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Author: Michael Reynolds

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The Long-Term Stability of the Euro

Focus: Convergence in the EMU

Michael Reynolds

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Department of Economics
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Abstract

In order for the Euro to be successful over time, certain conditions must be satisfied. First, the economies of the countries need to be similar so that a policy change does not cripple certain economies when it attempts to help others. Therefore, convergence among the interest rates of the different countries will be tested. Also, since the Euro has removed the individual monetary policies, the countries only have fiscal policy to use for stabilization of their economies. Provisions have been in place to prevent countries from overspending, which creates pressure for devaluation of the Euro. This paper will provide evidence that these countries have shown convergence in their economies since the inception of the Euro. It will also explore the literature surrounding the opinions about the role of fiscal policy. Together, these two topics will be used to support the belief that the Euro will be sustained in the future.
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I. Introduction

The topic of this thesis is the long-term stability of the Euro. In order for the Euro to be a successful common currency among the member states in Europe, certain conditions must be satisfied. First and foremost, the economies of the individual member countries must show similar reactions to economic shocks so that the monetary policy of the European Central Bank (ECB) can affect the countries as evenly as possible. At the very least, it is important that the monetary policy will help all of the countries involved when implemented rather than help some and cripple others. At the signing of the Maastricht Treaty in February 1992, the signing members “resolved to achieve the strengthening and the convergence of their economies and to establish an economic and monetary union including, in accordance with the provisions of this Treaty, a single and stable currency.”¹ This thesis will explore whether or not the aspirations of the member states have been realized, specifically through testing for convergence in their economies.

Additionally, since the member countries are now without a national monetary policy, the governments are left with only fiscal policy to affect their own economies. Since the ECB has to appease all of the member states, it is likely that there will be times when the change in interest rates determined by the ECB is different than what the member state would have chosen for its national economy. Therefore, fiscal policy is needed to overcome this difference. The current problem is that many of the countries are running deficits and are thus hindered with their ability to conduct expansionary fiscal policy, as it would increase the deficit. As a result, this thesis will also attempt to find signs that these countries will be able to solve economic problems when they occur.

¹ “Treaty on European Union.” Taken from European Union official website, www.europa.eu
primarily in their country. Through exploring the combination of convergence and fiscal policy, the goal of this thesis is to provide an opinion upon the future of the Euro as a stable world currency.

Europe has had some form of a pegged exchange rate among the countries for most of the period since World War II. It began with the signing of the Bretton-Woods agreement after a series of meetings in July, 1944. Each country fixed their currency to the US Dollar, which in turn was fixed to gold. This survived for almost thirty years, up until the point when countries began to speculate against the dollar and exchange their US Dollar reserves for gold, which forced Nixon on August 15, 1971 to announce that the US would no longer convert the dollar into gold. This eventually led to the demise of the Bretton-Woods agreement in 1973, as it lost credibility once the dollar was not on the gold standard.

After the collapse of the Bretton-Woods agreement, the European countries agreed to maintain a stable exchange rate system, which eventually led to the European Monetary System (EMS) and Exchange Rate Mechanism (ERM). These two systems forced the member countries to maintain exchange rates within a band of 2.25% per year above or below the rate determined from a basket composed of a weighted sum of the currencies involved. Only the Italian lira was allowed to fluctuate more, at six percent per year. The margin was expanded to fifteen percent for each currency in 1993 in order to minimize speculation against individual currencies, which had led to the removal of the British Pound from the ERM in 1992. Once the Euro was introduced into circulation in 1999, the ERM was replaced by the ERM II. The ERM II stipulated that the countries’ currencies cannot fluctuate more than fifteen percent from the Euro rather than from the
currency basket that had been the target under the ERM. Lastly, countries within the ERM II that satisfied more economic criteria were allowed to leave the ERM II and adopt the Euro, which is formally known as Stage Three of the Economic and Monetary Union (EMU).

The Euro was formally conceived as the third stage of the EMU on February 7, 1992 with the signing of the Treaty on European Union in Maastricht, Netherlands, known colloquially as the Maastricht Treaty. This treaty established the European Union and also provided for the adoption of the Euro, of which was stated, “The Community institutions and other bodies involved shall expedite all preparatory work during 1998, in order to enable the Community to enter the third stage irrevocably on 1 January 1999.”2 The first stage of the realization of the EMU began on July 1, 1990 and it laid the groundwork for the eventual transition to the Euro. Once the Maastricht Treaty was ratified, the second stage of the EMU marked this transition period leading up to the introduction of the Euro. Most importantly, this stage created the ECB while also being the period in which the ERM II was introduced. Finally, the third stage removed the national monetary policies and currencies and replaced them with the Euro and the ECB.

The Maastricht Treaty was signed by representatives from Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom to create the original twelve members of the European Union. On June 24, 1994, Austria, Sweden, and Finland accepted the Maastricht Treaty when they signed a Treaty of Accession to bring the number of member states to fifteen members. Another ten countries signed a Treaty of Accession on April 16, 2004 to bring the

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2 “Treaty on European Union.” Taken from European Union official website, www.europa.eu
number of member states up to the current level of 25 members, while on January 1, 2007, Bulgaria and Romania became the 26th and 27th members of European Union.

It is required that each country, except for Denmark and the United Kingdom, set a target date for the adoption of the Euro. Ideally, the framers preferred for all countries to be required to join the Euro, but after intense negotiation, the Maastricht Treaty added a clause that stated, “The United Kingdom shall not be obliged or committed to move to the third stage of Economic and Monetary Union without a separate decision to do so by its government and Parliament.”

Denmark had initially rejected the treaty and in return for ratification, they were able to obtain an opt-in clause that would permit them to have a referendum prior to adopting the Euro. The Maastricht Treaty took this into account by stating that the member countries have realized “that the Danish Constitution contains provisions which may imply a referendum in Denmark prior to Danish participation in the third stage of Economic and Monetary Union.”

Sweden is the only member from the original fifteen yet to have joined the Euro or been granted permission to abstain, hence it is required that they must convert at some point. Most recently, a referendum in 2003 to adopt the Euro failed as only 41.8% were in favor of joining (Miller and Taylor, 2003).

Although the Swedish government does not believe that they are required to eventually adopt the Euro, in fact they must, as they never obtained an opt-in clause when they ratified the Maastricht Treaty. Most of the remaining ten countries have target dates for inclusion within the next five years, with Slovenia being the most recent to join on January 1, 2007.

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3 “Treaty on European Union.” Taken from European Union official website, www.europa.eu
4 “Treaty on European Union.” Taken from European Union official website, www.europa.eu
In order for a country to join the Euro, certain economic requirements must be met, commonly referred to as the convergence criteria. There must be price stability, no excessive deficit, exchange rate stability, and interest rate stability.\(^5\) To fulfill the price stability requirement, the average inflation rate of the country must be within 1.5% of the inflation rates of the three countries with the lowest inflation rate. The government spending criteria is based upon the Stability and Growth Pact (SGP), which requires countries to have a deficit less than three percent of the GDP and a debt ratio less than sixty percent of GDP. The exchange rate stability criterion requires countries to be a part of the ERM or ERM II for at least two years and to have not devalued their currency during that period. Lastly, countries attempting to join the Euro need to have stability with their long-term interest rates. The rates must remain within two percentage points of the three best performing countries based on inflation data. Upon review of these criteria, the Commission will determine whether a member state “fulfils the necessary conditions for the adoption of a single currency.”\(^6\) Only then will a country be permitted to adopt the Euro, something which most recently occurred in May 2006 with Slovenia. Up for review in 2007 are Cyprus, and Malta, who are hoping to join on January 1, 2008.

So far, the Euro has shown signs of short-term and medium-term stability in the markets. Although over the first two years, the exchange rate with respect to the dollar depreciated from $1.19 per Euro to $0.8252, the Euro recovered once the currency was introduced for circulation in 2002. It appreciated back to its initial value and has been steadily increasing from $1.29 per Euro to $1.36 per Euro for most of 2007, reaching

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\(^5\) “Treaty Establishing the European Community,” Article 121. Taken from European Union official website, www.europa.eu

\(^6\) “Treaty Establishing the European Community,” Article 121. Taken from European Union official website, www.europa.eu
record highs in late April. It has so far shown stability in the short term and in the medium run from 1999 to 2007, therefore, it is left to determine whether this stability in the short and medium runs will translate over to long-term success.

This structure of the thesis will revolve around the attempt to determine if the current structure in the EMU will enable the Euro to be a success in the long run. Initially, it will explore the literature that deals with this topic by first reviewing the seminal international finance paper written by Robert Mundell nearly fifty years ago dealing with optimal currency areas, and then it will show how this paper still has great value in the modern world with regards to Europe. Afterwards, the current fiscal policy situation amongst the members of the Euro will be reviewed. It will explore the issues that have arisen in the recent years since the inception of the Euro, and it will deal with the problems that have been caused by the economic downturn during the initial stages of this period. Lastly, the literature review will conclude with a recent paper that studied convergence within the European economies. From there, the methodology section will lay forth the basics of the model used to deal with convergence and introduce a model that uses cointegration techniques to assess the extent of convergence. Finally, the results will be analyzed, and conclusions will be drawn about the future stability of the Euro.

II. Literature Review

The most basic question one can ask when analyzing the Euro is whether Europe is an area that will benefit from a common currency. What traits must an area have in order to obtain an advantage from using a common currency rather than a domestic
currency? Robert Mundell (1961) tackled this question in the era of Bretton-Woods by explaining why a series of currencies connected with a flexible exchange rate would be better than a system in which each currency was pegged to the dollar. However, his research can be extended to explain in which situations a common currency would be ideal. The benefits of a currency on a flexible exchange rate are that depreciation can offset unemployment and appreciation can offset inflation. Obviously, European countries using the Euro are no longer able to reap these benefits as they are all fixed to one another, which can pose a problem if the countries do not have economies that converge with one another. Therefore, Europe needs to show certain characteristics that will enable it to be an ideal currency area.

Mundell claims that factor mobility is the number one determinant for a currency area. He argues that stabilization would be more difficult under flexible exchange rates if factors were mobile. If factors are not mobile, flexible exchange rates would be the preferred mechanism. Therefore, if Europe exhibits a large amount of factor mobility now that the Euro is in place, it can be concluded that Europe is an optimal currency area according to Mundell’s research. One problem affecting Europe’s desire for a common currency is the lack of labor mobility. Barry Eichengreen (1992) has claimed that the low degree of labor mobility between the individual countries in Europe is a main reason why Europe is not an optimal currency area. Unlike in the United States where a move to a new region for employment purposes still allows one to live in America, a move to a new region in Europe would most likely require a change to a new country with a different language and a different culture. Thus, labor mobility is not as high as it should be in an ideal currency area.
Whether the currency area has multiple currencies or a single currency, the central banks cannot control both unemployment and inflation. In the case of a common currency, the pace of inflation is determined by the willingness of the authorities to allow unemployment to occur. When demand shifts from country A to country B, there are inflationary pressures in country B and a decline in output in country A, which leads to unemployment in country A. The central bank must decide between tightening to combat inflation in country B or expand to increase employment in country A. This will be the main issue that the ECB will have to deal with whenever they determine the interest rate level. Therefore, not only will the ECB have to maintain stability in the economy, political tactic will also be required in order to please each country when the policy does not help them as much as they had wanted. Thus, it will be necessary to account for the political appeasement of each country as well as the economic impacts whenever a decision is made.

While there are not absolute economic reasons for joining the Euro, there were political reasons that motivated countries to combine their currencies. Ben Bernanke (2004) claimed that the political benefits of a united Europe would be the creation of a political entity that could influence world events, provide a common defense, and reduce the chances of having another major conflict between European countries. Ideally, policymakers hope that they will create a cycle so that closer economic integration will lead to more political cooperation, which in turn will increase the chances for more economic integration, and so on. He then mentions that these political reasons are evident in the motives that nations such as Sweden and the United Kingdom had for joining the European Union because these countries had no interest in joining the Euro.
The Euro was launched on January 1, 1999 in eleven nations, and the conversion to a single currency in circulation was completed on January 1, 2002 with the removal of the national currencies. The motivation for the creation of the Euro varied from creating an alternative to the dollar in the world markets, imposing the economic model of Germany upon the rest of Europe, as well as being a form of political symbolism (Edmunds, 2002). Between 1999 and 2002, Euro-zone had seen a modest GDP growth of 1.7% compared to the 2.6% of the US. While it is low in comparison to the US, growth has been acceptable by historical standards. At the same time, the ECB has been able to keep inflation within the two-percent target rate. Although the Euro had appeared to be weak upon inception, dropping from $1.19 per Euro to $0.82 per Euro, it started its recovery in 2002 and has since become stronger relative to the dollar, reaching all-time highs in 2007.

There were a variety of reasons that explained systematically why the decline in the Euro was not a sign of it being a weak currency, which thus ensured that the Euro was stable in the initial short run. Timothy Edmunds (2000) summarizes these in his article reviewing the early years of the Euro. One major reason why the Euro was not weak was because the US economy was in the middle of a historic expansion at the outset of the Euro, which led to vast influxes of direct investment, especially in the technology sector. At the same time, Europe was in the middle of a stagnant economy with lower growth and higher unemployment than the US. As a result, companies were not interested in investing in Europe, and thus the demand for US currency was far greater than the demand for European currency. Euro defenders would claim that this depreciation would have been seen in the individual national currencies had the Euro not existed. Secondly,
the appearance of a weakness was caused by a cost of transitioning to a new currency. Prior to the Euro, the German Deutschemark was an extremely important reserve currency, with nearly a third of the deutschemarks being circulated outside of Germany. When it became evident that the deutschemark was going to be replaced by the Euro, some people decided to convert their deutschemarks into something else due to the uncertainty risk of a new currency. People preferred to have holdings in a historically stable currency such as the dollar, or they decided to place their money in other assets such as the housing market. Therefore, the demand for euros and currencies that would eventually be replaced by euros decreased, and hence, the exchange rate declined. After the Euro survived the initial years and became more stable, people became more confident in the Euro and began to use it as a reserve currency, thus contributing partially to the gain in the Euro since 2002. As a result, the initial weakness of the Euro can be attributed to factors other than the pessimistic view of the Euro being a doomed currency, and the revival after 2002 contradicts the pessimistic view.

The Euro also led to the inception of the European Central Bank (ECB), an agency that is required to provide an influential opinion on monetary policy. Timothy Edmonds (2002) gave a review of the ECB from a UK perspective. One criticism of the ECB at the time was that the Euro-zone economy was being outperformed by the UK economy, which in turn made the Monetary Policy Committee (MPC) of the Bank of England appear to be a more reliable agency. Obviously, the ECB had only been operational for three years at that point and managing twelve economies at the same time is not an easy task, but it would be ideal for the transition from twelve central banks to one to proceed as smoothly as possible. A second problem was, and still is, that the ECB
still has yet to make the Euro as dominant a currency as the US dollar. Once again, the lack of time is clearly a factor, but one would hope that the market share of the Euro would reflect the size of its economy compared to the United States and others. Thirdly, the ECB has been surprising the economy with their policy changes. So far the ECB has yet to prove itself to be a transparent and accountable central bank. At the time of publication of the Edmonds article, markets and economists had yet been able to determine what indicators the ECB had relied on mostly when deciding to change rates. The goal of the bank has always been to target the inflation rate and M3 monetary growth, but up until now, it has yet to be determined what the bank will do if one target is met and the other is not. As for accountability, the ECB President, Wim Duisenberg, has made some comments that have led the market to believe that the ECB is thinking in one direction, but in fact is not. He hinted in 2000 that the ECB would never intervene in the foreign exchange market to affect the Euro, which caused the Euro to plummet. However, during the following summer in 2001, the ECB proceeded to intervene in the foreign exchange market. Therefore, the ECB has yet to show that it is fully transparent.

Nevertheless, the ECB has succeeded in being able to maintain price inflation within the two-percent to three-percent range. Although they claim that the target rate is supposed to be below two percent, they have maintained a rate of inflation slightly higher but have been able to keep this rate stable. They also succeeded with the introduction of the Euro and the subsequent removal of the national currencies from circulation. At the same time, the ECB has not received complaints from individual countries when their policy does not affect these countries as well as a national monetary policy would. For example, the Bundesbank has not complained that inflation is too high, nor has Ireland
complained that their economy is overheating. They also have shown that they do care about the exchange rate of the Euro with their intervention in the summer of 2001. All of these are positive signs that both the member countries and the ECB want the Euro to be one of the world’s most dominant and successful currencies.

Since the Euro has placed the monetary policy in the hands of a central authority, it is important that the fiscal policy of the individual countries be monitored so that one country does not jeopardize the Euro by overspending. The budget discipline of the individual countries is guarded by the Stability and Growth Pact (SGP), which places a limit on the amount of money a government within the European Union is legally allowed to spend. Its goal was to create a budget discipline for each member nation to abide by as each country tries to get their economy prepared for the Euro and beyond. The SGP requires the deficit of the budget to be less than three percent of GDP and for overall debt to be less than sixty percent of GDP. As a result, member states in the medium run should attempt to balance their deficits so that when there is a downturn in the business cycle, the country will still be able to maintain the three-percent threshold. The intention was for the deficit and debt thresholds to be hard ceilings and sanctions would immediately be imposed. It succeeded initially, as the overall deficit in the Euro-zone was reduced from over four percent down to one percent by 1999, and all countries except Greece got below the three-percent threshold by 1997. Nevertheless, this discipline was short-lived, and after a few years, the SGP needed to be enforced. When key countries such as France and Germany crossed the thresholds provided, the European Commission recommended stepping up the sanctioning process. However, the Economic and Financial Affairs Council (ECOFIN) balked at sanctioning them and
instead drafted a reformed SGP. This immediately led to a loss in credibility of the SGP, and the future of budget discipline is now in jeopardy, as six of the twelve Euro countries have exceeded the three-percent threshold since 2002. Since the countries that are breaching the SGP are the largest countries whereas the smaller countries are the ones abiding by the rules, this could lead to future problems in which the large countries will try to flex their muscles in order to get what they want. Without the ability of countries to use devaluation in order to alleviate their debt problems, this could pose a future problem to the Euro.

The new SGP has broadened the number of exceptions to the three-percent threshold, in effect creating a soft ceiling for the member states. The medium-term objectives for budget discipline now vary slightly for each country as they depend upon growth rates and debt ratios, ranging from a deficit of one percent of GDP to a slight surplus. Those countries that are expected to be hit harder by a recession due to higher debt and lower growth will have to maintain a surplus in the medium run whereas stable economies will be allowed to run a slight deficit. Therefore, when a recession hits, the countries will still maintain the three-percent threshold.

Also included in the new SGP is a provision included for “exceptional cyclical circumstances” that will allow for countries to spend beyond the three-percent threshold if the increase in the deficit occurs from a negative growth rate or from a loss of output during a period where growth is extremely low. Regardless, the breach of the three-percent level must still remain temporary, and the deadline for correcting the problem will be a year after it was announced. According to Marco Buti (2006), although the new SGP has provided a better balance between flexibility and fiscal

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7 “Stability and Growth Pact.” Taken from European Union official website, www.europa.eu
discipline, the exceptions to the three-percent threshold make it appear that enforcing the SGP will become more lenient, especially with regards to the countries that can flex their political muscles. Nevertheless, the flexibility should remove part of the moral hazard of countries performing short-term spending cuts in order reach the three-percent threshold rather than make the structural change that will improve the budget in the long run. The measurement of the medium-run deficit will attempt to factor out these short-term measures and cyclical spending in order to keep that deficit less than one percent in the medium run. Therefore, the new SGP hopefully can reduce the incentive to plan the budget solely to reach the SGP guidelines, which will instead make countries spend for the future growth of the country.

This now brings the discussion to the impact and use of fiscal policy in the economy, which now plays an important role in economic planning as countries no longer have an independent monetary policy. Therefore, in order to combat economic shocks that only affect one member state, a country needs to conduct fiscal policy.

Immediately from the conception of the Euro, the framers realized that one major impediment to stability was the unsustainable budgets of the individual member states because it could lead to defaults and debt monetization. It was also realized that fiscal policy would become the cushion when there were national economic shocks and cycles since the monetary and exchange rate mechanisms were no longer national. This led to the restriction of three percent and sixty percent for the deficit and debt to GDP ratios previously mentioned. These worked well in the period leading up to the Euro because countries had the incentive of not being admitted into the Euro if they did not meet these restrictions. However, now that the incentive is no longer in place, countries have
become more relaxed. Secondly, countries did not have the incentive to be in a surplus in the days of strong growth during the late 1990s, which meant that they were pushing the three-percent threshold at the time when low growth began in 2001. Thus, when the bubble burst, the countries’ deficits were forced over the threshold, which in essence would force them to contract their fiscal policy so that they would have a deficit under three percent. However, contractionary policy during a weak cyclical period would be viewed poorly by the public. Thus, contractionary fiscal policy was not enacted and the rules were not enforced, as mentioned previously. Without the rules being enforced, this provides a further stress upon the Euro as countries currently face pressures to depreciate unless they fix their budgets. One major problem, according to Jonung and Larch (2004), is that the countries have a forecasting bias when they prepare their budgets. They are regularly overly optimistic when they plan their budgets so that they appear to balance, and when they fail, they blame a worse than expected outcome or bad luck in other sectors in order to defend the balance. Their solution is to produce an independent agency similar to the central bank that would attempt to create an unbiased budget forecast. In essence, they propose to remove some of the fiscal discretion in order to stabilize the fiscal policies across the EMU. It is hoped that by creating an independent agency to oversee the fiscal policies of each of the member states, countries will become more aware of the SGP thresholds and thus maintain budget discipline, which will provide more support for the long-term stability of the Euro. At the same time, it would allow the countries to still have fiscal sovereignty, unlike other papers that stress fiscal centralization in the Euro-zone, which seems unrealistic given the countries involved.
The final paper reviewed involves a similar model to the one that will be used in this paper. The paper is written by Christopher Baum and John Barkoulas (2006), and it deals with the German Dominance Hypothesis, which states that the other countries in the EMS depend upon the German short term interest rates to determine their rates. The period of interest in this paper was from 1980 up until the inception of the Euro. They used a fractional error correction model in order to determine the relationship, which is an advanced version of the model used in this paper. The results show evidence that the countries within the EMS during this time period depended upon the German interest rates in order to determine their rates, most likely to enhance their credibility in the markets because of the reputation of the Bundesbank. The model in the ensuing methodology section will build upon the framework described by Baum and Barkoulas and expand it to the current period. However, it will use long term government bond rates instead of the short term interest rates in order to allow for data after the inception of the Euro. This is necessary because the individual federal funds rates are now the same for each country due to the common monetary policy. Nevertheless, the model follows a similar structure to the one described in this paper.

III. Methodology

One of the major criteria for the future success of the Euro is the convergence of the economies that are currently using the Euro. Convergence is important because the countries gave up their ability to conduct monetary policy when they adopted the Euro. Therefore, in the long run, they will be forced to have similar economies so that the
impact of a monetary policy change by the European Central Bank is similar for each country. If convergence does not occur, it is possible that, in the long run, one country is negatively affected while other countries receive support. Most likely, this country would remove itself from the Euro, which could cause a major ripple effect if this country was a major country. This could lead to instability in the currency and future markets, which could inevitably cause the destruction of the Euro. Therefore, convergence of the economies is a strong requirement for future stability. This methodology section will create a model that can be used to test for convergence. It will be looking to see if there is a relationship between the economies as well as checking to see if this relationship has strengthened since the adoption of the Euro. Therefore, the model will be testing for structural change with the change being the introduction of the Euro into the economies of the Euro-zone.

The countries that will be explored are those major countries that have a large influence upon the European Union, and more specifically, the Euro-zone. It is not necessary to involve those countries within the European Union that are not using the Euro because although they might indirectly affect the Euro, they have no direct impact upon it. Therefore, the United Kingdom, Denmark, and Sweden will be excluded from the model. While it is possible that there would be evidence of convergence with these countries as well, it is more likely that the convergence would be due to the economic trade relations between these countries and their neighbors rather than a direct result of the Euro. In addition, the most recent twelve countries that have joined the European Union will not be considered for a variety of reasons, most importantly because they are each undergoing a vast transition as a nation, which would have a significant impact upon
their economic data. Second, like the UK, Denmark, and Sweden, they are not on the Euro. Lastly, most of the countries are former Eastern European communist countries. Therefore, data is not readily available before 1990 for these countries.

Also important for consideration is that the countries chosen should be ones that would create a strong ripple effect throughout other areas whenever one of those countries had an economic shock. While it is possible that a strong enough shock in Luxembourg would affect the entire Euro-zone, it is much more likely that a shock in Germany would have an impact everywhere. Therefore, it is important that the countries chosen be large in size. According to the World Bank and the International Monetary Fund, the six largest countries in the Euro-zone in terms of nominal GDP in 2005 are among the twenty largest countries in the world in terms of 2005 nominal GDP. These countries comprise 65% of the nominal GDP of the European Union and 88% of the nominal GDP of the original members of the Euro and Greece. These countries are, in order from largest to smallest, Germany, France, Italy, Spain, the Netherlands, and Belgium. Each country adopted the Euro on January 1, 1999, which makes the model simpler in that each country has the exact same time period for the change in monetary regime.

The specific type of economic data that will be used is the interest rates of the six countries. However, since the European Central Bank was created to deal with the monetary policy of the entire Euro-zone, each country has the same short term interest rates as they are all pegged to this funds rate. Therefore, the ten-year government bond rate will be used instead because it has still been allowed to fluctuate after the introduction of the Euro. The ten-year bond is also an interesting rate because it reflects
the long term view of the market, which plays well into the theme of the thesis. Ideally, it should be better at giving an insight to the success of the Euro in the long run. The data was obtained from the International Monetary Fund, and it ranges from March, 1978 up until July, 2007. Thus every data point was taken since the European Monetary System was established, which means that every time period had some sort of mechanism that forced the exchange rates of the countries to be tied together, with the Euro having the strictest conditions because it replaced all the currencies and removed any deviations between the exchange rates of the different countries.

The model that will be used to test the convergence of these six countries will be created from a simple OLS framework made to satisfy the assumptions of time-series OLS. The first assumption is that the data is linear in parameters. As a result, the basic equation for this model is:

\[ X_{jt} = \beta_0 + \beta_1 X_{it} + u_{it}, \quad j, i \in \Theta \]

In this model, \( X_{it} \) is the government bond rate for country \( i \) in time period \( t \) and similarly for \( X_{jt} \). \( \Theta \) is the collection of country \( i \)'s in the model, which are labeled from one to six as follows: 1 is Belgium, 2 is France, 3 is Germany, 4 is Italy, 5 is the Netherlands, and 6 is Spain. The dependent variable has a subscript \( j \), which will mean one specific country from \( \Theta \) whereas the variable with subscript \( i \) includes every country in the model. For the rest of this paper, \( i \) represents every country while \( j \) represents one specific country. Thus country \( j \) is always included in the set of \( i \) countries. Eventually, the subscript \( k \)
will be introduced, which represents all of the countries from $\Theta$ excluding $j$. Therefore, it will follow mathematically that the set $\{X_{it}\}$ equals the set $\{X_{jt}, X_{kt}\}$ for the duration of this thesis. Each of the beta coefficients other than $\beta_0$ will be the transpose of a $6 \times 1$ matrix in which row $m$ will correspond to one of the six countries already mentioned. Likewise, let $X_{i(t-\tau)}$ each be a $6 \times 1$ matrix in which row $m$ will correspond to the bond rates of these same six countries $\tau$ periods prior. Therefore, the product of these two matrices will be a $1 \times 1$ matrix, which is the same dimensions as $X_{jt}$, $\beta_0$, and $u_{it}$.

The second assumption of time-series OLS is that no variable in the model can be written as a perfect linear combination of the other variables. This would have been a problem if the short term rates were used since they are exactly the same from 1999 onwards. However, since the government rates are allowed to fluctuate, this assumption is satisfied.

The third assumption of zero conditional mean will require some amendments to the basic model in order to be satisfied. It states that the error term $u_{it}$ is uncorrelated with $X_i$ at any point in time. It seems likely that the error term is contemporaneously exogenous, but it would be unreasonable to assume that it is not correlated with the variables from other periods, especially the recent past. It is unlikely that the error term is correlated with the variables from periods far back in time. At the same time, it is unlikely that the values far in the future will have any relationship with the error term in the present or be influenced by the error term. It is possible that there is correlation between dates far apart, but any impact of the error term upon the past and future values of $u_{it}$ will be controlled for once cointegration is added to the model. However, assume for now that there is no correlation between the error terms and the values far away in
time. Therefore, it is the recent past and future data that needs to be controlled. Intuition says that the recent values of the data will have an impact upon the current bond rate. This is because information does not travel instantaneously nor is it processed instantaneously. Markets are fast to react, but small impacts specific to a certain country might take a month or more to affect the rest of the Euro-zone. It would not be surprising either if a country depended upon its own lags as well. Therefore, the lagged values of all of the countries must be included into the model. A selection order criteria test will run a series of likelihood tests to determine how many lags should be included in the model. Running the selection order criteria test upon the data from the six countries yielded the following results:

<table>
<thead>
<tr>
<th>lag</th>
<th>LL</th>
<th>LR</th>
<th>df</th>
<th>p</th>
<th>FPE</th>
<th>AIC</th>
<th>HQIC</th>
<th>SBIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-2707.7</td>
<td></td>
<td>.588252</td>
<td>16.4967</td>
<td>16.5243</td>
<td>16.5659</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>184.124</td>
<td>5783.7</td>
<td>36</td>
<td>0.000</td>
<td>1.7e-08</td>
<td>.863976</td>
<td>.670654</td>
<td>.379373*</td>
</tr>
<tr>
<td>2</td>
<td>271.32</td>
<td>174.39</td>
<td>36</td>
<td>0.000</td>
<td>1.2e-08*</td>
<td>-1.1752*</td>
<td>-.81617*</td>
<td>-.275219</td>
</tr>
<tr>
<td>3</td>
<td>301.831</td>
<td>61.023</td>
<td>36</td>
<td>0.006</td>
<td>1.3e-08</td>
<td>-1.14183</td>
<td>.617101</td>
<td>.173519</td>
</tr>
<tr>
<td>4</td>
<td>335.949</td>
<td>68.236</td>
<td>36</td>
<td>0.001</td>
<td>1.3e-08</td>
<td>-1.13039</td>
<td>-.439955</td>
<td>.600335</td>
</tr>
<tr>
<td>5</td>
<td>362.67</td>
<td>53.441</td>
<td>36</td>
<td>0.031</td>
<td>1.4e-08</td>
<td>-1.07398</td>
<td>-.21784</td>
<td>1.07212</td>
</tr>
<tr>
<td>6</td>
<td>408.212</td>
<td>91.085</td>
<td>36</td>
<td>0.000</td>
<td>1.3e-08</td>
<td>-1.13199</td>
<td>-.110144</td>
<td>1.42948</td>
</tr>
<tr>
<td>7</td>
<td>444.797</td>
<td>63.17</td>
<td>36</td>
<td>0.000</td>
<td>1.3e-08</td>
<td>-1.16594</td>
<td>.02161</td>
<td>1.81091</td>
</tr>
<tr>
<td>8</td>
<td>484.127</td>
<td>68.66</td>
<td>36</td>
<td>.001</td>
<td>1.3e-08</td>
<td>-1.15579</td>
<td>.197467</td>
<td>2.23643</td>
</tr>
<tr>
<td>9</td>
<td>512.92</td>
<td>57.585</td>
<td>36</td>
<td>0.013</td>
<td>1.4e-08</td>
<td>-1.11197</td>
<td>.406985</td>
<td>2.69562</td>
</tr>
<tr>
<td>10</td>
<td>539.49</td>
<td>53.141</td>
<td>36</td>
<td>0.033</td>
<td>1.4e-08</td>
<td>-1.05465</td>
<td>.630011</td>
<td>3.16832</td>
</tr>
<tr>
<td>11</td>
<td>565.395</td>
<td>51.809</td>
<td>36</td>
<td>0.043</td>
<td>1.5e-08</td>
<td>-.993282</td>
<td>.857087</td>
<td>3.64506</td>
</tr>
<tr>
<td>12</td>
<td>591.026</td>
<td>51.262*</td>
<td>36</td>
<td>.048</td>
<td>1.7e-08</td>
<td>-.930247</td>
<td>1.08583</td>
<td>4.12347</td>
</tr>
</tbody>
</table>

Since the asterisks signify the optimal number of lags, the results show that two lags is the most common choice, with one test opting for one lag and another for twelve lags. Therefore, the basic model will be amended to include two lagged values for each country, as shown below:
Another problem with the assumption of zero conditional mean is that some countries in general have higher rates than other countries due to causes that are country specific and not dependent upon time. For example, Italy might be considered to have a higher risk than other countries because they have had a history of high inflation, and thus their bond rate might be higher than average. On the contrary, Germany might be considered to be a safe bet because the Bundesbank has a strong focus on inflation, and therefore, they might have a lower bond rate. Or it could be some other unexplained heterogeneity factor that causes the average rates between the countries to be different. These factors do not depend upon time, thus they are time invariant factors and do not receive a \( t \) subscript. There could also be a time variant factor such as a trend that changes the bond rates from different periods, which would be explained by the inclusion of a variable for the time, \( t \). Therefore, equation (2) will become the following equation:

\[
X_{ij} = \beta_0 + \beta_1 X_{i(t-1)} + \beta_2 X_{i(t-2)} + a_i + u_{it}, \quad i, j \in \Theta
\]

Since there is no data available that can be used to explain the \( a_i \) variable matrix, a 6\times1 matrix similar to the \( X_{it} \) matrices, the \( a_i \) matrix cannot be measured in the model. Therefore, it needs to be effectively removed from the model in order to satisfy the assumptions already mentioned. Taking the first difference will maintain the meaning of
the beta coefficients while removing the unobserved heterogeneity because it will subtract the equation from time $t - 1$, which will eliminate the $a_i$ term because it does not change over time. As a result the model will become the following:

$$
(4) \quad \Delta X_{jt} = \gamma_0 + \beta_1 \Delta X_{i(t-1)} + \beta_2 \Delta X_{i(t-2)} + \Delta u_j, \quad i, j \in \Theta
$$

This model now satisfies the first three assumptions of time series OLS, which makes these estimators unbiased and consistent. Therefore, these estimators are the ones that will be used for the final model, but the variances still need to be adjusted in order to produce efficient estimators and accurate tests. The next two assumptions deal with heteroskedasticity and serial correlation in the error terms. In general, both are expected to be present in the model when the government bond data is used. Shocks in economies tend to last multiple periods, especially when the data is monthly. Thus, there is a strong chance of serial correlation. It is likely that the lags in the model will account for serial correlation. However, it is best to be cautious and account for serial correlation by adjusting the standard errors. Similarly, heteroskedasticity is likely to arise in this model because there have been certain prolonged periods when there was not much variation in the data, and other periods when the rates spiked, such as the early 1980s. Hence the variance in the former period would be smaller than in other periods, while the variance in the latter period would be larger than other periods. Thus the variance of the error terms does not remain constant over the different periods. It could also be affected by outside variables of unknown form. In order to solve this problem, Whitney Newey and
Kenneth West (1987) developed a method to create standard errors that are robust to both heteroskedasticity and serial correlation. They subsume the usual White robust standard errors by making the errors robust to serial correlation as well. The coefficients in the model are the same because they are consistent and unbiased estimators, but their standard errors need to be adjusted. Therefore, if the regression is done using Newey-West errors, assumptions four and five will be satisfied. Since events can be affected by seasonality, the Newey-West regression will allow for a full year of data to be included in order to remove the serial correlation. Thus, the regression will be set with a maximum lag order of autocorrelation at twelve lags. The final assumption of normality is assumed to be true given a data size of 339 periods and the Central Limit Theorem. Therefore, the usual test statistics and confidence intervals can be calculated. As a result, the model satisfies the six assumptions of time-series OLS, and the equation above will be the basis of the final model used in this paper.

The model used for this thesis is a modified Vector Error Correction Model (VECM) that deals with structural change and includes the Newey-West errors. The first step of the VECM is determining if cointegration exists. Cointegration is the notion that a linear combination of the variables in the model is a stationary process. The presence of cointegration would lead to the conclusion that the variables in the model move similarly with one another. This is expected in this situation because the variables all are dependent upon the Euro. Therefore, shocks in one country are expected to have an effect upon another country. A requirement for cointegration is that the variables used in the model are integrated of order one, or I(1). This means that they are unit root processes, and the first difference of the process is weakly dependent, or I(0). The
importance of an I(0) process is that the variance of an I(0) variable is finite, and innovation only has a temporary effect upon $X_{it}$ as it is expected that the variable will regress to the mean. Therefore, OLS can be regressed on the level values of the variables that are I(0). However, many variables show dependence upon its value in the preceding period, which means that these variables would not be I(0) processes. If the differences of these variables are I(0), then these variables are integrated of some order of at most one. In this case, the variance approaches infinity as $t$ approaches infinity, and innovation has a permanent effect upon $X_{it}$. Thus, the level values cannot be used in the model, and the differences must be taken. An augmented Dickey-Fuller test was done to determine whether the government bond rates are I(0) and whether the differences are I(0). The test does not say whether a process is I(1), but it does give the conclusion that these processes are integrated of some order, which will be assumed to be one. The test will allow for twelve lags to be part of the model, which represents a full year of data. It will also incorporate a time trend in case the rates have varied over time. The p-values obtained from these tests are shown in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Levels</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Belgium</strong></td>
<td>0.9497</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>France</strong></td>
<td>0.9275</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>Germany</strong></td>
<td>0.4296</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>Italy</strong></td>
<td>0.9415</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>Netherlands</strong></td>
<td>0.2593</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>Spain</strong></td>
<td>0.1064</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

A significant p-value would yield evidence that the variable is not a stationary process. Therefore, since none of the variables are significant even at the 10% significance level, their levels are not stationary. However, there is strong evidence that
their differences are stationary. Thus, the government bond data are at most I(1) processes as they depend highly upon the bond rate from the previous month. In order to keep the model away from the fractional correction model, it will be assumed that the data are I(1) processes.

Now that it has been shown that the variables in the model are I(1) processes, the next step is to determine the rank of cointegration. The linear combination of two I(1) variables is usually I(1) as well, but it is possible that it could be I(0). If this is the case, the variables are considered to be cointegrated. Therefore, an equation can be established between the countries that yields an I(0) process. Since there are six different countries in the model, there can be multiple cointegration equations that relate these countries, from zero to six. The Johansen test will be used to determine the rank of cointegration, which is equal to the number of cointegration equations. The results of the test are shown below:

Johansen tests for cointegration

<p>| Trend: constant | Number of obs = 339 |
| Sample: 1978m5 2006m7 | Lags = 2 |</p>
<table>
<thead>
<tr>
<th>maximum</th>
<th>rank</th>
<th>parms</th>
<th>LL</th>
<th>eigenvalue</th>
<th>trace</th>
<th>5% critical</th>
<th>1% critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>42</td>
<td>181.4663</td>
<td>0.14045</td>
<td>117.9706</td>
<td>94.15</td>
<td>103.18</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>53</td>
<td>207.11997</td>
<td>0.08631</td>
<td>36.0620</td>
<td>47.21</td>
<td>54.46</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>69</td>
<td>232.75998</td>
<td>0.05918</td>
<td>15.3832</td>
<td>29.68</td>
<td>35.65</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>74</td>
<td>236.99556</td>
<td>0.02468</td>
<td>6.9121</td>
<td>15.41</td>
<td>20.04</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>77</td>
<td>240.32826</td>
<td>0.01947</td>
<td>0.2467</td>
<td>3.76</td>
<td>6.65</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>78</td>
<td>240.4516</td>
<td>0.00073</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Johansen tests for cointegration

<table>
<thead>
<tr>
<th>maximum</th>
<th>rank</th>
<th>parms</th>
<th>LL</th>
<th>eigenvalue</th>
<th>SBIC</th>
<th>HQIC</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>42</td>
<td>181.4663</td>
<td>-1.3487923*</td>
<td>-6339139</td>
<td>-.82281</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>53</td>
<td>207.11997</td>
<td>-1.3110972*</td>
<td>-6708935*</td>
<td>-.9092624</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>69</td>
<td>232.75998</td>
<td>-1.2466937</td>
<td>-6675875</td>
<td>-.9464342</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>74</td>
<td>236.99556</td>
<td>-1.1873922</td>
<td>-6558063</td>
<td>-.9661356</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>77</td>
<td>240.32826</td>
<td>-1.1264517</td>
<td>-6288088</td>
<td>-.9616257</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>78</td>
<td>240.4516</td>
<td>-1.0945561</td>
<td>-6172791</td>
<td>-.9635886</td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>78</td>
<td>240.4516</td>
<td>-1.0780979</td>
<td>-6076095</td>
<td>-.9584165</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Since the asterisks show the rank of cointegration, the trace statistic suggests that the rank is one and this result is meaningful at the 5% and 1% significance levels. Therefore, this suggests that there is only one cointegration equation of the following form, as shown below:

\[
(5) \quad s_t = X_p - \varphi_0 X_{kt}, \quad i, j, k \in \Theta
\]

This is a legitimate OLS equation that represents the long-term relationship between the bond rates of the different countries, and it can be included in the model as the error correction term. If things stray too far from the long term equilibrium, the correction term will return the data back towards this equilibrium. Therefore, when the actual value of the dependent variable exceeds the predicted value calculated from the cointegration equation, the error correction term forces the value in the next period back towards this expected value.

A simple VECM model can determine the value for this error correction term. The VECM is a type of Vector Autoregression (VAR) that allows for the error correction variable. It relates each variable in the model to its own lagged values and the lags of the other variables in the model, as well as relates it to the error correction term. It also creates the cointegration equation for the model. There is no theory involved in this model, which allows one to merely observe the interaction between all of the variables. The resulting data for the cointegration equation is shown below:
Cointegrating equations

<table>
<thead>
<tr>
<th>Equation</th>
<th>Parms</th>
<th>chi2</th>
<th>P&gt;chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ce1</td>
<td>5</td>
<td>582.6251</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Identification: beta is exactly identified
Johansen normalization restriction imposed

| beta      | Coef.     | Std. Err. | z     | P>|z|     | [95% Conf. Interval] |
|-----------|-----------|-----------|-------|---------|----------------------|
| _ce1      |           |           |       |         |                      |
| belgium   | 1         | .         | .     | .       | .                    |
| france    | -.8790544 | .1478097  | -5.95 | 0.000   | -1.168756 - .5893527 |
| germany   | -.6089096 | .3437251  | -1.77 | 0.076   | -1.282598 .0647793  |
| italy     | .4639716  | .1186813  | 3.91  | 0.000   | .2313606 .6965827   |
| netherlands | -.9064603 | .3788197  | -2.39 | 0.017   | -1.648933 -.1639874 |
| spain     | .126327   | .0891719  | 1.42  | 0.157   | -.0484466 .3011006  |
| _cons     | 3.532055  |          |       | .       |                      |

As a result of the information above, which is jointly significant across all the countries with practically 100% confidence and individually significant at the five-percent level for every country except Spain, the cointegration equation can be plucked from the model and the variable $s_t$ can be created. Since we have determined that the data are unit root processes, the simple OLS equations (1) through (4) no longer have independent and identically distributed (i.i.d.) error terms. However, since they are I(1) processes, the equation that replaces the level values with their differenced values will have an i.i.d. error term. Thus, the error term in the model is not a differenced value because there was no i.i.d. error to be differenced in the equations using the level values, as these equations record an inaccurate error term. Therefore, equation (4), which had satisfied the time-series OLS assumptions can be adapted to equation (6) below by adding a cointegration variable and removing the difference from the error term:

$\Delta X_{jt} = \gamma_0 + \beta_1 \Delta X_{i(t-1)} + \beta_2 \Delta X_{i(t-2)} + \delta(X_{j(t-1)} - \varphi_0 X_{k(t-1)}) + u_{jt}, \quad i, j, k \in \Theta$
Finally, in order to test for convergence, a variable that represents the structural change must be included into the model. Once that has been accounted for, the model is ready to be tested and results can be given. In essence, this variable will be a dummy variable that will take a value of zero before the advent of the Euro and a value of one after the Euro entered the markets. However, the markets knew of the impending introduction of the Euro for years before it arrived. Once the Maastricht Treaty was signed on February 7, 1992, the markets were aware of the Euro, but most likely skeptical for the initial period. Therefore, the dummy variable should reflect a gradual increase from zero before the Maastricht Treaty to one after the Euro was introduced on January 1, 1999. A logistic curve was used to reflect this increase. It was then scaled so that it would equal exactly zero in February, 1992 and exactly one in January, 1999. This dummy variable, \( d_e \), is then interacted with all the terms in equation (6) to produce equation (7) below:

\[
\begin{align*}
\Delta X_{ji} &= \gamma_0 + \beta_1 \Delta X_{i(t-1)} + \beta_2 \Delta X_{i(t-2)} + \delta_0 (X_{j(t-1)} - \varphi_0 X_{k(t-1)}) + \gamma_1 d_e + \beta_3 \Delta d_e \cdot X_{i(t-1)} \\
&+ \beta_4 \Delta d_e \cdot X_{i(t-2)} + \delta_1 d_e \cdot (X_{j(t-1)} - \varphi_0 X_{k(t-1)}) + \Delta u_{iji}, \quad i, j, k \in \Theta
\end{align*}
\]

This is the final model that will be used to test for convergence in the government bond data. One regression for each country will be performed so there will be six regressions in total. Other dummy variables were tested besides the one with logistic curve, but the logistic curve had the highest F-statistic for each country. The other curves were linear, exponential, and one in which the logistic curve spanned an extra year. This last curve was interesting because the theory behind it was that the markets did not fully adapt to
the Euro until a year after it was introduced to the market. However, the data showed that the logistic curve that equaled one in 1999 fit better, which leads to the belief that the countries were prepared for the introduction of the Euro and were converging prior to the introduction of the Euro, further supporting to the efficient market hypothesis.

IV. Results

There will be five different tests for each equation generated. Hence, there will be thirty tests total that will be used to show that there is a relationship between these countries as well as showing that the relationship is growing stronger. The first test is a test created to see if the model is a significant model, which will determine whether there is a relationship between the different economies. A simple F-test on the model will determine the results, which are expected to be highly significant because cointegration has already been established. The second test will test for the effect of the structural change, which will test the significance of the modified dummy variable $d_e$ that was added to the model. Therefore, the test will need to be a joint significance test against the dummy variable and all its interactions. The third and fourth tests will be the same as the first two tests, but they will test the effect of the outside countries upon the dependent country. Therefore, the tests will assess the joint significance of all the variables, excluding the lags of the dependent variable. A final test will check for the significance of the error correction term.

The results are shown in the table below, with the F-statistic for each of the five tests and six countries given on the top line and the p-value reported below the F-statistic:
The results have shown that for the most part, there is a relationship between the major six countries in the Euro-zone, and this relationship has strengthened since the inception of the Euro. For each country, the model shows a significance of practically 100% for the relationship between the country and the entire data set, with a similar significance for the relationship between one country and the other five countries. These results are located in the first and third column of the table respectively. These results were expected due to the strong similarities between the countries involved and the amount of years that the countries have been pegging their currencies together with some form of an exchange rate mechanism. The interesting question was whether the linkages between the countries are stronger after the advent of the Euro than they were before it. These numbers are shown in the second and fourth columns. It is noted that in both columns, five of the six countries show significance at the 99% confidence level and above whereas Belgium shows significance at the 80% confidence level. Although
Belgium does not show a strong impact from the introduction of the Euro, it shows that it is likely that there was some sort of an impact of the Euro upon Belgium, albeit minor. The data also shows that collectively across the six countries, it is case that there is an extremely strong impact of the Euro upon the countries in the Euro-zone.

The last column shows the significance of the cointegration term. The importance of this term is to control for the error correction factor in each equation. As shown previously, the Johansen test showed that there is a cointegrating relationship between the countries, and the conintegration equation derived from the model had a significance level of practically 100%. Therefore, it is evident that the cointegration term should be included in the model, but would this term be significant across the six countries? From the results in the last column, this term is significant at the 99% level for Germany and Italy, while significant at the 95% level for the Netherlands. Belgium and France show some significance at the 80% and 70% levels respectively, but Spain shows no significance in this relationship between its bond rates and the cointegrating term. This is not surprising because the unit root tests had shown that there was evidence that the data for Spain are stationary at the 85% confidence level, while not stationary at the 90% confidence level and above. Therefore, the data for Spain are not likely to follow a unit root process, but also do not follow a stationary process as well. However, since the other five countries showed stronger results that the data are not stationary, it is allowed for Spain to be nonstationary as well because the data collectively are not stationary. A method of fractional error correction would provide a more accurate representation of this model, but the method is too complicated for the scope of this paper. In essence, it would allow for the data to be somewhere between a stationary process and a unit root process.
A second reason for the insignificance of Spain is that its significance level in the cointegrating equation shown previously was 0.136, which implies that the variable for Spain showed some evidence that it was not as cointegrated as the other countries. Therefore, it is not surprising to see that Spain does not depend upon the cointegrating variable as much as the other countries.

Two unanswered questions emerge from the results of the data. Why does Belgium show some signs that the Euro did not have a strong impact upon its economy when the other countries have extremely strong relationships? And why does data for Spain show some signs of following a stationary process whereas data for the other countries do not? The facts show that Belgium is the most heterogeneous among the countries because it consists of a mixture of French and German cultures. It is also the political center of the European Union, which could have some impact on the economy. At the same time, it has only been thirty years since the people of Spain have freed themselves of Franco and have been allowed to run the country. Thus the economy is relatively new compared to the others in the study. Whether these facts influence the results is left for another paper to decide.

V. Conclusion

In conclusion, the combination of the convergence of the government bond data and fiscal problems show that predicting the future stability of the Euro is not simple. From the information gathered above, it has been shown that the economies have become more similar and dependent upon each other since the inception of the Euro. Therefore,
it can be deduced that the monetary policy of the ECB will have a stronger impact upon the entire region when it conducts monetary policy, which is a strong indicator that there is a positive outlook upon the future of the Euro. On the contrary, the recent problems of the individual countries suggest that there could be fiscal issues that could force a country to consider leaving the Euro if these issues are left unchecked. Large deficits in individual countries could cause depreciation pressures, which cannot be immediately alleviated without intervention unless countries have their own currency. Therefore, it is vital to force the countries to abide by the Stability and Growth Pact or else the future of the Euro could be in jeopardy.

Nevertheless, the political ramifications of a unified economy lead to a strong incentive to keep the Euro, which should help persuade the countries to solve their fiscal debt problems without departing from their commitment to the Euro. At the same time, there will be transaction costs involved with returning to an individual currency that should also be an incentive to make the Euro succeed. Thus, it appears from the results of this thesis that although there do appear to be some problematic issues that have arisen since the inception of the Euro, there are many reasons that lead one to believe that the Euro is going to be a success in the long term, and it will continue to build off of its success in the short and medium runs.

However, this paper merely cracks the surface of this vast question of future stability. So many more factors are involved in the process, and they need to be looked at in order to provide a confident opinion about the future of the Euro. Most importantly is the question of labor mobility. Without mobility in the labor markets, prices and wages will vary across the countries, which will cause stress upon the Euro. Other areas of
future research could involve modifying the current model and performing a sensitivity analysis upon the convergence of the long-term bond rates. One example would be allowing different parameters in the cointegration term for the period before and after the advent of the Euro. This would allow one to test if there is a stronger cointegration between the countries since the Euro was adopted. Also, one could adjust the dummy variable to allow for it to extend prior to 1992, because it was increasingly expected that the Maastricht Treaty was going to be signed, especially because the first stage of the EMU had been in effect since 1990. The results from these alterations would be interesting, but they should not create any inconsistencies with the results from this paper, as there seem to be strong relationships among the countries. The idea that long-term interest rates for these countries are converging since the advent of the Euro is well defined in the data for the model, and it strengthens the belief that the Euro will survive in the long run.
VI. References

Baum, Christopher F. and Barkoulas, John (2006), “Dynamics of Intra-EMS Interest Rate Linkages”.


