ECB's QE program on Eurozone economies. Specifically, it seeks to establish whether the amount of sovereign debt that the ECB purchases from European governments affects the unemployment rates in those countries. As unemployment is often used as a proxy for economic health, the findings of this paper may be used to explain whether, and by how much, the ECB's debt purchases influenced the speed at which countries recovered from the global financial crisis of 2008.

Analytical Framework

This paper employs a linear population regression model using a panel dataset to investigate the relationship between PSPP purchases and monthly unemployment rates. The use of a panel data set distinguishes this paper from others, such as Gambetti et al. (2017) and Andrade et al. (2016) that also examine the effects of the ECB's debt purchases on the real economy. Many of the other studies rely on Eurozone aggregate data for their analyses. The problem with such an approach is that economic conditions vary across the region and certain dominant economies skew the data. Germany, the largest economy in the Eurozone, arguably recovered the quickest from the great recession. The rest of the region recovered slower. In

smaller countries, such as Spain or Italy, economic conditions took years to improve. But in the aggregate data, their story is eclipsed by the strength of the German economy.

This paper mitigates the problems with economic aggregates by sourcing data from each of the 18 Eurozone countries over a period of 33 months. The panel model captures cross country heterogeneity whereas a model using European aggregate data does not. In other words, individual country data allows one to see how the PSPP purchases affect each country differently. Additionally, one can determine whether the PSPP purchases were more effective in certain countries, represented by larger coefficients for the PSPP variable. The end result is more micro analysis of macro data. The discussion section, will include an evaluation of the ECB's purchases and whether changes to the distribution of their purchases would result in a more equitable recovery - evidenced by similar unemployment rates across nations - for Eurozone countries.

Included in the regression are a number of independent variables that may explain changes in unemployment. Their inclusion amounts to a sample of the myriad of macroeconomic variables that influence labor markets. The chosen variables tend to have the most dominant effects on unemployment and their significance appears well backed up by the literature. By including multiple explanatory variables, I will be able to see how the ECB's debt purchases affect unemployment holding constant the effects of other relevant factors. All data is available free from the ECB website and Eurostat. The variables included in the regression along with the reasons for including them, are listed below:

$UnemploymentRate_m$ - The monthly unemployment rate for each of the 18 Eurozone countries (Eurostat). For this analysis, it serves as the dependent variable. The unemployment rate is calculated as the number of unemployed workers in an economy divided by the total labor force. It shows the number of people actively looking for a job that cannot find one. As it represents the demand for workers in an economy, the unemployment rate is one of the most frequently used proxies for economic health. The more people that have jobs, the stronger the economy. Economists use real GDP growth to judge an economy's strength, too. For instance, in providing evidence for the Eurozone recovery, Gambetti et.al (2017) finds that the ECB's QE program boosted real GDP growth in the Eurozone. However, GDP growth does not accurately reflect an individual's situation; growth may be dominated by certain industries and only select groups may reap the benefits from the growth. And while lower unemployment often accompanies

economic growth, Sahin et al. (2014) notes that one does not always beget the other. Evidence from the U.S suggests that economies may experience "jobless recoveries". Therefore, to judge how well Eurozone countries recovered from the 2008 financial crisis, this paper uses the unemployment rate, as it provides a better indicator of the overall strength of an economy.

$ECBPurchase_m$ - The monthly PSPP purchases by the ECB from European governments measured in 100 EUR millions (ECB). I suspect that there exists an inverse relationship between ECB debt purchases and unemployment. Previous studies have connected ECB debt purchases to real economic growth (see Gambetti et al. (2017)) but none have extended the analysis to include unemployment. As mentioned in the literature review, debt purchases should transmit positive signals through various transmission mechanisms to the real economy, which in turn should reduce unemployment. Thus, countries where the ECB purchases large amounts of sovereign debt should experience lower rates of unemployment compared to countries where the ECB purchases less debt.

$ECBPurchaseSlopeDummy_m$ - The slope dummy is 0 for low growth countries and the $1*ECBPurchase_m$ for high growth countries. To split the countries into groups, I first find the median GDP growth rate for the 18 Eurozone countries. I then divide the countries into two groups, those with median growth rates higher and those with median growth rates lower than the median for all countries. The high growth countries are: Cyprus, Ireland, Latvia, Luxembourg, Malta, Netherlands, Slovakia, Slovenia and Spain. The low growth countries are: Austria, Belgium, Estonia, Finland, France, Germany, Italy, Lithuania and Portugal. I suspect that PSPP purchases affect the groups differently. However, I do not know whether the PSPP purchases are more effective in high growth countries or low growth countries so the expected sign is unknown.

$EuroDollarXRate_m$ - The monthly average Euro/Dollar exchange rate (Eurostat). The analysis uses Euro/Dollar exchange rates because the dollar serves as unit of transfer for much of world trade (Amadeo, 2018). For a net exporting region like the Eurozone, depreciation of their currency against the dollar makes exports relatively more competitive. Rodrik (2008) finds empirical evidence that the competitive advantage derived from a depreciating currency positively correlates with economic growth. I expect a positive relationship between Euro/Dollar exchange rates and unemployment as decreases in the exchange rate should boost economic growth leading to lower unemployment.

GovBondYield$_m$ - Monthly European government 10-year bond yields on the secondary market (Eurostat). Government bond yields are the primary mechanism by which monetary policy influences the real economy. They serve as benchmarks for interest rates on other assets. Interest rates affect bank lending and consumer/business borrowing which may lower unemployment through the channels discussed in the prior section. I therefore expect a positive relationship between bond yields and unemployment rates. The strength of the connection is unknown, however. It may be that bond yields respond little to the ECB's debt purchases. If that is the case, the resulting connection between bond yields and unemployment will be weak.

GDPGrowthRate$_m$ - A country's GDP growth rate compared to the same quarter one year ago (Eurostat). The data is converted into monthly format by repeating the quarterly GDP growth rate for each three months in the quarter. A strong inverse empirical relationship - best evidenced by Okun's law - exists between economic growth and unemployment. Economic growth signals increased aggregate demand which in turn should lead to higher demand for workers. Therefore, while no causation may be inferred, I expect GDP growth to be negatively correlated with the unemployment rate.

GovActivity$_m$ - Government revenue minus total expenditures as a percentage of GDP (Eurostat). The statistic explains, "the extent to which general government is either putting financial resources at the disposal of other sectors in the economy and nonresidents (net lending), or utilizing the financial resources generated by other sectors and nonresidents (net borrowing) (Government Finance Statistics Manual 2001)." Larger negative values indicate higher government spending and thus enlarge the government's financial impact on the economy. One might expect such values during times of recession when the government undertakes expansionary fiscal policy. Higher government spending increases aggregate demand and thus may lower unemployment. As a result, I expect a positive relationship between *GovActivity* and unemployment. That is, as the government expenditures increase (*GovActivity* turns more negative) unemployment declines.

Inflation$_m$ - The moving 12 month average monthly percent change in the Harmonized Index of Consumer Price (HICP) inflation (Eurostat). HICP inflation ensures that all countries follow the same methodology when measuring price changes. The literature studying the relationship between inflation and unemployment is vast, but inconclusive in its findings. The decades old Phillips Curve states that high periods of inflation correspond to high unemployment rates and

vice versa. But recently, economists have begun to question the strong relationship purported to exist by the Phillips Curve as unemployment rates across the developed world decline while inflation remains low. With such inconclusive debate, I do not know what sign to expect from the relationship. Nonetheless, it is important to include inflation in the regression to account for the effect, however small, it may have on unemployment.

Choice of Lags

It is clear that uncertainty surrounds the debate over the length of time required for monetary policy to affect real economic variables. The choice of lags for this paper follows closely from Gambetti et.al (2017) which lags both real GDP and inflation 1-3 quarters. Their results show that their three choices of lag time do not change the results significantly. However, with no lag, their findings become insignificant. For my analysis, I employ relatively short lags to unemployment, between 0-6 months (0-2 quarters) and 12 months. The lag times are similar to those of Gambetti et.al (2017) but I assume a shorter lag because of the timing of the PSPP purchases and data constraints. When the ECB implemented the PSPP, it had been over 7 years since the beginning of the financial crisis. The economy was firmly in recovery mode. Sprinkel (1959) suggests that a shorter lag time thus may be appropriate. Additionally, financial markets priced in ECB's monetary policy decision prior to the actual start of asset purchases, thus the effects to unemployment derived from the asset price channel may have already begun.

Methodology

For the analysis, I perform an OLS regression on the panel dataset. For each of the 18 countries in the dataset, there is 33 months of data. Spread over 6 independent variables, that makes for 594 observations per country and a total of 6,570 observations for the panel set.

There are a number of factors that complicate the analysis of the PSPP's effect on the real economy. For one, data is scarce. Despite a large panel dataset, the time period available only spans 10 quarters. Variable lags further reduce the time period. Additionally, many factors influence unemployment. Even by including a number of explanatory variables, there will

always be unexplained bias in the data. While inherent problems exist, performing certain robustness checks ensures the soundness of the analysis.

Due to the many possible biases, it's impossible to know the true expected value of the population errors. Therefore, no constants are interpreted in this analysis. The number of observations per variable is sufficient at 33. However, as I lag unemployment to account for the monetary policy delay, the number of observations declines. Thus, by the 12 month lag, only 21 observations remain. While it would be interesting to test whether longer lags add significance to the variables, the availability of data does not permit it. Another problem may be that the explanatory variables relate to one another. However, the test for multicollinearity yields low mean VIF values suggesting that the linear relationship between variables is weak (see table 1). Because the regression uses a panel dataset, it is necessary to choose between a fixed and random effects model. Upon performing a Hausman test, the results show that a fixed effects model is suitable for all the multivariate models whereas random effects is suitable for the univariate models (see table 2). The data appear robust.

Population Regression Model

I perform three analyses to test the relationship between unemployment and ECB debt purchases. The first uses univariate models where the two different models reflect the different lags to unemployment (3-6 months). The second analysis, made up of 8 models, incorporates the explanatory variables. Each model (1-7) adds another one month lag to unemployment (0 month lag to 6 month lag) to account for the monetary policy delay noted by the literature. Model 8 increments the lag to 12 months. The third adds the slope dummy to test the whether a countries growth rate affects the PSPP's effectiveness. The general univariate and multivariate models appear below.

1) $UnemploymentRate_{it} = \beta_0 + \beta_1 EcbPurchase_{it} + \varepsilon_{it}$

2) $UnemploymentRate_{it} = \beta_0 + \beta_1 EcbPurchase_{it} + \beta_2 EcbPurchase_{it} + \beta_3 GdpGrowth_{it} + \beta_4 GovBondYields_{it} + \beta_5 Inflation_{it} + \beta_6 EuroDollarXRate_{it} + \varepsilon_{it}$

3) $UnemploymentRate_{it} = \beta_0 + \beta_1 EcbPurchase_{it} + \beta_2 EcbPurchase_{it} + \beta_3 GdpGrowth_{it} + \beta_4 GovBondYields_{it} + \beta_5 Inflation_{it} + \beta_6 EuroDollarXRate_{it} + ECBPurchaseSlopeDummy_{it} + \varepsilon_{it}$

$i = countries\ (1 \dots 18), t = months\ (March\ 30th, 2016 - November\ 30th, 2017)$

Results

Results from the univariate models vary. Model 1 shows that the PSPP correlates with lower unemployment and the results are significant at the 10% threshold. However, upon extending the lag to 6 months, significance between the variables disappears. In both models, the constant appears highly significant ($P < 0.01$) suggesting that there exists substantial missing variable bias.

Findings from the multivariate model indicate that PSPP purchases do not significantly affect Eurozone unemployment rates. While the PSPP variable often shows expected signs, the results are not significant to the 5% or 10% level. The model's eight variations show different lag times for unemployment. Of the eight model, five show the expected negative relationship between ECB debt purchases and unemployment. The relationship is most significant ($p < 0.2$) when unemployment lags by three months. This result is most closely in line with the findings of Gambetti et.al (2017) which finds that PSPP purchases positively impacted Eurozone real GDP growth when a 3 month lag is used. Based on the theory, an extension of their analysis should show unemployment declines as well. The largest coefficient for PSPP purchases appears in model 8 where a 12 month lag results in $EcbPurchase_{it}$ = -0.187. The findings from model 8 suggest, with 80% confidence, that a €100 million increase in monthly ECB sovereign debt purchases corresponds to a 0.187% decrease Eurozone country unemployment rates.

To simplify the analysis, the remaining discussion of independent variables focuses on model 3 where the overall R^2 is highest. GDP growth appears highly negatively correlated ($p < 0.01$) with unemployment supporting the relationship claimed by Okun's Law. Government bond yields show a significant ($p < 0.1$) positive relationship with unemployment. A 1% decrease in Eurozone government bond yields results in a 0.09% decline in unemployment. Unlike the other variables, the Euro/Dollar exchange rate shows an unexpected relationship with unemployment. Results suggest that when the euro appreciates 1% against the dollar, unemployment rates

decrease by 0.58%. The variable measuring government involvement in the economy suggests that as government expenditures increase (*GovActivity* turns more negative) unemployment declines. Lastly, inflation shows an unexpected sign. The model indicates that a 1% increase in monthly inflation results in a 0.127% increase in unemployment suggesting that the Phillips curve relationship does not hold. Results are insignificant, however. The mean R^2 value for the 8 models is .09 with the highest value coming from model 3 where $R^2 = 0.191$. The mean value suggests that holding all else constant, changes in the independent variables account for 9% of the observed variation in the unemployment rate. The empirical strength of the relationships also varies across countries indicated by the average in between $R^2 = 0.24$. The results, though often insignificant, are consistent with the established theory. However, the presence of unexpected variable signs suggests that significant unexplained bias plagues the analysis.

Results from the high growth and low country analysis yield the expected sign, although results are quite insignificant. For low growth countries, a €100 million increase in monthly PSPP purchases corresponds to a 0.137% decrease in unemployment. The slope dummy measures the impact of PSPP purchases on high growth countries and suggests that the same €100 million increase in monthly PSPP purchases corresponds to a 0.316% decrease in unemployment. The findings suggest that PSPP purchases have a larger impact in countries with high growth than in those with low growth.

Discussion

The results from the univariate Model 1 are in line with the established literature and show significance. However, after controlling for other macroeconomic conditions that influence unemployment, the significance disappears. This suggests that the ECB's monetary policy may not play a significant role in lowering Eurozone unemployment. Rather, wider macroeconomic conditions determine the strength of a country's labor market. The analysis is not so simple, however. And many important conclusions may still be drawn from the findings.

The relationship between GDP growth and unemployment, for instance, appears quite strong. Models 1-7, show a strong highly significant ($P<.01$) negative correlation suggesting that increased GDP growth is associated with lower unemployment. The findings support those of Ball et.al (2012) who find similar evidence of Okun's law. Interestingly, as the lag time for

unemployment increases, so too does the coefficient for GDP. When unemployment is lagged 3 months, a 1% increase in economic growth is associated with a 2.09% decrease in unemployment whereas when unemployment is lagged 6 months, the same GDP increase decreases unemployment by 4.67%. The findings suggest that unemployment may lag behind changes in the real economy and that the benefits to unemployment may grow stronger with time. The relationship only holds up to a certain point, however. By the 12 month lag, results become insignificant and the sign reverses. It may be that effects to unemployment peak at a certain point. More data is needed to determine that point, however.

The presence of unemployment lags presents a problem, but the unpredictability of monetary policy lags complicates the results of this study too. It is clear that lags influence the observed effectiveness of the ECB's debt purchase program. For instance, Model 1, where unemployment is not lagged, shows a positive relationship between the PSPP and unemployment, whereas Model 8, in which unemployment lags 12 months, shows a large negative relationship. One might expect that results from model 1 would show unexpected signs; As Gambetti et.al (2017) finds, one month is simply not enough time for central bank policy to affect real economic variables. The ECB's money must first flow through a number of channels, of which some are more efficient than others, before it reaches the real economy. Friedman (1953) posits that policy lags are long and variable. Modern technology increases the speed at which market participants receive and process new information, supporting the notion that lag time may be shorter now than when Friedman theorized it. However, the stringent labor market laws and sticky government contracts, cited by Herwartza and Niebuhr (2011) and present in many Eurozone nations, may clog transmission channels, thus slowing down monetary policy's perceived effect on unemployment.

The data show that the effectiveness of some of the channels activated by the ECB's policy changes with lag time. For instance, the sign associated with government bond yields is negative (unexpected) for models 1-4. However, when unemployment is lagged between 4-12 months, the sign switches showing that decreases in government bond yields result in lower unemployment. It may be that banks take time to adjust the interest rates they offer on loans or that business and consumers take time to incorporate the lower interest rates into their spending/investing schedules. Government activity also shows the expected sign in the models where lag time measures 5-12 months, indicating that government expenditure may play a role

influencing unemployment. One explanation for the lag could be that European governments take time to refinance their debt at the lower interest rates caused by the ECB's debt purchases.

Results from the high growth and low growth country comparison suggest that PSPP purchases affect high growth countries more so than low growth ones. In fact, the impact of PSPP purchases on unemployment in high growth countries is more than double that in low growth countries. It may be that high growth countries better take advantage of the benefits of relatively lower bond yields and thus the effects translate into more significant declines in unemployment. Economic growth raises confidence and encourages business investment and consumer borrowing. Lower interest rates make it easier to do both. The large insignificance of the slope dummy ($P<0.65$) should be noted however, so no real conclusions may be drawn from the findings. An analysis with more data could better provide answers.

Future analyses would benefit from a timeline longer than the two and a half years this study encompasses. Many factors, beyond those included in this study, influence unemployment. As a result, there exists missing variable bias in the model. In studies, like this one, with limited data, lags magnify bias because they result in the exclusion of a substantial portion of the data. For instance, model 8 lags unemployment by 12 months reducing the number of observations for unemployment from 33 to just 21. While permissible, small samples become more susceptible to bias as the relative explanatory power of the independent variables declines. More data would permit for longer lag time on unemployment resulting in more substantive analysis.

Additionally, the highly significant relationship between unemployment and GDP growth points to a potential drawback of this paper. The limited nature of the current model may attribute an undue portion of the changes in unemployment to GDP growth. The multivariate model relates PSPP purchases to unemployment rates, controlling for other exogenous factors, such as GDP growth, that also affect unemployment. However, the PSPP purchases should influence the independent variables through the transmission mechanisms discussed previously. For instance, lower interest rates activate the exchange rate channel which in turn should boost GDP. The strong empirical relationship that emerges between GDP growth and unemployment may be influenced by PSPP purchases but the model does not document that influence. Future analyses would benefit from the use of a simultaneous equation model which may explain the causal relationships between the independent variables.

The current model also only analyzes trends, not shocks. It may be that ECB's debt purchases did little to influence unemployment. Rather the declines in unemployment observed since 2015 simply follow a trend, caused by endogenous changes in the economy. The standard OLS methodology employed in this analysis does not detect shocks such as those potentially caused by the PSPP program. A dataset with adequate lags spanning from the start of the recession to 2020 combined with a model that accounts for shocks may better detect the true effects of the ECB's monetary policy on unemployment.

Germany vs PIGS Case Study

The results from the panel analysis show the average effect of the PSPP on Eurozone unemployment rates. While the analysis shows important findings, the PSPP affected Eurozone countries differently, evidenced by the model's average in between R^2 of .24. In speaking about the great recession, journalists often contrast the sluggish recoveries of Portugal, Italy, Greece and Spain to that of Germany to highlight the varying effects that the financial crisis had on different countries. The shared weak economic conditions of the lesser economies earned them the nickname "the PIGS", after their respective country names. I thought it would be interesting to examine how the PSPP affected the PIGS compared to how it affected Germany. It should be noted that the ECB deemed Greece ineligible to participate in the PSPP due to its low credit rating so I only analyze the other three countries. The OLS regression results for the subgroup of Portugal, Italy and Spain vs Germany are shown in table 3. For the analysis, I use a three month lag on unemployment as it has the highest significance ($P > 0.22$) of all the lags. The three countries recovered from the recession much slower than Germany and the regression results highlight an important debate regarding how the ECB conducts the PSPP.

Although the results are largely insignificant, the four chosen countries demonstrate how PSPP's effects may vary by country. For the PIGS regions, the relationship between ECB debt purchases and unemployment is more pronounced. For the PIGS, a €100 increase in ECB debt purchases correlates to a 0.24% decrease in unemployment whereas in Germany, the same purchase results in only a .02% decrease in unemployment. The findings suggest that the ECB's purchases may be more effective in certain countries than others.

Since the inception of the PSPP, different sides have argued over the criteria that determines how much debt the ECB's purchases from member countries. Germany argues that purchases should be conducted according to the amount of capital each country contributes to the ECB (the capital key system). Germany contributes the most money to the ECB. They reason that were the ECB to purchase more than the proportional debt from Eurozone countries, the ECB would effectively aid those nation using German capital. Others argue that the ECB should conduct purchases according to country need because economic conditions vary so widely across the region. The ECB mainly imposed the capital key requirement to soothe German protectionists who fear a wealth transfer to other member states.

The PIGS region would benefit if the ECB deviated from its capital key constraints. On occasion, the ECB has strayed slightly from the capital key system, but no serious change to the key has been proposed (Ashworth, 2017). The problem with the current system is that it effectively floods the stable bond markets with cash while withholding funds from markets that are more volatile. Bond markets in the PIGS region overflow with government debt as a result of years of generous fiscal spending. Bond prices are low and yields remain high relative to those in Germany (see graph 2). Were the ECB to abandon the capital key system and increase the PIGS' share of debt purchases, bond yields in the region may further decline, activating the various transmission mechanisms that, in theory, lower unemployment. The results from the comparative analysis indicate that the ECB's debt purchases have a stronger effect in the PIGS region. Modifying the PSPP to account for country need would cost the ECB less money while also ensuring a more equitable recovery for countries in the Eurozone.

7. Conclusion

This paper analyses the effects of PSPP purchases on Eurozone unemployment. I find largely insignificant results and discover, rather, that unemployment is more closely related to other macroeconomic variables such as GDP growth. The findings do invite further research however, when more data becomes available. For instance, while insignificant, the results suggest that PSPP purchases impact high growth countries more than low growth countries. And in the specific instance of the PIGS vs Germany, the findings suggest that the ECB's debt purchases more effectively lower unemployment when spent in Portugal, Italy and Spain. All of

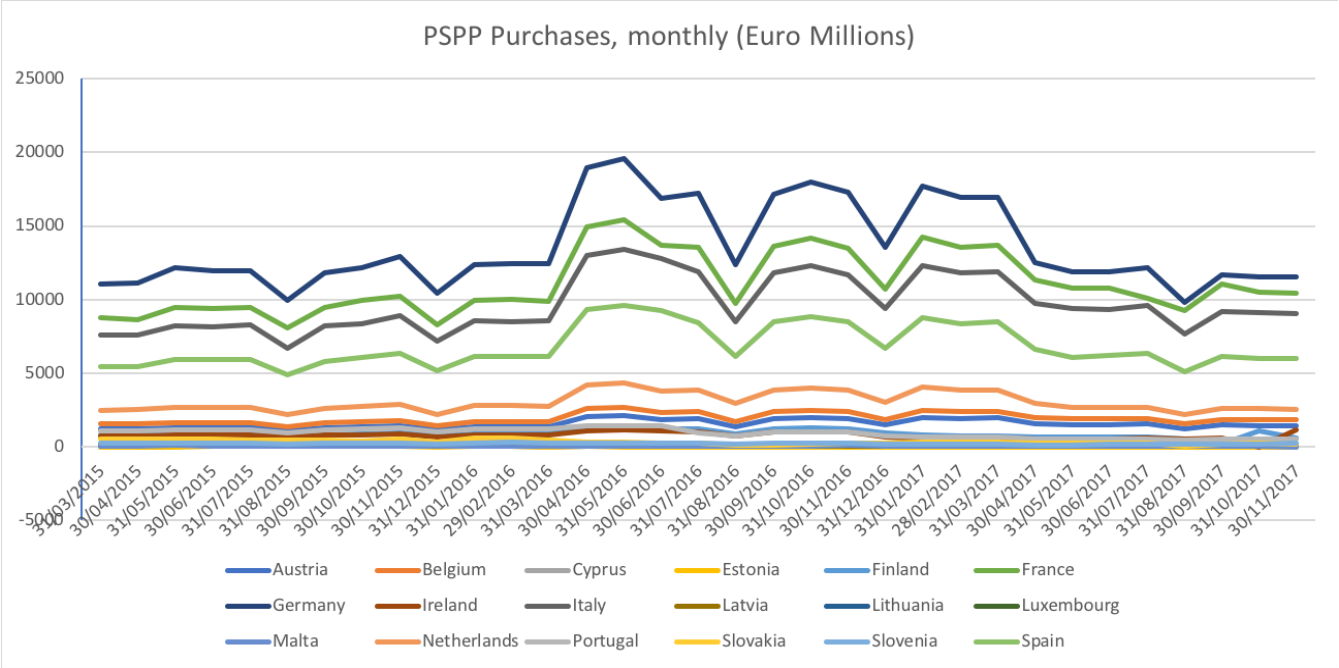
the results change depending on the lag time chosen suggesting that the choice of both monetary policy lag time and unemployment lag time is important. The initial findings of this paper may become more significant as more data becomes available. The PSPP program remains in effect and so it may be too early to judge how the ECB's purchases effect unemployment.

This paper invites future research. It's clear that monetary policy lags are imperfectly understood. Economists may understand how quickly a reduction in central bank interest rates affects the real economy, but less is known about how quickly QE affects real economic conditions. Additionally, much of the research into QE focuses on single country analyses (think the Fed and the U.S). The Eurozone presents researchers a great opportunity to investigate how a single central bank's actions can affect individual countries differently. Future research could investigate the economic conditions that influence monetary policy's effectiveness (GDP, population size, government regulation etc.). This paper serves as an introductory analysis to the relationship between monetary policy and unemployment. A more robust analysis, incorporating some of the suggested changes could provide policymakers insights into new applications for future QE.

Graphs

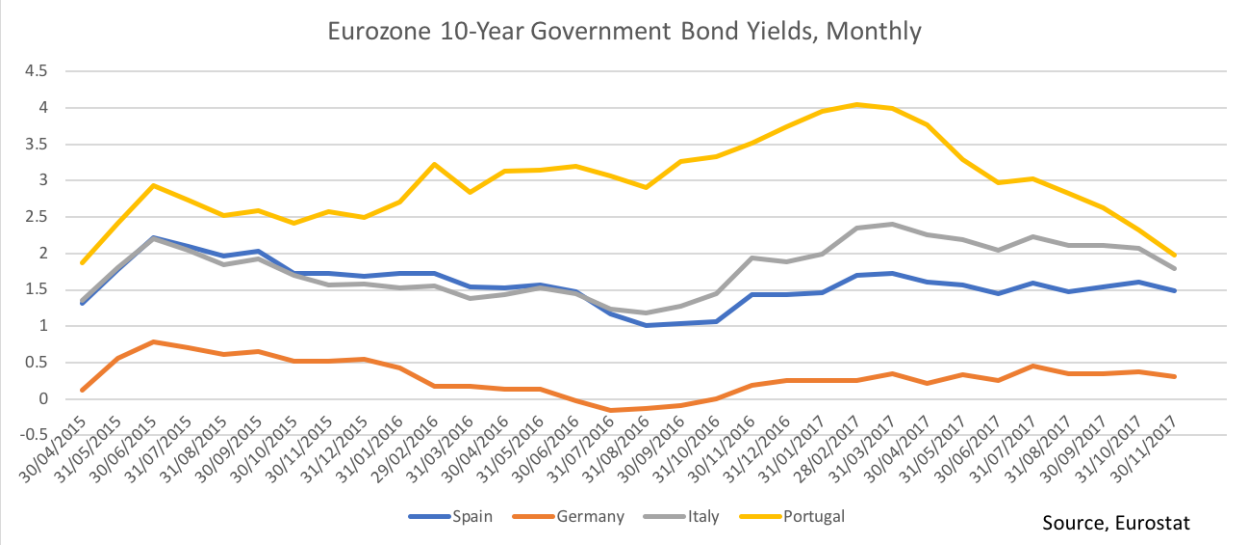
Graph #1

PSPP purchases by country



Graph #2

10-year government bond yields for PIGS and Germany



Tables

Table #1

VIF Test

Variable	**VIF**	**1/VIF**
$ECBPurchase_m$	1.08	0.87
$GdpGrowth_m$	1.06	0.97
$GovBondYield_m$	1.15	0.87
$EuroDollarXRate_m$	1.03	0.97
$GovActivity_m$	1.07	0.93
$Inflation_m$	1.17	0.08
Mean VIF	1.09	

Table #2

Hausman Test

	Univariate Model 1	Univariate Model 2	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Chi^2	0.83	1.87	18.24	11.74	12.25	16.33	30.42	39.80	85.36	15.20
$P>Chi^2$	0.36	0.17	0.00	0.07	0.06	0.01	0.00	0.00	0.00	0.02

Fixed Effects = consistent under Ho and Ha

Random Effects = inconsistent under Ha, efficient under Ho

Test: Ho: difference in coefficients not systematic

Table #3

Summary Statistics

Variable Name	**Mean**	**Std. Dev.**	**Min**	**Max**
$UnemploymentRate_m$	8.75	3.63	3.40	23.60
$ECBPurchase_m$	28.32	43.48	-0.34	195.73
$GdpGrowth_m$	3.27	3.75	-0.60	27.6
$GovBondYield_m$	1.13	0.95	-0.15	6.0
$EuroDollarXRate_m$	0.20	2.33	-4.41	4.66
$GovActivity_m$	-1.08	3.28	-10	8.1
$Inflation_m$	0.43	0.84	-1.8	3.6

Table #4

Expected Signs

Variable Name	**H:A**	**H:O**	**Sign of Coefficient**
$ECBPurchase_m$	B < 0	B >= 0	-
$GdpGrowth_m$	B < 0	B >= 0	-
$GovBondYield_m$	B > 0	B <= 0	+
$EuroDollarXRate_m$	B > 0	B <= 0	+
$GovActivity_m$	B > 0	B <= 0	+
$Inflation_m$	B = 0	B != 0	0
$ECBPurchaseDummy_m$	B = 0	B != 0	0

Table #5

Panel Regression (Univariate Models)

Dependent Variable ($UnemploymentRate_m$)	Model U1 (unemploymentRate-3)	Model U2 (unemploymentRate-6)

$ECBPurchase_m$	-0.16* (0.09)	-0.11 (0.10)
Cons	84.43*** (6.94)	82.39*** (7.25)
N	540	486
R^2	0.08	0.08
α_i	Random Effects	Random Effects

Table #6

Panel Regression (Multivariate Models)

Dependent Variable (Unemployment $Rate_m$)	Model 1 (no lags)	Model 2 (unemploymentRate-1)	Model 3 (unemploymentRate-2)	Model 4 (unemploymentRate-3)
$ECBPurchase_m$	0.01 (0.12)	-0.11 (0.12)	-0.14 (0.13)	-0.15[1] (0.13)
$GdpGrowth_m$	-1.45*** (0.51)	-1.69*** (0.52)	-2.01*** (0.54)	-2.59*** (0.56)
$GovBondYield_m$	-0.046 (0.05)	-0.09* (0.05)	-0.10* (0.53)	-0.08 (0.06)
$EuroDollarXRate_m$	-0.03 (0.55)	-0.58 (0.57)	0.34 (0.62)	-0.48 (0.62)
$GovActivity_m$	.624 (0.45)	0.024 (0.45)	-0.56 (0.46)	-1.07** (0.46)
$Inflation_m$	-1.56	0.13	-0.06	1.18

[1] Most significant p>0.226 with highest r^2 note high in between R2 = 0.2635

	(1.99)	(1.99)	(2.02)	(2.01)
Cons	90.33 (6.61)	97.68 (6.79)	99.34 (6.96)	98.12 (6.91)
N	6,570	6,552	5,534	6,516
R^2	.029	0.19	0.19	0.15
α_i	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects

Standard errors are in parentheses

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

Dependent Variable (UnemploymentRate)	Model 5 (unemploymentRate-4)	Model 6 (unemployment Rate-5)	Model 7 (unemployment Rate - 6)	Model 8 (unemployment Rate -12)
$ECBPurchase_m$	-0.08 (0.13)	0.08 (0.13)	0.13 (0.13)	-0.19 (0.16)
$GdpGrowth_m$	-3.28*** (0.57)	-4.05*** (0.57)	-4.67*** (0.57)	2.46 (1.49)
$GovBondYield_m$	0.006 (0.06)	0.13 (0.06)	0.22*** (0.06)	0.00 (0.08)
$EuroDollarXRate_m$	-0.05 (0.62)	-0.05 (0.62)	-0.27 (0.61)	0.05 (0.76)
$GovActivity_m$	-0.59 (0.47)	0.01 (0.47)	0.51 (0.46)	0.82 (0.59)
$Inflation_m$	2.46 (2.02)	4.41 (2.00)	5.73*** (1.98)	0.34 (2.52)
Cons	90.35	76.746	69.333	76.655

	(7.02)	(7.06)	(7.06)	(9.34)
N	6,498	6,480	6,462	6,354
R^2	0.02	0.03	0.05	0.08
α_i	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects

Standard errors are in parentheses

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

Table #7

High Growth vs Low Growth Country Comparison

Dependent Variable (UnemploymentRate)	Dummy Model 1 (unemploymentRate-3)
$ECBPurchase_m$	-0.14
$ECBPurchaseSlopeDummy_m$	-0.18
$GdpGrowth_m$	-2.59***
$GovBondYield_m$	-.076
$EuroDollarXRate_m$	-0.48
$GovActivity_m$	-1.06**
$Inflation_m$	1.10
Cons	98.49***
N	6,516
R^2	0.14
α_i	Fixed Effects

Standard errors are in parentheses

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

Table #8

By Country Panel Regression (Multivariate)

Dependent Variable (unemploymentRate)	Portugal, Italy Spain (y-3)	Germany (y-3)
$ECBPurchase_m$	-0.24 (0.22)	-0.02 (0.02)
$GdpGrowth_m$	12.93** (6.08)	-0.08 (0.71)
$GovBondYield_m$	-0.38** (0.16)	0.03 (0.02)
$EuroDollarXRate_m$	-1.18 (1.46)	0.21 (0.27)
$GovActivity_m$	0.65 (1.10)	0.26 (0.79)
$Inflation_m$	1.37 (5.07)	-5.72*** (1.12)
Cons	89.04 (34.13)	80.10 (4.48)
N	90	30
R^2	0.30	0.58
Adj R^2	N/A	0.467

Standard errors are in parentheses

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

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