Högskolan Dalarna

D-Level Thesis

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Inflation Convergence between Germany and Greece, Italy, Spain, Sweden, Turkey

- A co-integration Analysis

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Abstract

This paper looks for evidence of co-integration to the German inflation rate between the countries Greece, Italy, Spain, Sweden and Turkey. The method applied is based on econometrics since some certain statistical tests need to be performed to obtain more accurate results. The main tests used are Dickey-Fuller and Augmented version of this test which is vital to test for unit-root and co-integration in this paper. Since the data need to be stationary to perform the analysis in this paper, second difference and the deseasonalisation methods are also used for this purpose. Deseasonalisation method helps this paper progress in two means; to determine the months which have seasonal effect and to form another model with the help of the seasonal months, to obtain stationary series. Finally the original co-integration model is then tested again after deseaonalisation with Dickey-Fuller and Augmented Dickey-Fuller tests. After the tests, I found evidence that Greece, Italy, Sweden, and Turkey are co-integrating with German inflation rate whereas there is no evidence for Spain.

Table of Contents

1. Introduction

The economic convergence of the European countries is a subject that has been discussed and analyzed starting from the first phase of the evolution of the European Union. It was not easy to reach the agreement of a common currency. The countries had to follow certain stages of the European Monetary Union in order to prove that they were willing to implement the policies led by the European Central Bank(ECB). However it is an important point to check if they are still implementing the policies of the ECB. That is, are they converging in the way that ECB desires? This can only be checked by the economic indicators throughout the time. My study investigates the answer of the same question but in terms of inflation which is the key element of the convergence criteria put forth in the Maastricht treaty. Other purposes of this paper include presenting the situation of a candidate country, to clarify the role of inflation on a union and to explain the differences in the Phillips curve when in short and long run. Since it has been a subject of such big attention, many studies have been made about the inflation convergence of the European Union (EU). These studies examine one or more criteria by using econometric techniques such as the co-integration framework and error correction models. MacDonald and Taylor (1991) found convergence in real and nominal exchange rates and money supplies. Karfakis and Mochos (1990) used co-integration analysis to test for interest rate linkages holding Germany as a proxy in the period April 1979 to November 1988. Hafer and Kutan (1994) and Hafer, Kutan and Zhou (1997) again used co-integration analysis to test interest rate convergence for a group of EU countries in the period March 1979 to December 1990 and March 1979 to June 1995 respectively.

However it is even more interesting to include candidate countries of the EU since it will help a lot to decide if they should be let in. My study includes Turkey in the light of this. I take German inflation rate as a proxy to see whether Swedish, Spanish, Italian, Greek and Turkish rates are converging to it. Germany’s inflation rate is used as a measuring tool since it represents a consistency in the union and I aim to find if the countries in question are converging in the means of inflation with Germany which also will help me find out if they are implementing the policies set by the European Central Bank.

After this section, by the help of the inflation theories, I explain the effects of inflation and what it does to a single country which leads to better understanding of what it can do to a union. The role of the ECB in the EU and its policy and instruments follow. The third part includes the econometric analysis where I use time series data, Dickey Fuller and Augumented Dickey Fuller tests to test for unit root and co-integration. Deseasonalisation of the data is also included in this section and finally I move on to the conclusion where I present the results and comment on them**.**

2. Inflation, EMU[1], ECB

2.1 The effects of inflation:

Inflation has many negative effects on the economy and maybe one of the most significant of them is on the competitiveness of the country in the international market. This will lead to a policy which includes exchange rate depreciation so that some of the competitiveness can be regained. Increasing inflation will decrease the share of the goods in the world for the country in question which means the export rate will decrease. The country will end up importing from outside world instead of producing inside. Eventually this will affect the level of employment and the economic growth as a chain reaction.

The high prices in the country will urge the workers to demand higher wages as they want to keep their real standard of living. When they actually receive higher wages this will increase the unit labor cost since the wage differential is not the result of extra labor productivity. In other words, the workers are not assigned higher wages because they are producing more but because of inflation. The crucial point here is to be able to break this inflationary cycle since the process can start again making it harder to get rid of inflation at the end. In this case the inflation will be more and more structural if no precaution is implemented.

The inflation can also have a strong effect on the savings of the public by reducing the real value of the savings. This process is most clearly seen when the real interest rate is negative. (Of course high nominal interest rates will be present at the economy at this time). The same process is applied also to the debts of the people since the real value of their debts will diminish over time. Thus it is clearly seen that inflation favors borrowers rather than lenders. Those who choose to save money lose and those who choose to borrow money to pay back later win in a time of inflation.

The people with a fixed income at their job and pensioners will also experience a reduction in the real value of their earnings.

[1] European Monetary Union

Uncertainty is another effect disturbing the business planning and investment methods. It also results in inefficient allocation of resources since the public and the firms do not have unambiguous data about the future and can not decide clearly which goods to buy first or to produce.

2.2 Theories of Inflation:

2.2.1 Quantity theory of money:

The classical and the neo classical economists tried to explain the phenomenon of inflation by using the quantity theory of money. In its transaction version the quantity theory of money states that the value of all sales of goods must necessarily equate to the value of all purchases:

$$M*V=P*T \qquad (1)$$

M is the money supply, V is the velocity of money, P is the general price level and T represents the real volume of transactions. In this framework aggregate supply in the goods market is given.

$$AS=T \qquad (2)$$

Aggregate demand is given by:

$$AD=MV/P \qquad (3)$$

Now T may be interpreted as representing the real output, which is determined according to the long run production. Equilibrium in the goods market requires that AS=AD and hence

$$T=MV/P \qquad (4)$$

Now we assume in accordance with the classical economists, that V and T are constant in the short run. The transactions equation in the long run can then be rewritten to yield a price equation for the economy:

$$P= (\bar{V} / \bar{T}) M \qquad (5a)$$

Equation (5a) states simply that doubling the money supply doubles *ceteris paribus* the price level. That is the general price level is solely an increasing function of the money supply, or in other words an excess supply in the money market causes, other things being equal, an excess demand in the goods market. It should be added that the relative version of the equation (5a) can simply be interpreted as the inflation equation of the quantity theory of money:

$\pi = (v-g) + m$ (5b)

Where π, v, g, m represent the percentage changes in P, V, T and M respectively while v and g are assumed to be zero.

In its extreme interpretation, this simple classical or neoclassical approach states that inflation is only a monetary phenomenon if one ignores the possible changes in V and T. Therefore in a classical or neo classical economy, the money supply should be reduced to fight against inflation. [2]

2.2.2 Philips Curve:

For many years most economists and policy makers believed that there was an inescapable trade-off between inflation and unemployment: if you want less inflation you have to live with permanently higher unemployment and vice versa.[3] Philips found a clear (although non linear) negative correlation between unemployment and the rate of money wage inflation in the United Kingdom in the period 1861-1913. Philips then showed that the curve fitted to the 1861-1913 data was able to explain the relationship between UK unemployment and wage inflation in the much later period 1948-1957. Apparently he discovered a very stable and fundamental trade-off.[4] In the 1960´s US data was also showing the same behavior. The equation below can represent it:

$\pi = \alpha U$ (6)

U is the unemployment rate. The trade-off or negative correlation was stated by $\alpha<0$.[5] However in the 1970´s the relationship broke down completely. Many times during the 1970´s the US experienced a simultaneous rise in inflation and unemployment, much to the perplexity and frustration of economic policy makers. The same thing happened in practically all OECD countries during that decade. [6] The name of this phenomenon was stagflation. The observed evidence of incompatibility between the Philips curve relationship and the coexistence of stagnation and inflation was actually predicted by monetarist economists such

[2] Kibritcioglu 2002 p:46
[3] Sørensen & Jacobsen p:520
[4] Ibid
[5] Kibritcioglu 2002 p:50
[6] Sørensen & Jacobsen p:520

as Milton Friedman and Edmund Phelps who proposed a so called expectations-augmented Philips curve in the late 1960´s.

$$\pi = \pi^e + \alpha (\bar{u} - u) \qquad \alpha > 0 \qquad (7)$$

Where π^e is the expected inflation rate, u is the actual rate of unemployment and $\bar{u}$ is the natural unemployment rate.[7] Equation 7 shows that for any given expected rate of inflation, a lower level of unemployment is associated with a higher actual rate of inflation, and vice versa. Unanticipated inflation ($\pi > \pi^e$) will drive unemployment below its natural rate. The reason is that an unexpected rise in the rate of inflation causes the real value of the pre-set money wage of trade unions to decrease, thereby inducing firms to expand unemployment beyond the natural level.[8]

Towards the end of the 1960´s inflation had been systematically positive and gradually rising for several years, so people started to consider a positive inflation rate as a normal state of affairs. As a consequence the expected inflation rate started to increase. According to equation (7) this tended to drive up the actual rate of inflation associated with any given rate of unemployment.[9] This was mainly the reason of the stagflation and the breakdown of the Philips curve during the 70´s.

The implication of all these is that the simple negative Philips curve relationship between inflation and unemployment is a short-run trade off which will hold only as long as the expected rate of inflation stays constant. Whenever expected inflation rate increases the short run Philips curve will shift upwards as seen in **Figure 1**. In long run equilibrium the expected inflation rate equals the actual inflation rate.

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[7] Sørensen & Jacobsen p:523
[8] Sørensen & Jacobsen p: 528-529
[9] Ibid

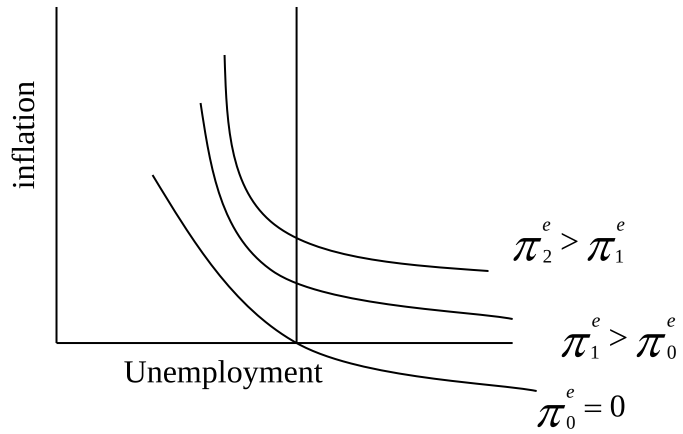

Figure 1 The expectations-augmented Phillips curve

As seen in the figure only one unemployment rate is compatible with the long run equilibrium and that is the natural unemployment rate. Hence there is no permanent trade off between inflation and unemployment.[10]

2.2.3 Institutional Theory of inflation:

Starting from the 1990´s the data of some countries started to show patterns which would again breakdown the theory of Philips curve. These developments were pointing out a structural improvement in the economies. From the time of the 70´s when the economy suffered from stagflation these time data were showing that unemployment could decrease without driving the inflation upwards. This phenomenon is called the “new economy”. In this approach of inflation, the most important factor which provides low unemployment together with stable inflation is the growth of the economy. In a time of accelerating productivity growth the rate of inflation associated with any given level of unemployment and expected inflation, will decrease.

A period of low inflation is the right time to begin to put into place the institutional and policy arrangements conducive to low inflation. In contrast most (perhaps all) prices and income policies were crisis measures to bring down high and/or rising inflation. A continuing fall in unemployment may be possible without an upswing in inflation. However, if the goal of full

[10] Sørensen & Jacobsen p: 530

employment is ever to be achieved, then there would have to be in place the institutional and policy arrangements which are consistent with low inflation and low unemployment. In so far as the moves to a so-called flexible labor market have reduced inflationary pressures, they have been at the expense of increased job insecurity. Apart from the undesirable nature of higher job insecurity, it is debatable whether full employment is consistent with such job insecurity. The approach advocated here is to seek to construct institutional arrangements which would reduce inflationary tendencies. This approach is neither an easy one nor one which would generate quick results. Three components of this approach can be identified. The first element is the construction of a consensus over what constitutes a fair and reasonable distribution of income, between wages and profits and within wages between different groups of workers, and moreover the achievement of an income distribution which corresponds to that consensus.[11]

The writer here proposes a specific way of reducing the inflation rate in Britain by implementing a "national economic assessment". This centralized way of approaching the problem can easily be implemented also in the European level. This centralized approach is better explained as an "active encouragement of the re-emergence of centralised collective bargaining". The essence of the argument here is that in a decentralised model, each party to the settlement is only concerned with the immediate effect on their own pay or costs of that settlement, and does not and cannot take account of the spill over effects of their settlement on the general pace of inflation. In a fully centralised model, the impact of a wage settlement on prices would be clear to all concerned, and a settlement with, say, a three per cent nominal wage increase with zero price increase would be equivalent to a ten per cent nominal wage increase with a seven per cent price increase attached.[12] In spite of the fact that the fully centralised bargaining system is not practiced in many countries, apparently a policy with the tendency to this approach may just as well decrease inflation.

2.3 The EMU:

The economic regime of EU is characterized by price stability, sound public finance and well functioning product and labor markets. A high degree of price stability represents both an entry criterion and a permanent feature of the monetary environment in EMU.

[11] *Malcolm Sawyer* 1997
[12] Ibid

The inflation convergence criteria are based on the fear that the future monetary union would have an inflationary bias. It can be explained by the Barro-Gordon model. In order to explain it we can assume two countries which are assumed to be identical except for the preferences of the authorities, called Germany and Italy. Before these countries form any kind of monetary union Germany has low and Italy has high inflation. This difference in the preference can be expressed easier with the help of the graph below.

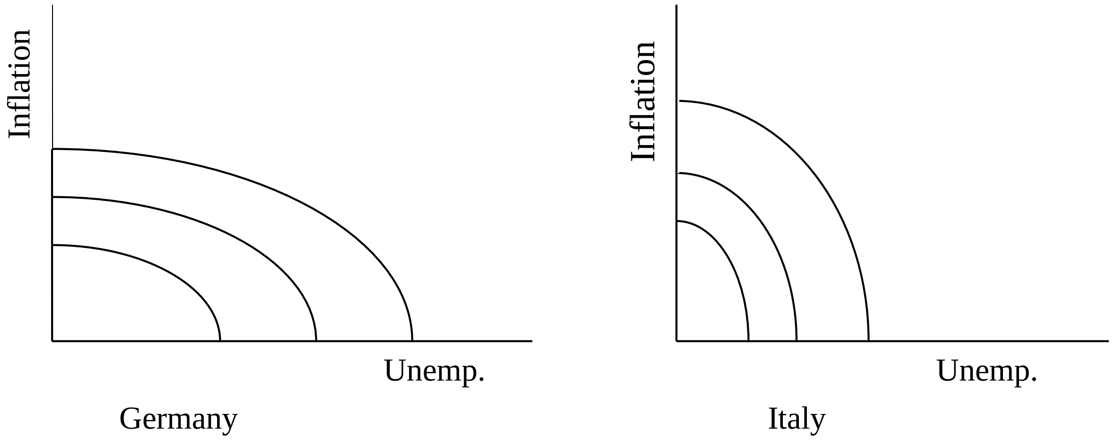

Figure 2[13] The Inflation Preferences

As seen, the indifference curves of the governments reveal their preferences between inflation and unemployment. Germany is ready to bear more unemployment for the sake of decreasing inflation whereas Italy can bear more inflation for the sake of decreasing unemployment.

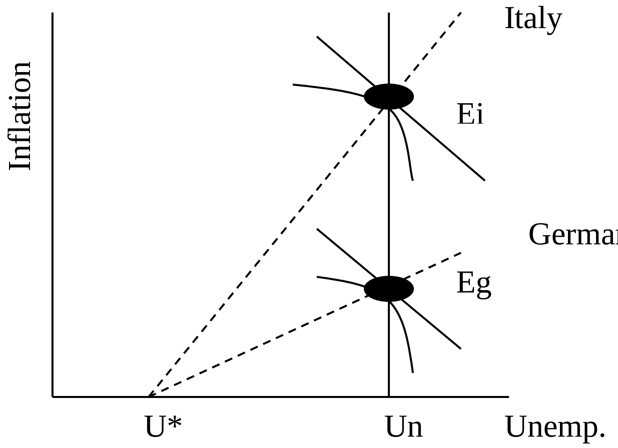

Figure 3[14] The Barro-Gordon Model

[13] De Grauwe (1997) p:40
[14] De Grauwe 1997 p: 128

As seen on the graph above, the natural unemployment rate is the same in both countries and so is the target unemployment rate. Thus, inflation is on average higher in Italy than in Germany. When these two countries form a union, the resulting inflation will be the average and in the graph above it will be somewhere between points Ei and Eg. So the inflation rate increases in the union. A monetary union between these two countries implies a common central bank. In such a union, the low inflation country (Germany) always reduces its welfare by forming a monetary union with the high inflation country (Italy) because the union's central bank is likely to reflect the average preferences of the participating countries. Thus the low inflation country will not want to join the union unless it can impose conditions. This condition must be that the union's central bank should have the same preferences as the German central bank. This can be achieved in two ways. One is that Germany insists that the future European central bank should be a close copy of the Bundesbank but the European central bank is composed of representatives of the participating countries. Even so, these representatives may have different inflation preferences. In order to avoid high equilibrium inflation rate in the union Germany would want to control entry into the union, so that only those countries with the same preferences can join.

The convergence criteria agreed in Maastricht Treaty may be interpreted in this perspective. Before the entrance to the monetary union, the candidate countries are asked to provide evidence that they care about a low inflation rate as Germany does. During this disinflation process a temporary increase in the unemployment rate is inevitable. A prior reduction of inflation by Italy is not necessary for forming a union but it is to form a union with a low inflation rate.[15]

2.4 The role of the ECB

The Maastricht treaty and the convergence criteria offer strong guarantees for price stability that is provided by monetary policy and independent ECB. Monetary instrument, financial structure and therefore the speed and impact to monetary policy on the behavior of economic agents differ from country to country. These differences can affect the outcomes of monetary policy in a monetary union. EMU eliminated these difficulties by establishing the ECB and consequent use of single set of monetary policy instruments in all participating member states. The main objective of ECB is to provide price stability. The other major

[15] De Grauwe 1997 p: 129-130

objectives of ECB are to support general economic objectives such as high employment, and maintenance of a stable credible Euro in an open market economy with free competition. According to governing council[16] of the ECB, price stability defined as a year on year increase in the Harmonized Index of consumer prices for the euro area of below 2%. On the other hand according to Maastricht treaty, the ECB can not be held responsible for short term movements in inflation, because of the lags between a change in monetary policy and its effect on prices. In order to provide price stability, the ECB´s main tasks are to define and implement the monetary policy of the euro zone, conduct foreign exchange operations, hold and manage the official exchange reserves of the countries of the euro zone, issue notes in the euro zone, promote smooth operation of payment systems. ECB is also responsible for collecting the necessary statistical information, either from national authorities or directly from economic agents such as financial institutions, following developments in the banking and financial sectors, and promoting the exchange of information between the European system of central banks and banking authorities.[17]

The Eurosystem has to support the general economic policies in the European Community without prejudice to the primary objective of price stability. In pursuing its objectives, the Eurosystem has to act in accordance with the principle of an open market economy with free competition, favouring an efficient allocation of resources.

In order to achieve its objectives, the Eurosystem has at its disposal a set of monetary policy instruments; the Eurosystem conducts *open market operations*, offers *standing facilities* and requires credit institutions to hold *minimum reserves* on accounts with the Eurosystem.[18]

Open market operations play an important role in the monetary policy of the Eurosystem for the purposes of steering interest rates, managing the liquidity situation in the market and signalling the stance of the monetary policy. Five types of instruments are available to the Eurosystem for the conduct of open market operations. The most important instrument is the reverse transaction (applicable on the basis of repurchase agreements or collateralised loans). The Eurosystem may also use outright transactions, the issuance of debt certificates, foreign exchange swaps and the collection of fixed term deposits.[19]

[16] The Governing council is ECB´s highest decision making body.
[17] Artis and Lee 1995 p:362
[18] ECB
[19] Ibid

2.4.1 Repurchase agreements:

A **repurchase agreement** (or **repo**) is an agreement between two parties whereby one party sells the other a security at a specified price with a commitment to buy the security back at a later date for another specified price. Most repos are overnight transactions, with the sale taking place one day and being reversed the next day. Long-term repos—called **term repos**—can extend for a month or more. Usually, repos are for a fixed period of time, but open-ended deals are also possible. **Reverse repo** is a term used to describe the opposite side of a repo transaction. The party who sells and later repurchases a security is said to perform a repo. The other party—who purchases and later resells the security—is said to perform a reverse repo.[20]
The repo rate is the one of the main instruments in adjusting the price stability and thus the inflation rate. In the Euro area this rate is referred as the Eurepo. Since the introduction of the euro, the European repo markets have developed significantly with more and more emphasis on cross border financing trades. This has led to an increasingly homogeneous Euro-denominated General Colleteral (GC) market. Eurepo is the rate at which one prime bank offers funds in euro to another prime bank if in exchange the former receives from the latter Eurepo GC as collateral. Eurepo has been launched on the 4th March 2002.[21]
The term transmission mechanism refers to the way in which changes in the repo rate affect inflation and the rest of the economy. In actual fact, the transmission mechanism consists of several different interacting mechanisms. Some of these act on inflation more or less immediately while others take longer to have an effect. It is generally held that a change in the repo rate has its greatest impact on inflation after one to two years.
The channels through which market interest rates affect resource utilisation can be categorised in different ways, but channels that are generally considered important for monetary policy are the interest rate channel, the credit channel and the exchange rate channel.[22]

On the other hand, national central banks have become the regional agencies of ECB with no independent power to alter local monetary conditions. But monetary stance and the implied common inflation rate chosen by ECB may be inappropriate for certain member states. This study may also be helpful to determine if the countries in question (except for Turkey) are able to follow the monetary policy of ECB.

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[20] Risk glossary Repo
[21] Eurepo
[22] Sveriges Riksbank

3. Econometric Analysis

To analyze the inflation convergence for member countries I use the co-integration framework. For this purpose each country's inflation rates are compared with German inflation rate. Price stability and price convergence in EU is provided by policies of the European Central Bank. If the countries are able to follow the policies of ECB they should be able to achieve the same outcomes in terms of inflation rates. The European average inflation rate does not involve the characteristics of the policy of the ECB because the ECB has not been in existence long enough.

3.1 Data and empirical assessments of inflation convergence

In this study inflation rates are based on the Consumer Price Index because the consumer prices are more relevant as the inflation rate targets of the monetary policy, and the official convergence criterion of the Maastricht treaty is defined in terms of this index. All series except for Turkey are obtained from Ecowin[23] database. The Turkish data is obtained from Turkish State Institute of Statistics. All series are used in monthly form. It covers the period 1998-2005 for Turkey and 1995-2005 for the rest of the countries. Three years is skipped from Turkey in this analysis because of the currency crisis in 1994 and its effects on the following four years.

The series will be tested for stationarity anyway but before we begin we can investigate some other characteristic of them which is seasonality. This effect is common in CPI data. One way to see if there is seasonality in the data is to ´look at the average inflation rate of the countries for each month. The following figures represent it. The graphs which belong to Sweden and Turkey are shown separately so that it is easier to see the seasonal fluctuations.

[23] Ecowin system is the Ecowin Economic & Financial database.

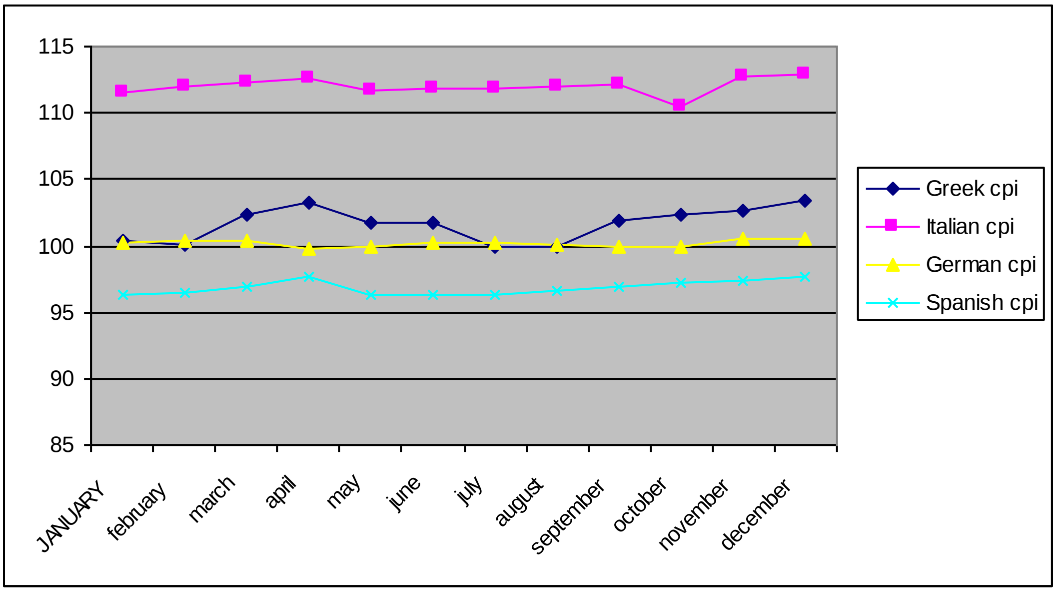

Figure 4 Average inflation rates of Greece, Italy, Germany, and Spain for each month

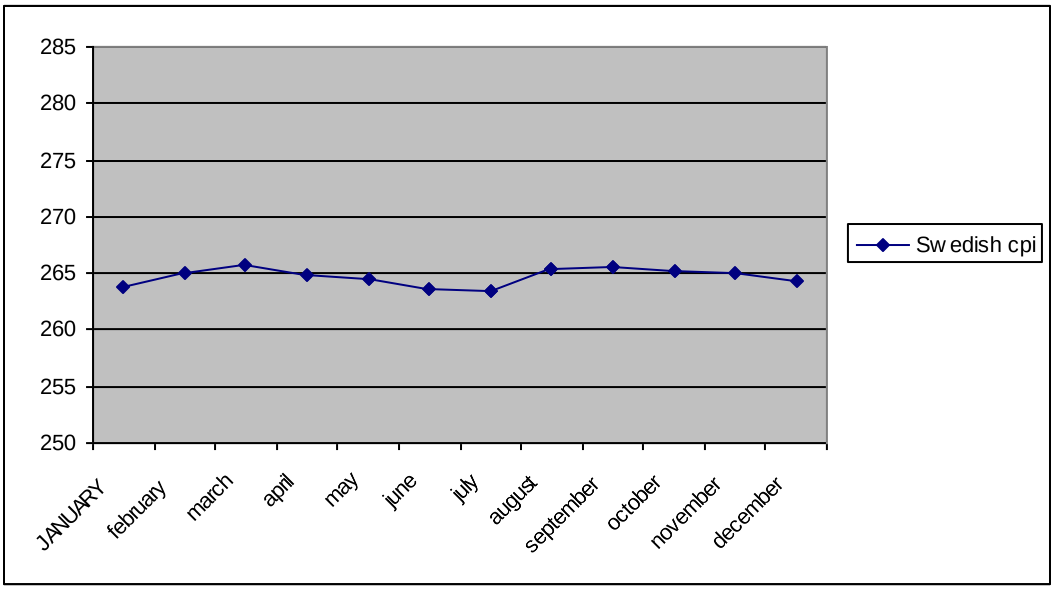

Figure 5 Average inflation rates of Sweden for each month

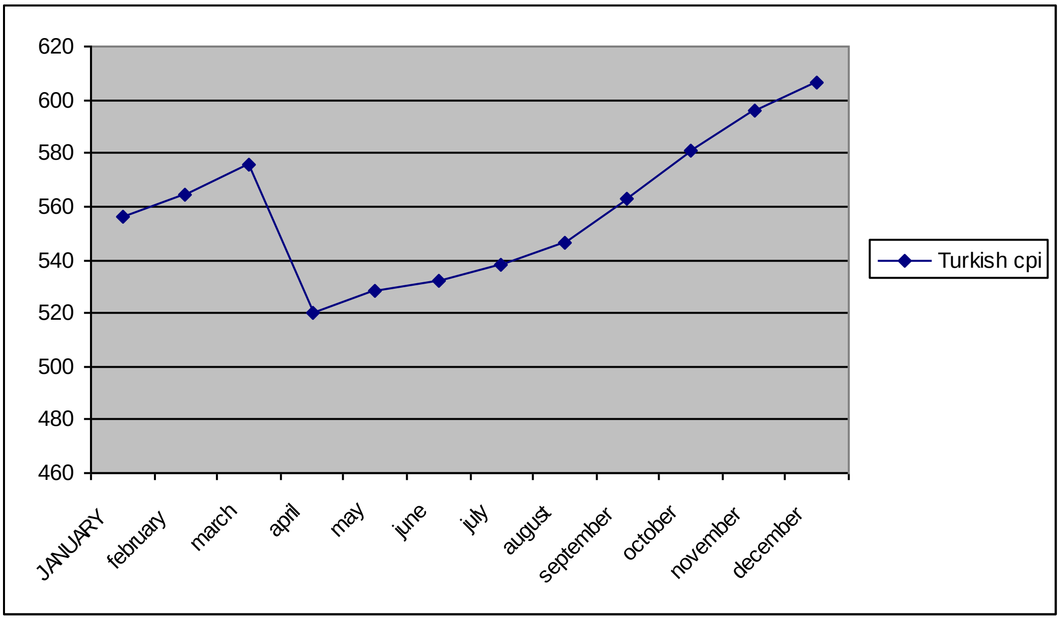

Figure 6 Average inflation rates of Turkey for each month

As seen in the figures above there is seasonality in every series. However the strongest seasonality seems to be present in Turkey. In the econometric analysis part we will be able to see precisely which months have seasonal effects in our data.

3.2 Tests and results:

This part gives the empirical results of the tests.

I will look at the relationship of co-integration separately for each country fixing the German CPI as a base. The basic regression which the idea starts from is the co-integration regression below.

$$Yt = \alpha + \beta Xt + \varepsilon t$$

Where Yt is the German CPI and Xt is the CPI of the country that is in the analysis.

However, since the time series data have to be stationary in order to make an analysis, I have to check if stationarity exists in each of the data. If there is no such case, I have to make the data stationary. In order to check for stationarity I use the Dickey-Fuller and the Augmented Dickey-Fuller tests.

3.2.1 Stationarity of data:

$Yt = \alpha + \rho Y_{t-1} + \varepsilon t$ (1)

Where, Y_{t-1} is the lagged German inflation rate.

Hypotheses: $Ho \rightarrow \rho=1$ (there is unit root, the series is non-stationary)

$H_1 \rightarrow \rho<1$ (the data is stationary)

However we can simplify the equation by subtracting Y_{t-1} from both sides.

$\Delta Yt = \alpha + Y_{t-1}(\rho-1) + \varepsilon t$ (2)

Let's call (ρ-1) as γ and now the new hypotheses become:

$Ho \rightarrow \rho=1 \leftrightarrow \gamma = 0$ there is unit root

$H_1 \rightarrow \rho<1 \leftrightarrow \gamma < 0$ there is no unit root

$\Delta Yt = \alpha + \gamma Y_{t-1} + \varepsilon t$ is our new transformed model to analyze and ΔYt is called the first difference of our dependent variable which is German CPI. The unit root test results of this first model are listed in table 1. The critical value is -2,87 for 5% level of significance.

I used twelve lags when I implemented the Augmented Dickey Fuller (ADF) test for I have monthly data. Looking at the table we see that we can not reject the null of a unit root meaning that the series are non stationary. In the first table there is no need to go on to the augmented tests since we know that the values will be more and more positive.

Table 1. *Dickey-Fuller test results*

	Germany	Greece	Italy	Spain	Sweden	Turkey
DF	-1,678	-1,047	-1,748	-1,148	-1,956	0,834

Since our model is an AR (1) process, our dependent variable is the first difference of the series of each country. However in this situation we could not get any stationary series in neither of them. We have to make our model stationary to keep on the analyses. In some cases taking the first differences is insufficient to obtain stationarity and another differencing step is required. If a series must be differenced twice before it becomes stationary, then it is said to be integrated of order two, denoted I (2) and it must have two unit roots.[24]

Thus I take another difference of the series which changes the model in to:

$$\Delta\Delta Yt = \alpha + \beta\, \Delta Y_{t-1} + \varepsilon t \qquad (3)$$

$\Delta\Delta Yt$ refers to the second difference of the series and ΔY_{t-1} is the first lag of the first difference of the series. Now that we have transformed the model, we test for the unit root again by DF and ADF tests. The test results are in table 2.

Table 2. *Twelve lagged Augmented Dickey-Fuller test results*

	Germany	Greece	Italy	Spain	Sweden	Turkey
DF	-13,312	-10,370	-9,137	-7,743	-9,495	-4,091
ADF 1	-7,989	-11,839	-7,220	-8,068	-9,395	-4,250
ADF 2	-7,431	-8,520	-5,613	-13,544	-8,529	-3,735
ADF 3	-8,213	-16,636	-5,560	-6,676	-8,838	-3,248
ADF 4	-5,875	-8,999	-5,449	-6,349	-5,698	-2,686
ADF 5	-5,273	-4,243	-3,965	-4,010	-3,463	-2,257
ADF 6	-4,621	-4,117	-3,574	-3,944	-3,109	-2,604
ADF 7	-5,169	-4,560	-3,348	-3,504	-3,537	-2,305
ADF 8	-5,691	-4,479	-3,481	-4,576	-3,318	-2,067
ADF 9	-4,488	-5,845	-4,418	-3,661	-3,590	-2,066
ADF 10	-4,551	-5,160	-3,739	-2,409	-2,944	-1,868
ADF 11	-2,354	-2,373	-3,339	-1,691	-1,873	-1,497
ADF 12	-2,207	-2,297	-2,975	-2,100	-1,906	-1,732

These results require more attention as the presence of unit root is not clearly seen in some countries. Firstly, it is clearly seen that taking another difference managed to make the Italian series stationary. The second striking inference we get from this table is how important the 11^{th} or 12^{th} lag is in monthly data. As in the case of Germany, Greece, Spain and Sweden we are able to reject the presence of a unit root until the 11^{th} lag. Despite this fact we fail to reject the presence of a second unit root in these series. However German and Greek series differ from Swedish and Turkish series in the sense that they are closer to the rejection area. Though graphical inspections suggest us to conclude that the series are stationary, the numerical ADF test with the right value of lag indicates that the series are not stationary.

[24] Verbeek 2004 p:267

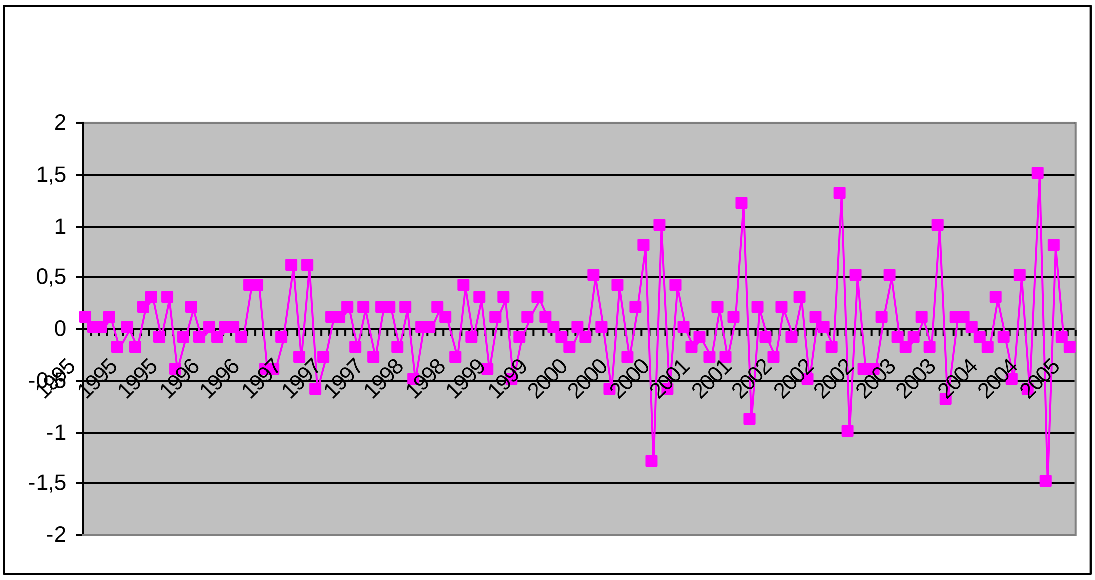

Figure 7. Second Difference of the German Series

If we look at these figures it is clear to see that both series fluctuates around a mean and it is even more tempting to conclude for stationarity since this mean is zero.

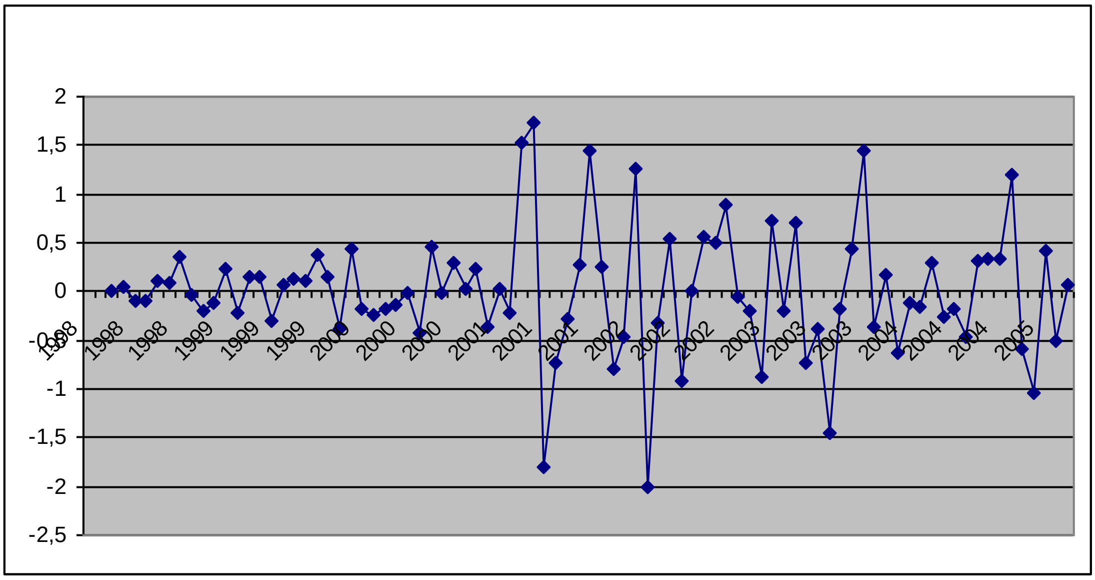

Figure 8. Second Difference of the Turkish Series

3.2.2 Deseasonalising the data:

We can go on differencing the model to obtain stationarity but this method is considered not to have much economic relevance in the literature. Instead we can look to the problem from a different approach. One problem of the time series data (especially in our case with the CPI) is its seasonality. The seasonal prices are common inside the consumer price indices. So I will try to remove this effect from the series. There are mainly three ways in the literature which are the moving average method, exponential smoothing or using the seasonal dummy variables. I choose to implement the dummy variable method since it is widely accepted in the literature. Since we have monthly data, twelve dummies representing each month will be implemented in the model to determine which months have the seasonal effects on the series. Eventually the model becomes:

$$\Delta\Delta Yt = \beta_1 \text{jan} + \beta_2\text{feb}+\ldots\ldots+ \beta_{12}\text{dec} + \beta_{13}\Delta Y_{t-1} + \varepsilon t$$

The trick here is not to fall into the *dummy variable trap* when we have to implement so many dummies in the equation. To avoid it I have taken the constant α out of the model. Another way to avoid this is to implement m-1 categories instead of one. So in this case it would mean to use eleven categories. However since the analysis depends very much on the seasonality of the each month, it would cause ambiguity to erase one of the months completely. To see which months include seasonal effect, I check the significance of each month by looking at their t-values. Since we have observed the seasonality of the series before in section 3.1, we have some *a priori* expectations even before this analysis. For instance we definitely expect to find a seasonal effect in the months of January, March and April for Turkish series. Similarly January, March, June or July, August are the months which definitely seem to have seasonal effect in the Swedish series. For the Greek series we expect the months January, April, July or August, December to have such effect. Finally we expect to have the same effect in April for both German and Spanish series.

In the table below the seasonal months affecting each country is shown:

Table 3. *Seasonal months for each country observed*

Countries	**Seasonal months**
Germany	January, February, April, may, June, November, December
Greece	January, February, march, April, may, July, September, October
Spain	March, April, august, October, December
Sweden	January, February, march, April, June, august, October, December
Turkey	January, march, April, September, October

From the table above we see that there is strong consistence between our *a priori* expectations and the actual results. Only December does not seem to have effect on the Greek series unlike our expectations.

The ultimate goal is to test for co-integration so stationary series which will be used to make this co-integration test have to be obtained. To obtain these series now I will use the seasonal months for each country and obtain a model. The residuals of the model of each country will give the deseasonalised series with which I can test for co-integration.

For instance the equation of Germany is:

$$Yt = \alpha + \beta_1 \, jan + \beta_2 \, feb + \beta_3 \, apr + \beta_4 \, may + \beta_5 \, june + \beta_6 \, nov + \beta_7 \, dec + \varepsilon t \quad (4)$$

Now I have to test for unit root again to see if I can obtain stationary data for the test of co integration. The table below shows the results:

Table 4. *Test results for unit root after deseasonalisation*

	Germany	Greece	Spain	Sweden	Turkey
DF	-13,312	-7,398	-8,378	-9,617	-4,296
ADF 1	-11,342	-7,504	-7,746	-8,750	-4,406
ADF 2	-11,267	-6,899	-10,029	-7,451	-3,972
ADF 3	-12,464	-6,437	-4,691	-6,387	-3,757
ADF 4	-11,773	-6,339	-3,997	-5,645	-3,421
ADF 5	-11,445	-5,583	-2,925	-5,225	-3,117
ADF 6	-11,117	-6,533	-3,339	-5,124	-2,984
ADF 7	-11,119	-7,662	-2,986	-5,039	-2,895
ADF 8	-11,088	-9,444	-2,928	-4,901	-2,793
ADF 9	-10,726	-8,547	-2,642	-4,845	-2,907
ADF 10	-10,614	-7,293	-1,698	-4,311	-2,840
ADF 11	-10,287	-3,203	-1,136	-3,765	-2,759
ADF 12	-9,985	-3,032	-1,451	-3,682	-2,698

As we can see from the table above there is a strong rejection of the null of unit root for German series. Clearly Greek and Swedish series are also stationary after the deseasonalising process. The Spanish series did not become stationary even after the deseasonalising process which prevents me from doing co integration test for Spain. Turkish series however are really close to the rejection area which implies there is some evidence of stationarity. The 12^{th} lag is marginally higher than the critical value -2,86.

3.2.3 Co-integration

Now I will use the co integration analysis to test if there is a convergence between Germany and the other countries´ inflation rate. For this the model is the co-integrating regression:

$$Yt = \alpha + \beta Xt + \varepsilon_t$$

Where Yt is Germany’s inflation rate and Xt is the tested country’s inflation rate. Of course in this analysis we will use the series which we have deseasonalised. In order to say that there is co integration the residuals obtained from this regression must be stationary. So DF and ADF tests are the appropriate tests again.

When we test unit root in the error terms then the equation is:

$$\Delta \varepsilon_t = \rho \, \varepsilon_{t-1} + \varepsilon_t \qquad (5)$$

And the hypotheses are: Ho: $\rho=0$ => the series are not co-integrated

H_1: $\rho \neq 0$ => the series are co-integrated

One important point is that when we test for co-integration the critical values are more negative to prevent the rejection of the null of unit root too often. Thus our critical value is -3,34 this time with 5% level of significance.

The results are shown in table 5.

Table 5. *Results for the test of co-integration.*

	Greece	Italy	Sweden	Turkey
DF	-20,992	-20,916	-21,043	-16,454
ADF 1	-13,224	-13,081	-13,262	-10,861
ADF 2	-9,902	-9,902	-10,068	-8,031
ADF 3	-9,077	-9,056	-9,171	-7,401
ADF 4	-8,388	-8,398	-8,582	-7,086
ADF 5	-7,580	-7,491	-7,564	-6,023
ADF 6	-6,769	-6,800	-6,860	-5,790
ADF 7	-6,524	-6,549	-6,553	-5,486
ADF 8	-6,808	-6,846	-6,768	-5,656
ADF 9	-6,212	-6,196	-6,122	-4,869
ADF 10	-7,956	-7,941	-7,938	-6,074
ADF 11	-6,616	-6,669	-6,705	-4,816
ADF 12	-5,447	-5,515	-5,480	-3,823

As seen from the table above Greece, Italy, Sweden and Turkey are converging with Germany in inflation.

4. Conclusion

This paper was investigating for an evidence of co integration between the selected countries and Germany. I chose to implement augmented Dickey Fuller tests to look for this evidence and the results show that Greek, Italian, Swedish, Turkish inflation rates are co-integrating with the German inflation rate, meaning that there is a long run relationship in the means of inflation. This paper could not find any evidence for Spain because the Spanish data did not become stationary. There maybe several causes of this resulting from the data. One of them may be that the goods included in the Spanish index cause a difference.

One surprising result of this study was that the Turkish and the German inflations were co integrated. This can be explained by the policies implemented in Turkey after 1994 currency crisis. However as the data for Turkey starts from 98 some of the volatile inflation rates are omitted and this may be another reason why we found co integration.

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APPENDIX

Testing unit root by taking the difference : Tests for Sweden

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,231	,093		2,493	,014
	DIFF(LAGswe,1)	-1,090	,116	-,831	-9,395	,000
	DIFF(DIFLAGswe,1)	,258	,088	,258	2,917	,004

a Dependent Variable: DIFF(DIFswe,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,276	,094		2,929	,004
	DIFF(LAGswe,1)	-1,302	,153	-,989	-8,529	,000
	DIFF(DIFLAGswe,1)	,418	,116	,420	3,621	,000
	DIFF(DLAGswe_2,1)	,194	,091	,194	2,127	,036

a Dependent Variable: DIFF(DIFswe,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,357	,095		3,767	,000
	DIFF(LAGswe,1)	-1,669	,189	-1,268	-8,838	,000
	DIFF(DIFLAGswe,1)	,731	,150	,732	4,862	,000
	DIFF(DLAGswe_2,1)	,440	,118	,442	3,728	,000
	DIFF(DLAGswe_3,1)	,286	,091	,282	3,137	,002

a Dependent Variable: DIFF(DIFswe,1)

Tests for Germany

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,132	,031		4,325	,000
	DIFF(LAGger,1)	-1,142	,143	-,738	-7,989	,000
	DIFF(DIFLAGger,1)	-,046	,092	-,046	-,494	,622

a Dependent Variable: DIFF(DIFger,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,153	,033		4,644	,000
	DIFF(LAGger,1)	-1,322	,178	-,854	-7,431	,000
	DIFF(DIFLAGger,1)	,141	,144	,141	,981	,329
	DIFF(DLAGger_2,1)	,157	,093	,156	1,688	,094

a Dependent Variable: DIFF(DIFger,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,198	,035		5,719	,000
	DIFF(LAGger,1)	-1,713	,209	-1,107	-8,213	,000
	DIFF(DIFLAGger,1)	,486	,174	,485	2,795	,006
	DIFF(DLAGger_2,1)	,509	,140	,509	3,650	,000
	DIFF(DLAGger_3,1)	,301	,092	,297	3,289	,001

a Dependent Variable: DIFF(DIFger,1)

Tests for Italy

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,174	,029		5,990	,000
	DIFF(LAGit, 1)	-,785	,109	-,616	-7,220	,000
	LAGS(DIFDIFit,1)	-,087	,086	-,086	-1,013	,313

a Dependent Variable: DIFF(DIFit,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,159	,033		4,836	,000
	DIFF(LAGit,1)	-,726	,129	-,548	-5,613	,000
	LAGS(DIFDIFit,1)	-,187	,109	-,187	-1,712	,090
	LAGS(lagDDit1,1)	-,160	,085	-,160	-1,881	,063

a Dependent Variable: DIFF(DIFit,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,175	,036		4,876	,000
	DIFF(LAGit,1)	-,808	,145	-,601	-5,560	,000
	LAGS(DIFDIFit,1)	-,126	,131	-,126	-,959	,340
	LAGS(lagDDit1,1)	-,137	,110	-,137	-1,248	,214
	LAGS(lagDDit2,1)	-,014	,087	-,014	-,166	,869

a Dependent Variable: DIFF(DIFit,1)

Tests for Greece

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,465	,101		4,603	,000
	DIFF(LAGgre, 1)	-1,357	,115	-,994	-11,839	,000
	LAGS(DIFDIF gre,1)	,438	,084	,439	5,228	,000

a Dependent Variable: DIFF(DIFgre,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,497	,111		4,493	,000
	DIFF(LAGgre, 1)	-1,453	,171	-1,058	-8,520	,000
	LAGS(DIFDIFg re,1)	,503	,120	,501	4,188	,000
	LAGS(lagDDgr ek1,1)	,072	,095	,070	,762	,448

a Dependent Variable: DIFF(DIFgre,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,847	,083		10,191	,000
	DIFF(LAGgre, 1)	-2,511	,151	-1,826	-16,636	,000
	LAGS(DIFDIFg re,1)	1,511	,122	1,503	12,368	,000
	LAGS(lagDDgr ek1,1)	,744	,089	,718	8,332	,000
	LAGS(lagDDgr ek2,1)	,742	,066	,717	11,198	,000

a Dependent Variable: DIFF(DIFgre,1)

Tests for Spain

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,228	,042		5,423	,000
	DIFF(LAGspn, 1)	-,943	,117	-,752	-8,068	,000
	LAGS(DIFDIF spn,1)	,279	,094	,276	2,962	,004

a Dependent Variable: DIFF(DIFspn,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,379	,037		10,199	,000
	DIFF(LAGspn, 1)	-1,606	,119	-1,279	-13,544	,000
	LAGS(DIFDIFs pn,1)	,762	,092	,753	8,281	,000
	LAGS(LAGDD spn1,1)	,670	,077	,658	8,754	,000

a Dependent Variable: DIFF(DIFspn,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,297	,050		5,902	,000
	DIFF(LAGspn, 1)	-1,256	,188	-1,003	-6,676	,000
	LAGS(DIFDIFs pn,1)	,543	,129	,539	4,205	,000
	LAGS(LAGDD spn1,1)	,467	,114	,460	4,085	,000
	LAGS(LAGDD spn2,1)	-,230	,098	-,219	-2,350	,021

a Dependent Variable: DIFF(DIFspn,1)

Tests for Turkey

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	40,437	11,461		3,528	,001
	DIFF(LAGtrk,1)	-,385	,091	-,468	-4,250	,000
	LAGS(DIFDIFtrk,1)	,138	,110	,138	1,252	,214

a Dependent Variable: DIFF(DIFtrk,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	40,112	12,548		3,197	,002
	DIFF(LAGtrk,1)	-,380	,102	-,460	-3,735	,000
	LAGS(DIFDIFtrk,1)	,134	,115	,134	1,167	,247
	LAGS(lagDIFDIFtrk1,1)	-,022	,113	-,022	-,195	,846

a Dependent Variable: DIFF(DIFtrk,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38,834	13,616		2,852	,006
	DIFF(LAGtrk,1)	-,364	,112	-,439	-3,248	,002
	LAGS(DIFDIFtrk,1)	,115	,125	,115	,919	,361
	LAGS(lagDIFDIFtrk1,1)	-,033	,117	-,033	-,280	,780
	LAGS(lagDIFDIFtrk2,1)	-,058	,114	-,057	-,506	,615

a Dependent Variable: DIFF(DIFtrk,1)

Deseasonalised Greek data unit root tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,290	,056		5,164	,000
	DIFF(LAGGRCPI,1)	-,361	,048	-,548	-7,504	,000
	LAGS(desGRE,1)	-,239	,074	-,237	-3,244	,002

a Dependent Variable: Unstandardized Residual

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,285	,057		4,993	,000
	DIFF(LAGGRCPI,1)	-,371	,054	-,560	-6,899	,000
	LAGS(desGRE,1)	-,226	,078	-,223	-2,882	,005
	LAGS(LAGdesGRE,1)	,012	,087	,011	,132	,895

a Dependent Variable: Unstandardized Residual

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,315	,058		5,417	,000
	DIFF(LAGGRCPI,1)	-,349	,054	-,527	-6,437	,000
	LAGS(desGRE,1)	-,280	,080	-,276	-3,478	,001
	LAGS(LAGdesGRE,1)	-,053	,092	-,050	-,571	,569
	LAGS(LAGdesGRE2,1)	-,193	,082	-,182	-2,347	,021

a Dependent Variable: Unstandardized Residual

Deseasonalised Turkish data unit root tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	34,269	9,437		3,631	,000
	DIFF(LAGtrk,1)	-,323	,073	-,457	-4,406	,000
	LAGS(deseason TRK,1)	,084	,104	,084	,809	,421

a Dependent Variable: Unstandardized Residual

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	33,359	9,917		3,364	,001
	DIFF(LAGtrk,1)	-,311	,078	-,437	-3,972	,000
	LAGS(deseason TRK,1)	,072	,105	,072	,684	,496
	LAGS(lagdeseas TRK1,1)	-,071	,106	-,071	-,666	,507

a Dependent Variable: Unstandardized Residual

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	34,325	10,589		3,242	,002
	DIFF(LAGtrk,1)	-,319	,085	-,448	-3,757	,000
	LAGS(deseason TRK,1)	,082	,112	,081	,726	,470
	LAGS(lagdeseas TRK1,1)	-,066	,109	-,066	-,603	,548
	LAGS(lagdesTR K2,1)	,030	,111	,030	,272	,786

a Dependent Variable: Unstandardized Residual

Deseasonalised Swedish data unit root tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	,125	,069		1,815	,072
	DIFF(LAGswe,1)	-,617	,070	-,620	-8,750	,000
	LAGS(deseason SWE,1)	-,162	,070	-,163	-2,297	,023

a Dependent Variable: Unstandardized Residual

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	,111	,067		1,644	,103
	DIFF(LAGswe,1)	-,544	,073	-,545	-7,451	,000
	LAGS(deseason SWE,1)	-,268	,077	-,269	-3,464	,001
	LAGS(deseaslag_1,1)	-,222	,074	-,222	-2,981	,004

a Dependent Variable: Unstandardized Residual

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	,103	,068		1,511	,134
	DIFF(LAGswe,1)	-,504	,079	-,505	-6,387	,000
	LAGS(deseason SWE,1)	-,331	,091	-,331	-3,648	,000
	LAGS(deseaslag_1,1)	-,290	,091	-,289	-3,185	,002
	LAGS(deseaslag_2,1)	-,110	,083	-,110	-1,327	,187

a Dependent Variable: Unstandardized Residual

Deseasonalised German data unit root tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,142	,029		4,941	,000
	DIFF(LAGger,1)	-1,225	,108	-,792	-11,342	,000
	LAGS(deseason GER,1)	,044	,092	,034	,481	,632

a Dependent Variable: DIFF(DIFger,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,151	,029		5,179	,000
	DIFF(LAGger,1)	-1,299	,115	-,840	-11,267	,000
	LAGS(deseason GER,1)	,184	,121	,139	1,523	,130
	LAGS(lagdesea sger1,1)	,180	,102	,136	1,776	,078

a Dependent Variable: DIFF(DIFger,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,173	,028		6,126	,000
	DIFF(LAGger,1)	-1,470	,118	-,950	-12,464	,000
	LAGS(deseason GER,1)	,420	,130	,317	3,232	,002
	LAGS(lagdesea sger1,1)	,544	,135	,410	4,038	,000
	LAGS(lagdesger 2,1)	,402	,104	,301	3,860	,000

a Dependent Variable: DIFF(DIFger,1)

Deseasonalised Spanish data unit root tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,168	,036		4,694	,000
	DIFF(LAGSPCPI,1)	-,726	,094	-,652	-7,746	,000
	LAGS(desSPN,1)	,089	,084	,089	1,053	,295

a Dependent Variable: Unstandardized Residual

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,234	,035		6,763	,000
	DIFF(LAGSPCPI,1)	-,994	,099	-,892	-10,029	,000
	LAGS(desSPN,1)	,323	,088	,323	3,658	,000
	LAGS(LAGdesSPN,1)	,447	,084	,424	5,310	,000

a Dependent Variable: Unstandardized Residual

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,137	,038		3,611	,000
	DIFF(LAGSPCPI,1)	-,593	,126	-,532	-4,691	,000
	LAGS(desSPN,1)	,110	,095	,110	1,156	,250
	LAGS(LAGdesSPN,1)	,177	,098	,168	1,813	,073
	LAGS(LAGdesSPN2,1)	-,434	,092	-,406	-4,730	,000

a Dependent Variable: Unstandardized Residual

Co-integration Germany and Sweden tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,001	,024		-,053	,958
	LAGS(RESGERxSWE,1)	-2,076	,157	-1,168	-13,262	,000
	LAGS(DRESGERxSWE,1)	,315	,088	,315	3,575	,001

a Dependent Variable: DIFF(RESGERxSWE,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,003	,024		-,106	,916
	LAGS(RESGERxSWE,1)	-2,506	,249	-1,410	-10,068	,000
	LAGS(DRESGERxSWE,1)	,680	,187	,679	3,632	,000
	LAGS(DRESGERxSWE1,1)	,206	,094	,206	2,201	,030

a Dependent Variable: DIFF(RESGERxSWE,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,002	,024		-,106	,916
	LAGS(RESGERxSWE,1)	-3,080	,336	-1,733	-9,171	,000
	LAGS(DRESGERxSWE,1)	1,209	,281	1,208	4,305	,000
	LAGS(DRESGERxSWE1,1)	,633	,194	,632	3,257	,001
	LAGS(LAGDRESGERxSWE2,1)	,239	,095	,232	2,499	,014

a Dependent Variable: DIFF(RESGERxSWE,1)

Co-integration Germany and Turkey tests

ADF 1 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,001	,029		-,031	,976
	LAGS(resGT,1)	-2,021	,186	-1,152	-10,861	,000
	LAGS(DresGT,1)	,316	,106	,315	2,971	,004

a Dependent Variable: DIFF(resGT,1)

ADF 2 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,001	,030		-,028	,978
	LAGS(resGT,1)	-2,350	,293	-1,339	-8,031	,000
	LAGS(DresGT,1)	,593	,218	,592	2,720	,008
	LAGS(lagDresGT,1)	,163	,112	,162	1,456	,149

a Dependent Variable: DIFF(resGT,1)

ADF 3 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,001	,029		,042	,966
	LAGS(resGT,1)	-2,907	,393	-1,657	-7,401	,000
	LAGS(DresGT,1)	1,110	,328	1,107	3,386	,001
	LAGS(lagDresGT,1)	,578	,227	,576	2,542	,013
	LAGS(lagDresGT2,1)	,237	,113	,236	2,095	,039

a Dependent Variable: DIFF(resGT,1)

Co-integration Germany and Italy tests

ADF 1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-,001	,024		-,048	,962
	LAGS(resGERxIT,1)	-2,053	,157	-1,157	-13,081	,000
	LAGS(DresGERxIT,1)	,304	,088	,304	3,435	,001

a Dependent Variable: DIFF(resGERxIT,1)

ADF 2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-,002	,024		-,094	,925
	LAGS(resGERxIT,1)	-2,456	,248	-1,383	-9,902	,000
	LAGS(DresGERxIT,1)	,647	,187	,647	3,466	,001
	LAGS(lagDresGERxIT,1)	,196	,094	,195	2,083	,039

a Dependent Variable: DIFF(resGERxIT,1)

ADF 3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-,002	,024		-,089	,929
	LAGS(resGERxIT,1)	-3,009	,332	-1,695	-9,056	,000
	LAGS(DresGERxIT,1)	1,159	,278	1,158	4,169	,000
	LAGS(lagDresGERxIT,1)	,612	,193	,610	3,165	,002
	LAGS(lagDresGERxIT2,1)	,235	,096	,229	2,456	,016

a Dependent Variable: DIFF(resGERxIT,1)

Co-integration Germany and Greece tests

ADF 1 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,001	,024		-,060	,952
	LAGS(resGERxGRE,1)	-2,071	,157	-1,166	-13,224	,000
	LAGS(DresGERxGREK,1)	,313	,088	,313	3,547	,001

a Dependent Variable: DIFF(resGERxGRE,1)

ADF 2 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,003	,024		-,108	,914
	LAGS(resGERxGRE,1)	-2,469	,249	-1,390	-9,902	,000
	LAGS(DresGERxGREK,1)	,652	,188	,651	3,474	,001
	LAGS(lagDresGERxGREK2,1)	,192	,094	,192	2,043	,043

a Dependent Variable: DIFF(resGERxGRE,1)

ADF 3 **Coefficients(a)**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,003	,024		-,110	,912
	LAGS(resGERxGRE,1)	-3,032	,334	-1,706	-9,077	,000
	LAGS(DresGERxGREK,1)	1,173	,280	1,171	4,194	,000
	LAGS(lagDresGERxGREK2,1)	,615	,194	,614	3,168	,002
	LAGS(lagDresGERxGREK3,1)	,238	,096	,231	2,483	,014

a Dependent Variable: DIFF(resGERxGRE,1)