

# **Inflation differentials in the euro zone and their impact on monetary policy**



**Master Thesis**

**Erasmus University Rotterdam**

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Rotterdam, March 30<sup>th</sup> 2010

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**Abstract:** Inflation differentials in the euro zone should not lead to the renunciation of the uniform monetary policy as set by the European Central Bank. Results in this paper suggest that during the period 1999-2008 almost all member states had inflation rates around average inflation, which leads to the conclusion that the uniform monetary policy was appropriate for almost all countries during the observed period. Countries that however did tend to deviate from average inflation are countries with small open economies with unstructured labour markets like Greece and Ireland. Deviating countries should at all time be observed and monitored by the ECB and other European institutions. In case of economic crisis they should be supported through specialized channels. This can for example be done by designing individual programs to restore the optimal allocation of resources for a deviating country.

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# 1. Introduction

Last year Slovakia became a member of the Economic and Monetary Union (EMU) and thereby adopted the euro as her new official currency. Equally to the other 15 countries of the European Union which replaced their former currency with the euro, Slovakia is subject to the uniform monetary policy as set by the European Central Bank (ECB). With an extending number of countries entering the EMU, the question arises if the uniform monetary policy designed by the ECB is appropriate for all member states.

One of the most important problems arising with this uniform monetary policy lies in the fact of inflation differentials within the euro zone. Monetary policy set by the ECB in a situation of different inflation rates can work pro-cyclical for those countries that deviate from average inflation and can cause severe problems for them.

In Chapter 2 the effects of inflation differentials in the euro zone will be pointed out. Countries that deviate from average inflation can lose competitiveness when disadvantageous monetary policy is implemented. Countries can also be harmed when monetary policy turns out to work pro-cyclical for them. This for instance, can happen through the negative effect the nominal interest rate, which is set by the ECB, has on countries that face asymmetric shocks. Countries that face asymmetric shocks are harmed by the nominal interest rate because this rate is determined with the main reason of maintaining price stability in the euro zone *as a whole*; it consequently does not take the needs of deviating countries into account. If there is a situation with only one country experiencing high inflation, for instance due to an asymmetric shock, the average inflation and thus the nominal interest rate is not being influenced much by that country alone. This means that for the country with higher than average inflation, the real interest rate is lower than for the other member states. As a result, consumption and investment will be increased in that country while saving is being discouraged. Just as described in Walter's critique: "Now, the real interest rate channel no longer acts as a brake on the cycle but instead accelerates regional economic developments".

Inflation differentials are not only of concern in Europe. In the United States, which is also a monetary union, researchers found that persistent inflation differences may influence inflationary expectations and can amplify regional business cycles as well. Within a monetary union, the adjustment mechanism can be vulnerable to a self-reinforcing effect (I.J.M. Arnold and C.J.M. Kool, 2003). These kinds of effects in the EMU will lead in a similar way to a negative impact of the monetary policy set by the ECB and will lead to the fact that inflation differentials will become bigger instead of smaller.

The effects mentioned by Arnold and Kool (2003) however, are only present when the inflation differentials turn out to be persistent. To find out if this is the fact in the euro zone, Chapter 3 will

focus on the shape and size of the inflation differentials in the euro zone. Last year Belgium, Cyprus and Malta had deviating inflation rates comparing to the other countries within the euro zone. The question arises if the inflation differences are persistent or that there is a form of an adjustment mechanism that drives the different rates to the same rate. According to general economic thought the existence of inflation differentials is part of the adjustment process that takes place after adoption of the euro. When the euro is adopted, economic imbalances and shocks that take place in the euro zone can not longer be corrected by the usual instruments like changing the exchange rate or monetary policy. Theoretically inflation differentials arising short after adopting the euro should disappear because of equalizing relative prices and wages and because of labor and factor mobility. When in fact inflation differences do not turn out to be persistent, separate monetary policy is not needed and the uniform monetary policy as set by the ECB can be successful in the future.

The ECB and other institutions have done empirical research on the size and shape of inflation differentials within the euro zone since the start of the EMU. Different institutions, using a different number of countries and methods of investigation came to different results each year. In this paper I carry out my own research on the size and shape of inflation differentials using more countries over a longer period of time than which is done in the previous literature.

In Chapter 4 the main sources of inflation differentials are discussed and a model focusing on the prediction of inflation differentials is being presented.

In several papers the main reasons of inflation differentials are being put forward. In one of their working papers, the ECB sums up a list of factors that contribute to the experienced inflation differentials. The ECB states that inflation differentials are best explained by a combination of temporary and structural factors and possible structural rigidities (ECB, 2003). Temporary factors explaining inflation differentials may be because of on-off domestic policy measures. The fact of different indirect tax measures between states for instance, can lead to differences in inflation because it can make products more expensive in one country than in the other. As to structural factors/rigidities, the level of wage rigidities can contribute to inflation differentials. This is for instance the case when wages are not flexible. Countries that can not adjust their prices due to rigid wages will face higher or lower prices compared to other countries.

In their paper, Hendrikx and Chapple (2003) divide factors causing regional inflation differentials into three groups: differences with respect to national policies, differences in structural factors and differences with respect to the timing of cyclical factors between the member states of a monetary union. An example of the first group mentioned in this paper is national fiscal policies that put pressure on a member states' rate of inflation, like for example the VAT and energy taxes in the Netherlands in 2001. Differences in reactions between member states when a shock occurs, for instance related to a sudden rise in the oil price, illustrates a way in which differences in structural factors can cause regional inflation differentials. An example of the last group of factors that cause

inflation differentials is the fact that national inflation trends might not be synchronized, in other words: there is a discrepancy between the timing of business cycles which leads to inflation differentials.

In chapter 5 the question is answered if separate monetary policy is needed in the euro zone.

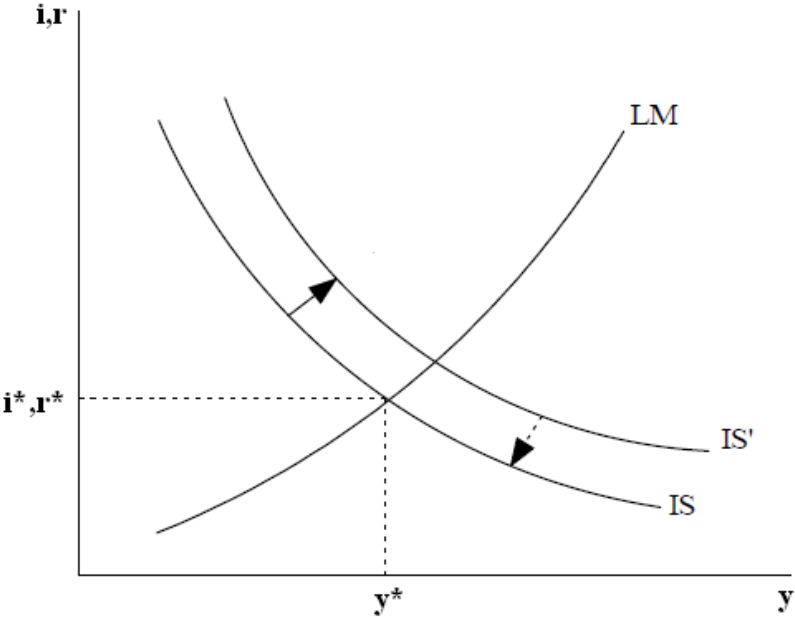
Previous researchers found that in the first three years since the start of the EMU, regional inflation differentials did not cause any problems related to the the adoption of the single monetary policy for the majority of member states (Hendrikx and Chapple,2003) They came to this result comparing the actual distribution of member states' inflation rates to two extreme theoretical distributions, namely a distribution with two outliers causing the inflation differences and one where there are two groups at each end of the observed absolute inflation spread. With the first theoretical distribution there is no need for different monetary policy, this in contrast to the second distribution where a single monetary policy does harm to almost all the countries. I will use the same model to investigate on the need of specialized monetary policy in this paper expanding my period to 2008. In this way I can investigate on the past ten years instead of the past three years. Another way in which I can extend their research is by adding economic weight to the model in order to find out what kind of countries deviate from average inflation. These findings can be combined with the results of chapter 4 to conduct a clear statement of: i) what kind of countries cause inflation differentials, ii) what the need is of specialized monetary policy, and iii) what policy recommendations can be made.

Economic theory relating to the concept of a single monetary policy in a currency area lies in the phenomenon of an Optimal Currency Area (OCA). Different researchers that criticize the single monetary policy set by the ECB claim that the euro zone does not fulfill the requirements of an OCA and therefore the EMU does not benefit of the implementation of a single currency. They underpin this by stating that the euro zone is characterized by asymmetric shocks or shocks that have a different level of impact in different countries, because of exceptional economic and institutional characteristics in the national economics. This is according to them, due to a lack in labor mobility because of linguistic and cultural differences. Also differences in tax systems are of importance. On the other hand, putting the phenomenon of an OCA in perspective it has to be said that the OCA theory is a static traditional view on currency areas, where it is assumed that country characteristics are unchangeable. This is in contrast with the EMU that itself leads to changes in economic structures and performance.

## 2. The effect of inflation differentials on member states

Regional inflation differentials can have an effect on the length and amplitude of business cycles when it comes to the transmission of regional shocks. In order to explain this statement it is useful to look through which channels the influence of shocks on business cycles can be tempered in a situation where there is no such thing as a monetary union. When in this kind of economic environment a positive shock takes place, which results in a positive output gap and high inflationary expectations, two important channels strengthen each other in order to slow down the economy. Slowing down the economy is needed to prevent a country from inflation and excess production. The two channels that reinforce each other are the real interest rate channel and the real exchange rate channel. The real interest rate will increase in the described situation and this will lead to lower consumption and investment, which is in contrast to savings that will be stimulated. The real exchange rate on the other hand will appreciate because of the positive shock. This will lead to less competitiveness on the international market and therefore leads to less demand. Inflation will be tempered because of that. Together both channels work anti-cyclical and smooth business cycles in that way. The previous can be better explained through the IS/LM model:

**Figure 1 – The effect of inflation differentials in the absence of a monetary union**



**Note:** After the positive shock, IS moves up, which leads to an increase in  $i^*$  or  $r^*$ . This leads to lower consumption and investment nationally and internationally which makes IS to move back to its original position.

With the realisation of a monetary union like the EMU, inflation differentials can have a different effect on the length and strength of business cycles because the transmission of regional shocks will work differently as described above in this situation. The effect of the real interest rate channel changes, because the nominal interest rate is set by the ECB in a way that benefits the euro zone as a whole. The ECB looks at the output gap and the expected inflation in the EMU as a whole; consequently country specific inflation plays no role in the decision of setting a new nominal interest rate. In countries in which positive asymmetric shocks and therefore higher inflation occur, the real interest rate will be lower than in the rest of the EMU. This will lead to higher consumption and investment and to lower savings. These are pro-cyclical effects which will strengthen and lengthen business cycles. Not only the way the real interest rate channel works changes, but also the way the real exchange rate channel cools down the economy becomes different. It is in a situation with a monetary union not possible to change the nominal exchange rate after the occurrence of a shock. However, the real exchange rate still influences the country experiencing a positive shock, through higher relative prices. In this way economic growth is being cooled down, but in a slower and less powerful way.

Another important aspect to focus on is the fact that inflation differentials lead to both direct and indirect effects on wealth. A direct effect lies in the inflation on nominal asset prices like stock prices and the prices of real estate that is caused by inflation differentials. The indirect effect can be understood as the effect inflation differentials can have on wealth through the real interest rate. An example can be given by The Netherlands which had high inflation and therefore a low real interest rate in 2000. The purchase of houses became more attractive which resulted in a boom in the housing market. The inflation differentials in the EMU resulted in the indirect effect of inflation in the housing market.

There has been done some research on the effect of both the real interest rate and the real exchange rate channel on the length and strength of business cycles. In research done by Arnold and Kool (2003) on those effects in the monetary union of the United States, it has been stressed that the pro-cyclical effect of the real interest rate dominates the anti-cyclical effect of the real exchange rate in the short run. In the long run the real exchange rate channel gets a deeper impact. The relevance for the EMU in this context is the fact that the authors expect that the real interest rate will dominate the real exchange rate channel even more because of the fact that the economy of The United States is more flexible and better integrated. For instance labour mobility is lower in the euro zone which leads to less arbitrage opportunities. Therefore inflation differences between countries are harder to fight and can increase the length and amplitude of business cycles.

The existence of inflation differentials can also have an impact on the Stability and Growth Pact (SGP) and can have a destabilizing effect on the European Union as a whole. This is because of the fact that



member states are tempted to use fiscal policy (instead of monetary policy, which they would have used before entering the EMU) to fight their inflation. Countries that face lower inflation than average for instance, can choose to implement a fiscal expansion which can cause the annual budget deficit to be bigger than 3% or the national debt to be bigger than 60% and in that way harm the criteria of the pact. With the SGP the EMU is being facilitated and can be maintained. Harming the criteria of the pact is thus something that is not being desired. In extreme cases, countries can even choose to leave the EMU to gain back control over their monetary policy. This would lead to the disruption of financial markets within the euro zone and can be a threat for the EU as a whole.

When it becomes common knowledge that monetary policy works pro-cyclical because of inflation differentials there is the chance of a perception of persistent excessive inflation. In this kind of situation, adjustment mechanisms after the occurrence of a shock work even less optimal. When people expect inflation to be persistent after a shock, because they know what kind of influence monetary policy has on their deviating inflation, inflation becomes reinforced.

The last effect of inflation differentials that has to be mentioned is the possibility of the negative effect it can have on the optimal policy set by the ECB. According to Beningo (2004) the optimal policy is an inflation targeting policy in which more weight is given to the inflation of the region with high nominal rigidities. At the same time however, that optimal target has to be raised in order to protect countries that are at the edge of deflation. Setting the optimal target is thus in that situation not possible anymore.

After combining all the negative effects of inflation differentials it is now useful to find out to what extent inflation is in fact differentiated across countries. This will be done in the next chapter.

### **3. The size and shape of inflation differentials**

To get a clear look on the evolution of inflation differentials and the possible convergence of inflation rates, the inflation differentials in the euro zone have to be measured. The following measures have been used in previous literature:

- The absolute spread between the (three) highest and (three) lowest observations.
- The weighted and unweighted standard deviation.
- The coefficient of variation.

Not all the measures are equally useful since they have different benefits or disadvantages. First of all, the absolute spread is highly sensitive for outliers. This can however be reduced by measuring the absolute spread of the three highest and three lowest observations. Second, when using unweighted

standard deviation, every country is assigned the same economical importance. Results from doing research with this measure can give an incomplete view on the real evolution of inflation differentials. To solve for this problem the weighted standard deviation can be used as a measure. Each country is with this measure assigned an economic weight, for instance based on the national consumer expenditures of that country. This measure is said to be more appropriate for doing research on the euro zone, but it can keep important inflation developments in smaller countries unrevealed. Last of all, in my analysis the coefficient of variation as a measure of inflation differentials is not valuable since the observations that are being used come relatively close to zero.

It has been stated that the absolute spread between the three highest and three lowest observations give the same result as the weighted standard deviation (ECB, 2003). In this paper I choose to use the weighted standard deviation instead of the absolute spread of the three highest and lowest countries. Next to this measure I will use the unweighted standard deviation and the absolute spread of the highest and lowest country to get a clearer view of the development of inflation differentials and inflation convergence. The measures that are used in this paper are summarized by the following equations:

Absolute spread:

$$\text{Inflation dispersion} = \pi_{j,h} - \pi_{j,l}$$

Unweighted standard deviation:

$$\text{Inflation dispersion} = \sqrt{\frac{1}{N_j} \sum_{i=1}^{N_j} (\pi_{i,j} - \bar{\pi}_j)^2}$$

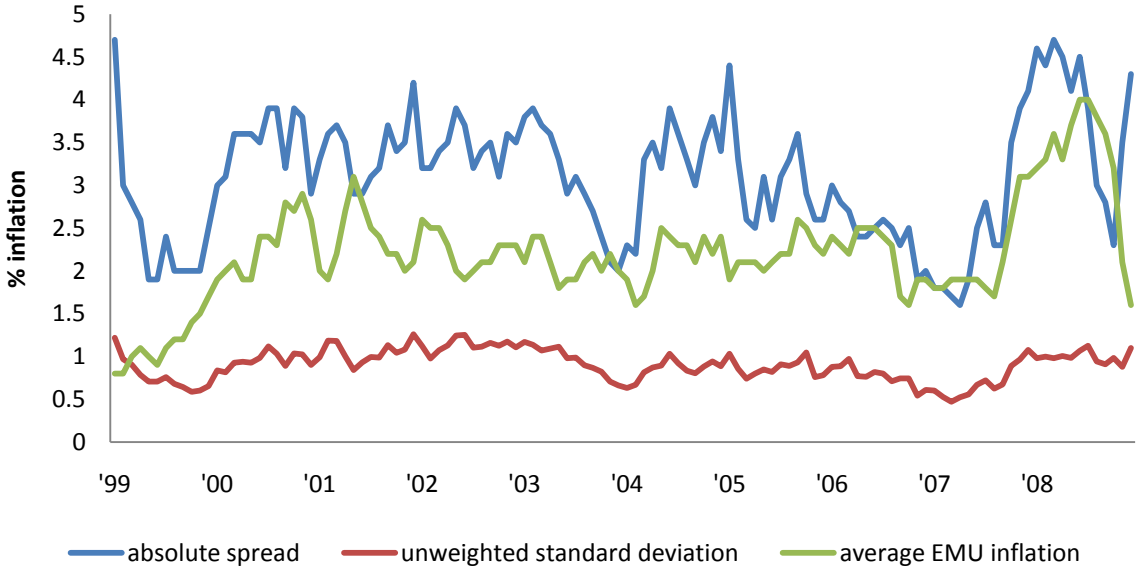
Weighted standard deviation:

$$\text{Inflation dispersion} = \sqrt{\sum_{i=1}^N w_i (\pi_{i,j} - \tilde{\pi}_j)^2}$$

where  $\pi_{i,j}$  denotes the inflation rate of country  $i$  in year  $j$ ,  $\pi_{j,h}$  and  $\pi_{j,l}$  stand for the highest respectively lowest inflation rate in year  $j$ ,  $\bar{\pi}_j$  and  $\tilde{\pi}_j$  cover average respectively weighted average inflation in year  $j$ ,  $N_j$  is the number of countries that are member of the EMU in year  $j$  and where  $w_i$  denotes the

economic weight<sup>1</sup> of country i. The countries that are object of investigation are Belgium, Ireland, Greece, Spain, France, Italy, Cyprus, Luxemburg, Malta, The Netherlands, Austria, Portugal, Slovenia and Finland. Countries are added into the calculations from the year of joining.

**Figure 2 – Inflation dispersion: absolute spread and unweighted standard deviation**



Taking a first look at the absolute spread, there is no sign of inflation convergence since the start of the EMU, since the rates are not coming close to zero. Looking closer there is however some inflation convergence from 2005 until 2007 but it is not very convincing. In 2007 and 2008 the new member states Cyprus, Malta and Slovenia joined the EMU. They may have caused the sharp increase in dispersion which can be seen in the figure. To find evidence for that statement Table 1 gives some important insights.

**Table 1 - Inflation rates new member states in percentages**

Average inflation:	2007	2008
Cyprus	-	4.37
Malta	-	4.68
Slovenia	3.75	5.55
Euro zone	2.13	3.28

The table reveals that the new member states possibly can be considered as outliers in the EMU. Their inflation rate is much higher than average inflation and there is a probability that they detain inflation from convergence at some level at this moment.

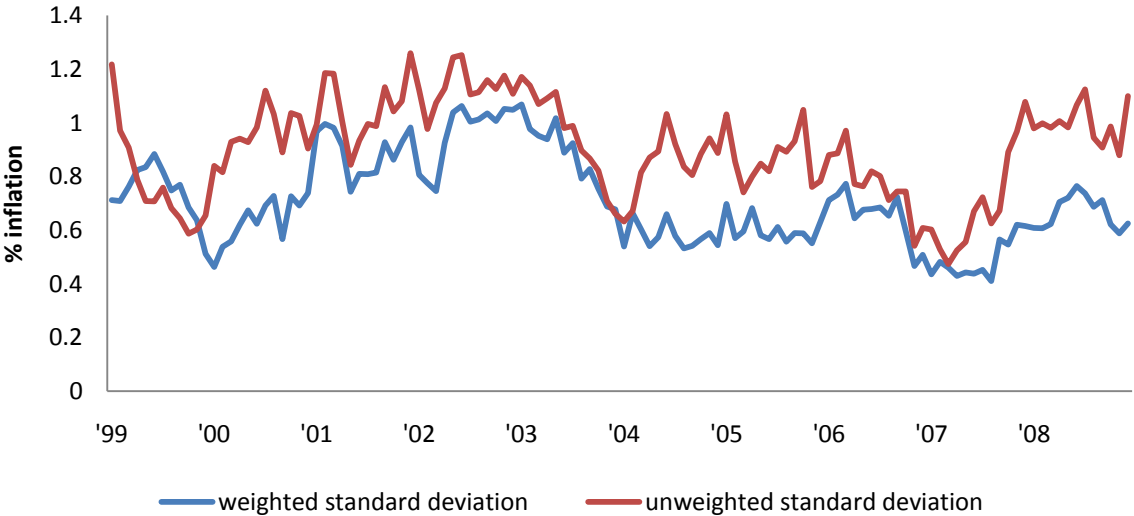
<sup>1</sup> The economic weight is derived from national consumer expenditure in 2005.

When taking a closer look at the data it is clear that countries that deviate strongly from average inflation just after entering the EMU, will still be deviating in 2007 or 2008. This is the case for Greece who has had one of the highest inflation rates from the year of entering the EMU (which was in 2000) until 2008. Also Ireland had a similar pattern of constant high inflation rates. Those countries that structurally deviate from average inflation are withholding inflation from convergence.

From Figure 2 can be drawn the conclusion that when inflation dispersion is measured with the unweighted standard deviation there is no sign of converging inflation rates either. Since the unweighted standard deviation and the absolute spread are similar methods of measuring, this is not totally unexpected. The fact that both measures give similar results makes me confident about the credibility of them. Again it has to be mentioned that there is an increase in inflation differentials when new member states join the EMU. This does not mean however that new member states are full responsible for the lack of the convergence of inflation rates, because the absolute spread and the unweighted standard deviations were far from zero already before 2007.

As stated before, Cyprus, Malta and Slovenia are the countries that are possibly retaining the inflation rate from divergence in the years 2007 and 2008. Those countries are small economies. It is therefore worthy to plot the evolution of the inflation differentials measured by the weighted standard deviation to take into account different economic sizes of the countries.

**Figure 3 – Inflation dispersion: weighted and unweighted standard deviation**



When economic weight is taken into account you can see from Figure 3 that there is more support for inflation convergence. As you can see in the figure this is especially the case in the period 2005-2007. In these years the weighted standard deviation lies closer to zero than the unweighted standard

deviation which is a sign of less inflation dispersion and therefore more convergence of inflation rates. Deviating inflation rates are in this case present on a smaller scale.

Figure 2, Figure 3 and Table 1 seem to support the following statements:

- There is some inflation convergence within the euro zone, especially in the period 2005-2007.
- There are individual countries that deviate structurally from average inflation, like new EMU member states and countries with small economies.

The previous statements are of great importance to answer the question if different monetary policy is needed in the euro zone. In order to be able to answer that question, more detailed information about the causes of inflation differentials within the euro zone is needed. Those are further explored in the next chapter.

## **4. Causes of inflation differentials**

In the previous chapter it was shown that inflation differentials have not vanished since the introduction of the euro. Therefore the question arises if the single monetary policy set by the ECB is still useful. It can be argued that member states differ too much from each other which will lead to the situation that a uniform policy will worsen the situation for countries that are not average. In order to find out if this kind of critique on the uniform monetary policy is really sustainable it is useful to investigate on the underlying causes of inflation differentials. Only when those underlying causes are discovered, valuable reform recommendations for monetary policy can be made. The focus will be on the following main sources:

- Transitory factors.
- Structural differences between countries.
- Policy differences between countries.

### **4.1 Transitory factors**

This group of effects is said to be of biggest importance right after the introduction of the euro. These effects are of no structural importance and should therefore fade away after a period of approximately two years. When inflation differentials are caused by these kinds of factors, different monetary policy will only be needed for new entering member states.

The first important transitory factor lays in the fact that countries had to adjust their nominal interest rate to the low rates in the most credible countries prior to the introduction of the euro. Countries with high inflation saw their interest rate going down which led to more spending and therefore a sustained

upward pressure on prices. The effect of this interest rate equalization is only temporal because it does not have a structural source and can be corrected for in a small period of time.

Another transitory factor that can be mentioned is the introduction of the euro itself. With the introduction of the euro, price levels rapidly equalized in comparison to the period before the introduction of the euro which led to a new average price level. Countries with price levels that were furthest away from this new average price level at the introduction of the euro, have known the highest inflation or deflation rates as a result of trying to approach the new average price level. In that way price level convergence led to inflation divergence in the beginning of the euro period. This factor is temporal because it causes inflation differentials more due to the “sudden” aspect than to any other structural factor.

Since the ECB is not able to influence transitory factors in any way because it is simply a convergence process, I am not going to test what precisely the effect of these factors is. More interesting are the structural factors where the ECB in contrast to the transitory factors, can have an influence on. The structural factors will be handled in the next section.

## **4.2 Structural differences between countries**

In contrast to the transitory factors, structural differences between countries influence inflation differentials over a much longer time horizon. Long lasting or sometimes even permanent differences in economic as well as institutional and financial structures of countries can withhold the inflation rate from convergence. In this chapter the possible structural factors that cause inflation differentials will be pointed out and their *theoretical* influence on inflation differentials will be described. After this the structural factors will be tested in a model to see what their *actual* influence on inflation differentials is.

### **4.2.1 Differences in productivity growth**

In this paragraph the differences in productivity growth covers the differences in the total growth of the total productivity between countries. This in contrast to the focus on the differences in productivity growth between the tradable and non-tradable sector which is covered by the Balassa-Samuelson theory which will be discussed later in the section of the influence of the amount of non-tradables on inflation differentials.

The basic economic idea is that when productivity increases either as a result of a rise in the marginal product of capital or as a result of an increase in the marginal product of labour, the interest rate

respectively the wage rate rises with the same amount<sup>2</sup>. The wage rate and the interest rate influence prices since they are direct costs for the producer. A country with high productivity growth will experience high wages and a high interest rate, which leads therefore to higher prices. The influence on inflation becomes visible when countries of the euro zone differ in their level of productivity growth. When this is the case they will consequently also differ in inflation rates. An equal development in productivity is therefore needed in order to realise inflation convergence.

Already before the introduction of the euro it was acknowledged that differences in productivity growth could lead to a severe adjustment problem for the countries with deviating productivity patterns. This was put forward by Beachill and Bugh (1998) who stated that the UK would not join the EMU since that country had a different evolution of productivity compared to other European countries. This was in contrast to France and Germany who faced similar productivity patterns and consequently were more suitable to join the euro zone.

#### **4.2.2 Differences in unit labour costs**

Another factor that can cause inflation differentials in the euro zone is the differences in Unit Labour Costs (ULC) between countries. Countries with higher ULC than average tend to have higher inflation than average inflation in the euro zone. This is because of the fact that labour costs form the basis of prices, since prices are simply a mark-up over the ULC. When labour costs differ between countries, prices will also differ, resulting in different inflation rates between countries.

Differences in ULC are basically differences in wage developments (also known as the compensation per employee component) in combination with differences in labour productivity growth. A problem with inflation differentials due to variation in wage developments is the fact that a lot of countries commit to backward looking wage indexation. When these countries deviate at some point with their ULC from average, this turns out to be persistent since wages are set on the basis of last year wages. Distortions like this in the functioning on the labour market are of course undesirable. It has been stated that differences in the wage developments are actually the most important factor for inflation differentials (ECB, 2005). In 2005 Germany had relatively low ULC in contrast to Portugal which experienced relatively high labour costs. This was reflected in the inflation rates of those countries by Germany displaying relatively low inflation and Portugal having relatively high inflation compared to average inflation. When a country in addition to deviations with respect to wage also has a deviating productivity growth, inflation dispersion becomes even bigger.

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<sup>2</sup> This since in general economics  $MPL = w$  and  $MPL = r$ .

Unit labour costs in the euro zone have to converge in order to get rid of inflation differentials between member states. In relation to this convergence two definitions have to be separated:

- Absolute convergence: This is the case when the ULC growth rates of all member states converge to the same rate. In my paper the focus is nevertheless on the other definition which is:
- Relative convergence: This holds when the relative distance between the ULC growth rates of different member states is stationary. I am particularly interested in the relative convergence since I want to form an opinion about the adequacy of the uniform monetary policy of the ECB. When countries at least have labour costs that move in the same direction, monetary policy can only be more effective for one country than the other, but it can not harm other countries. This is because of the fact that with similar ULC developments between countries the ECB can not impose counter effective policy since no country develops in an opposite direction.

The effect that differences in labour costs can have on inflation has been pointed out in the previous section. The question now becomes what the cause is of this variation in labour costs. In other words, why do wage developments differ and why can labour productivity be different around countries in the euro zone? This is due to the following reasons:

- Angoli and Ehrmann (2004) conclude that differences in the market structure of labour and products can lead to differences in productivity growth. When markets are structured differently the speed of adjustment will be lower. Labour productivity can in that case not move to equilibrium which leads to a variation in ULC.
- When it comes to differences in wage developments, inappropriate wage setting in countries leads to differences in wage development and therefore differences in ULC between member states. (Fritsche and Kuzin, 2007). This is for example the case with the earlier mentioned indexation clauses.

When unit labour costs are compared to other monetary unions like the US it becomes clear that the dispersion in the euro zone is much more unstable than the dispersion in the US. Another thing that is typical for the euro zone is the fact that the differences in ULC are combined with unemployment and low labour mobility. This has a negative effect on the economy of the European Union. Only when globalization gets a stronger effect on competition, ULC can converge.

### **4.2.3 Price rigidities**

For countries with rigid prices it is not possible to adjust their prices to the underlying changes in the euro economy. These countries will therefore have different inflation rates compared to countries that are able to adjust their prices easily to the euro average. Rigid prices lead to the fact that the price



formation mechanism will not function optimal when a demand or supply shock occurs. In that situation the essential adjustment of prices will not take place immediately which leads to long lasting distortions in relative prices. Persistent inequality of these relative prices will be transformed into inflation and can for that reason lead to long lasting inflation differentials in the euro zone.

In 2004 the Eurosystem Inflation Persistence Network (EIPN) carried out an in-depth study on price rigidities and inflation persistence in the euro zone. One of their results was that the euro zone experienced greater price rigidity in the retail sector than the US which led to higher inflation differentials in the euro zone than in the US. Unfortunately, the EIPN did not carry out any similar research in the recent past so no conclusions can be drawn for the last few years.

In the same study the EIPN also mentioned the most important reasons for unwanted price rigidities (i.e. those that are not caused by a stable macroeconomic environment). They can be described in the following way:

- A lot of relationships between producers and customers are on a long run basis. In this situation producers are anxious to sudden price changes because they fear that they will lose customers because of that. When producers choose to keep prices stable, price rigidity is inevitable.
- Some prices are determined by precise contracts which are costly to re-negotiate. In that situation price rigidity arises from the fact that it is just impossible to adjust prices to the underlying changes in the economy.
- A last important reason for price rigidities occurs as a result of firms' strategic price setting mechanisms. It is well known that in some sectors of the economy firms only wish to change their prices when competitors do so. In that situation long periods without any price changes can be a matter of fact.

#### **4.2.4 Wage rigidities**

First of all it is important to realise that the influence of wage rigidities on inflation differentials has to be seen in context with the influence labour mobility and the differences in ULC can have on inflation differentials. A low level of labour mobility for example means that wages are not subject to international demand or supply of labour. This means that wages will not change with certain demand or supply movements. Low level labour mobility therefore leads to rigid wages. On their turn, rigid wages lead to differences in ULC between countries because countries are not able to adapt to a certain average level. This is also stated by Arpaia and Pichelmann (2007) who conclude that the core source of inflation differentials related to the structure of the labour market are wage rigidities which lead to other derivative forms of inflation, like inflation caused by differences in ULC.

Despite the interconnection of above mentioned variables it is still interesting to investigate on the

influence of each of them separately to find out the main problem in the labour market which has led to inflation differentials in the euro zone in the last decade.

The way in which wage rigidities can lead to inflation differentials can be illustrated by an example where wages are persistently too high. In that situation the high wages lead to more demand than the economy can handle which leads to high inflation. Inflation in countries with rigid wages that are too high will therefore experience higher than average inflation than countries with flexible wages.

The most common type of wage rigidity in the euro zone is downward rigidity. This means that countries in the euro zone are resistant to reducing their nominal wages which is (generally) caused by the following:

- Labour unions (and with them employees) have a strong position in most of the euro countries. This leads to extended labour legislation and collective bargaining agreements which prevent wages from being adjusted downwards.
- A labour contract is a contract for a longer period of time. During a labour contract wages are not likely to be re-negotiated which leads to rigid wages.
- Some research proved that sometimes even firms can be against wage reductions. Agell and Benmarker (2002) found that employers oppose to wage reductions since it can lead to the increase of employee turnover because reducing wages makes the incentive for employees to leave bigger. Another reason for the fact that employers are against wage reduction can be that wage reduction will make employees less motivated which is undesirable for a firm.

#### **4.2.5 Labour mobility**

Labour mobility has a negative effect on inflation differentials according to the general economic thought. In other words the more people move from one country to the other in order to work there, the more inflation will converge. A lack of labour mobility results in the fact that demand and supply of labour are not equalized between countries and will therefore lead to wage differentials between them. This has a direct effect on inflation, since the height of the wages influences the demand of goods and as a result influences the prices of goods.

Labour mobility works as an adjustment system of asymmetric (external) shocks and differences in business cycles between countries. Shocks and differences in business cycles can lead to inflation differentials in the absence of an independent monetary policy adjustment mechanism, and are therefore clearly unwanted. The idea that labour mobility can solve these kinds of problems forms the basis of the Optimal Currency Area theory. In this theory full labour mobility makes inflation move to equilibrium. When labour mobility is limited it will be harder to accommodate shocks. Countries in recession will suffer income reduction in the absence of labour mobility which will lead to further

integrated inter-regional disparities since inhabitants of such countries are not able to find work and earn money abroad.

Labour mobility is said to be low in the euro zone, especially relative to labour mobility in the United States. There are several reasons mentioned for this in the previous literature like language and cultural differences, different social security systems and non-coordinated pensions or entitlement systems within the EMU (Obstfeld and Peri 1998 & Piracha and Vickerman 2002). This does not imply that labour mobility will never increase in the euro zone. In the future, the opposite will probably be true. For the EU as a whole there is already some evidence of increasing labour mobility caused by the joining of eastern countries like Poland and Slovakia. When new member states will join the EMU, the same effect on labour mobility in the euro zone is expected. Acceding countries influence labour mobility in a positive way as a result of the sizable wage differentials between those countries and the western Europe countries (Boeri and Brücker, 2005). People of acceding countries have a greater incentive to get employed in a foreign country because of higher wages, which make language and cultural differences become less relevant in their decision to work abroad or not.

One thing that is worth mentioning is the fact that the focus in this section is on the effect of labour mobility *between* countries rather than *within* countries. The effect of labour mobility within countries on inflation differentials in the euro zone is expected to be positive, this in contrast to labour mobility between countries. Labour mobility within countries is an aspect which is more interesting in the light of the so called Balassa-Samuelson effect and that will be explained in the section of the non-tradables.

#### **4.2.6 Capital mobility**

With full capital mobility, the rate of return on capital will be equalized between countries of the euro zone. When capital can freely move from one country to another there can be full competition on the capital market which leads to equalized prices of capital. Since the price of capital is better known as the interest rate, capital mobility leads to equalized real interest rates between countries. Equalized real interest rates is a condition that can contribute to inflation convergence.

A few researchers found however also a negative influence of capital mobility on inflation differentials. In their research, Karfakis et al. (2004) found that under a fixed exchange rate regime like the euro zone, there is a positive influence of capital mobility on inflation persistence. They did empirical research on Greece over a period of a few years before entering the EMU in 2000<sup>3</sup> and discovered that in this process towards joining the EMU the high degree of capital account openness

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<sup>3</sup> In that period their exchange rate was already fixed to the euro exchange rate.

(which is a measure of capital mobility) led to inflation persistence. Inflation persistence can lead to severe inflation differentials because it leads to a situation where it is not possible for countries to move to average inflation.

There is however much more evidence for the statement that capital mobility contributes to inflation convergence than to inflation persistence.

Already before the start of the EMU there has been done a lot to increase capital mobility in Europe. Because a lot of these measures were successful, a high level of capital mobility in most EU countries is reached. Capital is more likely to move than labour because money can move easier than people. It is however not true that there is full capital mobility in the euro zone. There are for example barriers due to different capital regulations which prevent full capital mobility. Another problem is that the infrastructure in the EMU is not yet optimal for full capital mobility. There is consequently some progress that can be made in the near future concerning capital mobility.

#### **4.2.7 Degree of openness**

Differences in the degree of openness between member states coupled with fluctuations in the exchange rate can have a positive effect on inflation differentials between member states. In that way, countries with a high degree of openness deviate more from average inflation in the years that there are significant fluctuations of the euro dollar<sup>4</sup> exchange rate than countries with relatively closed economies.

There are roughly spoken three ways in which a high degree of openness can lead to inflation differentials:

- **Import effect.** When a country imports a great amount of goods or raw materials from non-EMU countries with a relatively strong currency compared to the euro, inflation can be imported from that non-EMU country. Especially small open economies, given their lack of sufficient economies of scale in crucial industries, are above average importers of that kind of inflation (Mc Aleese, 1997). This can be easily explained by a small example. Belgium is a small open economy that lacks an industry of raw materials. Belgium mainly produces finished goods and uses for that production imported raw materials from all over the world including the US. In periods that the dollar is relatively strong compared to the euro, inflation from the US can be imported into Belgium. Belgium is more sensitive to changes in the exchange rate because of the high degree of openness Belgium faces and their inflation rates will for that reason differ.

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<sup>4</sup> I refer to the euro dollar exchange rate since the US is the biggest trading partner of the EMU member states; other member states not taken into account.

Besides the import of inflation through the exchange rate channel, external shocks occurring in the trading country can also lead to sudden high inflation in the importing country. If the shock is originated abroad its effect is larger the higher the degree of openness (J. Andrés et al., 2003).

- Policy effect. When a monetary policy rule is being set by the ECB it can have different effects on countries that have a high degree of openness than on countries that are less open to extra union trade. Open economies experience a deeper effect of policy rules because demand and supply react stronger to it. This is because of the fact that open economies will relatively gain or lose more competitiveness than countries that are relatively close (Dornbusch et al., 1998). When the ECB lowers the interest rate for example, it is more attractive for countries outside the euro zone to spend money in the euro zone than in other places. Countries which are open to trade are therefore facing a higher gain in demand than countries that are not. Their inflation will therefore also tend to be higher.
- Indirect effects. The above mentioned effects are direct trade effects. Open countries can on the other hand also have deviating inflation because they are involved in world trade and therefore are more popular to investors. Countries with a high degree of openness for example are subject to larger amounts of FDI which can stimulate inflation.

The degree of openness contributes to inflation differentials in the ways mentioned above. With this it has to be taken into account that only the degree of openness matters when it concerns trade with countries that are not in the euro zone. Only in that way inflation can be imported through the exchange rate. Since the degree of openness plays still an important role in explaining inflation differences it can be concluded that full European integration is not yet realized. When intensification of intra EMU trade can be realized in combination with a reduction in European market segments, less trade with non euro countries will occur and inflation differentials will diminish. It is expected that this will actually happen in the future.

A last thing that is interesting to mention related to the degree of openness as a cause of inflation differentials is the fact that acceding countries tend to be very open. For those countries that trade with non euro countries it is important to keep in mind that inflation is easily imported. Most of the open acceding countries trade however most with other euro countries so this effect will not be of major concern.

#### **4.2.8 Non-tradables**

Countries that produce a large amount of non-tradables relative to tradable goods can deviate more from average inflation than countries that produce relatively more tradable goods. The HICP, the measure of inflation that is used in this paper, is constructed of the harmonized prices of both traded

and non-traded goods. Prices of non-tradable goods can deviate more between countries due to the lack of competition in the non-tradable goods market. This can lead to the fact that countries with a big share of non-tradable production can deviate with their price level from average and can therefore have deviating inflation rates. In other words, a large proportion of the total inflation comes from the rise of prices of goods and services which are not traded to other countries in the euro zone.

The effect of a large share of non-tradables in total production on inflation differentials can be best described by the Balassa-Samuelson effect.

The traded goods sector in a country usually encounters more productivity gains than the non-traded goods sector. This is because of the fact that traded goods are subject to more competition which enforces a higher productivity in order to keep the production process being profitable. Another reason for the higher productivity in the traded goods sector is that this sector is more capital intensive. A big share of the non-tradable consumption on the other hand, exists of services where not much capital is used. When productivity rises in the tradable sector, wages will also rise in that sector. This is because of the fact that in a normal economic setting, wages must be equal to the marginal product of labour. Since there is competition in the goods market combined with labour mobility within a country, the non-tradable and tradable sector fight over the same employees. This leads to the fact that wages equalize between those sectors. The non-tradable sector faces in this new situation higher wages without the compensating productivity gains. Since prices are formed by a mark-up over marginal costs (including wages) the prices in this sector have to rise in order to keep the same profit. This leads to inflation in the non-tradable sector, which is part of total inflation. Countries that have a higher amount of non-tradables compared to other member states will consequently experience more of this effect and will deviate therefore more from average inflation. According to Hofmann and Remsperger (2005) Greece and Ireland had the highest implied Balassa-Samuelson inflation rates in 2002 of respectively 3,6 and 3,4%. In that year they also deviated most from average inflation compared to other euro zone countries.

The reason that it is possible for goods in the non-tradable sector to be priced higher with this mark up over marginal costs lies in the fact that there is a lack of competition in this sector. Prices are not reflecting European market prices in the non-tradable goods sector. There is no mechanism that pushes non-tradable goods to their equilibrium price. The non-tradable goods face therefore a higher degree of price stickiness. Because there are less frequent price changes in the non tradable goods sector, adjustment goes slower which leads to structural deviation from average inflation in the countries with a large share of non tradables. Another negative consequence of the price stickiness in the non-traded good sector is the fact that momentary policy is not effective in this sector of the economy. When the interest rate is tightened to reduce inflation for example, prices will not immediately adjust because of

the price stickiness and inflation will remain high. It is up to policy makers to take this effect into account properly.

The numeric effect of the amount of non-tradables a country produces on inflation has already been subject of investigation by Ogowa and Kumanato (2005) who found that cross country dispersion in the inflation rate of tradable good reduced among the euro area countries in the last few years while dispersion of the inflation rate of non-tradable goods did not. This has an evident impact on the dispersion of total inflation between countries. They also found that both the intrinsic and the extrinsic inflation persistence are larger in the non-tradable sector. This means that the persistence of inflation inherited from the past (intrinsic) and from inflation that arises from exogenous shocks in the economy (extrinsic) both contribute to inflation differentials across countries.

#### **4.2.9 The estimation**

In order to investigate on the influence of the most important determinants of inflations differentials I will test a model using panel data since I have to deal with both cross-section (countries) and time-series (time) data. By using panel data I am able to use more data which makes my analysis more accurate. The period of testing is 1999-2008 using yearly data. The countries that are scope of the investigation are: Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, The Netherlands, Austria, Portugal and Finland from the year of joining. I discard from the recently joined members in my model because they would make the model inaccurate and non representative because they only have one or two year that can be tested. Because I am more interested in the cross-section effects than the development over time of my variables I make use of the Fixed-Effects Model in pooling the data. In this way I can draw conclusions about the effects of the given variables on the inflation differentials different countries have respectively to the euro average. After testing the assumptions that must hold to use the Ordinary Least Squares method for estimating the model (which are linearity, normality, homoskedasticity and serial correlation) I found that there is an indication of heteroskedasticity<sup>5</sup>. To account for that I estimate the model using Generalized Least Squares with cross section weights.

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<sup>5</sup> For the results, see Appendix I.

The model that will be tested is the following (where i stands for a certain member state in a certain year j):

$$\begin{aligned}
 INFL_{i,j} - \overline{INFL}_j &= c + \beta 1 PROD.DIFF_{i,j} + \beta 2 ULC.DIFF_{i,j} + \beta 3 PRICE.RIG_{i,j} \\
 &+ \beta 4 WAGE.RIG_{i,j} + \beta 5 LAB.MOB_{i,j} + \beta 6 CAP.MOB_{i,j} + \beta 7 DOP_{i,j} \\
 &+ \beta 8 NON.TRAD_{i,j} + \varepsilon_{i,j} \quad ^6
 \end{aligned}$$

Results of the model estimation are explained and summarized in the following table:

**Table 2 – Model estimation: summary and results**

Term	Meaning	Expected Sign/ $\beta$	Actual Sign/ $\beta$	Significant
<b>INFL</b>	country specific inflation	-	-	-
$\overline{INFL}$	average inflation	-	-	-
<b>c</b>	constant term	-	-	yes
<b>PROD.DIFF</b>	difference in productivity growth from euro average	positive	positive	no
<b>ULC.DIFF</b>	difference in Unit Labour Cost from euro average	positive	positive	<b>yes</b>
<b>PRICE.RIG</b>	level of price rigidities	negative <sup>7</sup>	negative	no
<b>WAGE.RIG</b>	level of wage rigidities	negative <sup>8</sup>	negative	no
<b>LAB.MOB</b>	degree of labour mobility	negative	negative	<b>yes</b>
<b>CAP.MOB</b>	degree of capital mobility	negative	positive	no

<sup>6</sup> The regression output can be found in Appendix II.

<sup>7</sup> PRICE.RIG is measured by the average monthly rate at which prices change. Therefore: the higher the rate, the lower inflation differentials are expected to be.

<sup>8</sup> WAGE.RIG is measured by the average yearly rate at which wages change. Therefore: the higher the rate, the lower inflation differentials are expected to be.



<b>DOP</b>	degree of openness	positive	positive	<b>yes</b>
<b>NON.TRAD</b>	amount of non-tradables in total production	positive	positive	<b>yes</b>
<b>ε</b>	error term	-	-	-

The results indicate that at a significance level of 5% the degree of openness, the labour mobility, the amount of non-tradables and the difference in unit labour costs of a member state with the euro average are of significant influence on inflation differentials. Evidently, labour factors are very important in the explanation of inflation differentials since labour is of relevance in all the significant variables except the degree of openness. This finding is important to answer the question which measures the ECB or member states can take to fight inflation differences in the euro zone. This question will be answered in the next chapter.

A last thing worth mentioning is that from Table 5 in Appendix II can be concluded that the regression was successful for approximately 98%, which means that the model predicts 98% of the dependent variable in the sample.

### 4.3 Fiscal policy differences between countries

When countries join the EMU they give up important channels with which they can influence and stabilize their economies. Changing the interest rate for example, can no longer be used to gain competitiveness relative to other countries. To make up for this loss, countries use fiscal and economic policies instead. In this part the focus will be on fiscal policy and more important on the influence fiscal policy can have on diverging inflation rates. The problem with fiscal policies set by different member states lies in the fact that countries can individually choose what kind of fiscal policy they implement and thereby are able to implement fiscal policies that lead to deviating national inflation rates.

I choose to explain the influence of fiscal policy by giving a brief overview of the literature concerning this topic. I will not do empirical research since there is almost no accurate data available regarding fiscal policy for all the member states during the whole observed period.

Fiscal policy can have an influence on inflation through the following channels:

- When countries vary with respect to their regulated and administered prices<sup>9</sup>, they will vary with their inflation, because goods subject to administered and regulated prices form a substantial share of the HCPI basket. Their influence on the price level and consequently inflation is therefore big. Only when regulated and administered prices will be changed systematically across member states, the impact on inflation will be unaffected. The question rises if that is to be expected.

Administered prices have a weight of approximately 20% in the HCPI basket. Influence on inflation is therefore likely. Especially close before the introduction of the euro up to 2001, goods with administered prices had important impact on inflation. These goods and services experienced inflation rates around 5% which was way higher than headline inflation in that same period (Égert et al., 2004). In the beginning of the EMU era a lot of public enterprises opened up to be private companies. This lowered the amount of administered prices, but not all the countries opened up at the same speed. Differences in administered prices and therefore inflation were significantly high in that period. Since the amount of administered priced goods is decreasing nowadays, the effect of these goods in inflation is expected to be less important in the future.

This is not the case for regulated prices. There will always be sectors remaining in the hand of the government based on political and strategic motives. Prices set by the government are not determined by competition factors and they consequently can differ between countries.

Besides these political and strategic motives there are also areas like the water supply sector and the railway sector in which competition is hardly possible. Prices in those sectors are necessarily set by the government which can lead to deviating inflation rates.

- Indirect taxes that vary between countries can also have their impact on inflation differentials between member states. Examples of indirect taxes are VAT and excise taxes<sup>10</sup>. The problem with for example VAT is the fact that some countries use the standard VAT rates while others make use of super reduced VAT rates. This has consequences for the prices of the goods in those countries and can lead to inflation differentials between those countries. In 2003 Ireland implemented high VAT rates according to data from the European Commission. In this year Ireland also experienced high inflation according to my data. This may have been caused by the higher than average VAT rates.

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<sup>9</sup> Regulated prices are being provided by the private sector, but are subject to price ceilings. Administered prices are fees on products produced or provided by the government.

<sup>10</sup> VAT are value added taxes which is a consumption tax levied on any value added to a product. Excise taxes are taxes on the production or sale of a certain good.

As mentioned before, the structural factors that are mainly of influence on inflation differentials are mostly labour related. The labour sector is greatly under the influence of national fiscal policy, for example due to wage settings, which makes the influence on inflation differentials even bigger. The conclusion that can be drawn from this is that no variable on its own is of major importance, but that there is always cohesion with other factors, like for example fiscal policy.

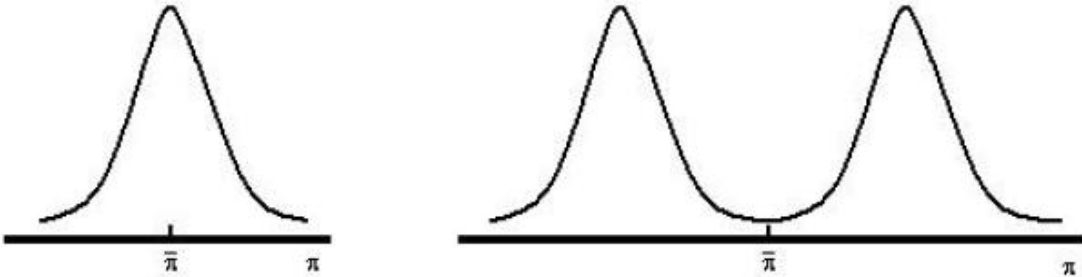
A last remark that is worth mentioning with respect to fiscal policy is the fact that regulated and administered prices are of even bigger importance in the eventually acceding countries of the EMU. Goods with regulated and administered prices cover between 10 and 25 percent of the HCPI basket in the countries that are candidate for joining the EMU. The possible impact on inflation can consequently be higher in those countries.

## 5. Policy recommendations

The different causes of inflation differentials can be used to design monetary policy that is appropriate for everybody. The question is however if inflation differentials are so severe and persistent that the uniform monetary policy will harm most member states. In other words: Is the current uniform monetary policy set by the ECB appropriate to fight the causes of inflation differentials or does the uniform monetary policy make the problems worse? In order to get that question answered I will follow the model of Hendrikx and Chapple (2003) as well as extending that model which will make it possible to draw more detailed conclusions about the topic.

According to Hendrikx and Chapple there can be theoretically two extreme situations in which inflation differentials occur.

**Figure 4 – Two extreme theoretical distributions of inflation**



**Note:** In the first situation (which is illustrated left in Figure 4) all the countries have the same average inflation rate but there are two outliers that cause inflation differentials. In this case monetary policy set by the ECB will most likely favour almost every country in the euro zone since it is based on average inflation which is equal to the inflation of almost all the countries in the euro zone. In the second situation (which is illustrated right in figure 4), there are two

groups of countries at each end of the observed inflation spread. Average inflation will therefore be at a level that not one country faces. The uniform monetary policy based on this average inflation level will therefore be too tight for one group of countries and too loose for the other group. To summarize: when only two countries are responsible for the inflation differentials, the uniform monetary policy as set by the ECB is appropriate. On the other hand, when all countries differ from average inflation because there are two opposite inflation groups, uniform monetary policy of the ECB will do damage to all the countries in the euro zone.

The actual distribution of inflation in the EMU will be compared with these two extreme distributions in order to find out which distribution suits the EMU best. Hendrikx and Chapple use the coefficient of variation in order to measure the inflation differentials. A downside of using the coefficient of variation is that it is most valuable when you use variables that are always positive, which is not the case in my data. Besides that, conclusions taken from this measure are restricted since it does not take economic weight into account. To get solutions that are as accurate as possible I will first follow the method of Hendrikx and Chapple and after that I will adjust the model by using the weighted standard deviation.

## 5.1 The model

I want to find out how the actual inflation distribution is located compared to the two extreme distributions. The two extreme distributions represent the lowest and highest possible inflation differentials the EMU can have. After all, in the first situation there are only two countries that cause inflation differentials, and in the second situation all the countries deviate from average inflation. When using the unweighted coefficient of variation the following equations represent the level of inflation differentials in the two extreme situations<sup>11</sup>:

$$C_{min} = \frac{1}{\bar{\pi}_t} \times \sqrt{\frac{(\pi_t^{min} - \bar{\pi}_t)^2 + (\pi_t^{max} - \bar{\pi}_t)^2 + (N - 2)(\pi_t^* - \bar{\pi}_t)^2}{N}}$$

$$C_{max} = \frac{1}{\bar{\pi}_t} \times \sqrt{\frac{\alpha_t N (\pi_t^{min} - \bar{\pi}_t)^2 + (1 - \alpha_t) N (\pi_t^{max} - \bar{\pi}_t)^2}{N}}$$

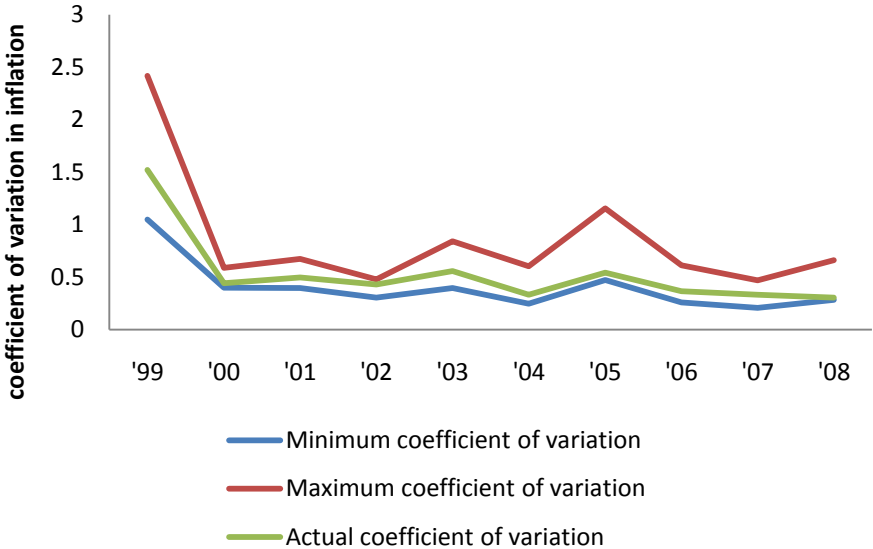
where  $C_{min}$  and  $C_{max}$  represent the lowest possible respectively highest possible inflation spread (measured by the unweighted coefficient of variation),  $\pi_t^{min}$  and  $\pi_t^{max}$  equal the lowest respectively the highest inflation rate of that year,  $\bar{\pi}_t$  and  $\pi_t^*$  stand for the average respectively the adjusted inflation rate,  $\alpha_t$  represents the proportion of countries that has the lowest inflation rate in a given year and N is the amount of EMU member states.

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<sup>11</sup> For the derivation of the formulas of the corridor see Appendix III.

In Figure 5 the actual distribution of inflation of the EMU is compared with the previous two extreme situations; the actual distribution lies in a corridor of two extreme situations:

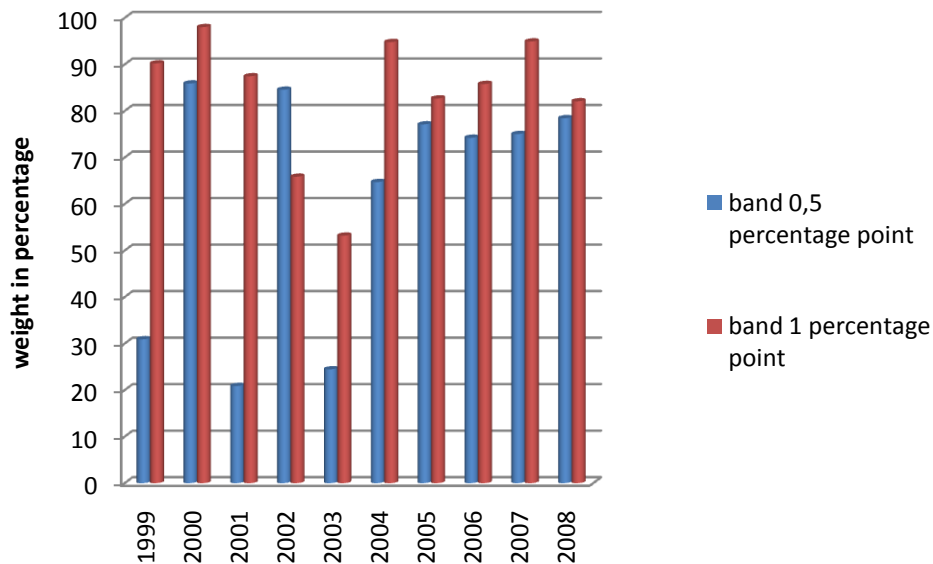
**Figure 5 – Inflation corridor: coefficient of variation**



In the whole observed period the actual distribution lies closer to the theoretical minimum than to the theoretical maximum. Especially from the year 2002, the actual distribution gets further and further removed from the maximum distribution. This implies that most countries have around average inflation rates and that there are a few outliers that cause inflation differentials. Given that fact, the uniform monetary policy seems to be appropriate for the biggest share of countries in the EMU. Countries that deviate from average inflation in this situation, should therefore try to restore equilibrium by national policies or transformations instead of expecting the ECB to implement specialised monetary policy.

In their research, Hendrikx and Chapple integrate economic weights in the analysis by constructing a band of 0,5 and 1 percentage point around average euro area inflation. They count what percentage of member states is located within this band by calculating their aggregate economic weight. When a significant share of countries (in terms of economic weight) is located close to average inflation, there is no need for separate monetary policy. When not many countries are located around average inflation (and fall outside the band) the opposite holds.

**Figure 6 – Inflation and economic weights: band of average inflation**



**Note:** The figure gives an indication of what percentage of EMU countries (in terms of economic weight) falls inside the band of average inflation.

Figure 6 shows that a significant share of countries lie within the 0,5 percentage point band around average inflation. This means that the countries with the more trivial economics are the source of inflation differentials in the euro zone. This has to be taken into account when policy recommendations are being made.

## 5.2 The adjusted model

Some remarks can be made when looking at the previous described methods of Hendrikx and Chapple. First of all, the coefficient of variation is being used to construct a corridor of two extreme distributions. Since using the coefficient of variation is most optimal when the data contains only positive values, this way of measuring does not suit my data perfectly. In my view the standard deviation would be a better method that can be used when constructing a corridor of extreme situations in which the actual distribution lies. A second downside of the method used is the fact that economic weight is integrated in the analysis by constructing a band around average inflation in which a certain percent of member states are located. Since there is no reference for the size of that band, no significant conclusions about optimal policy can be drawn from this information. Combining the two points of critique as mentioned above it seems better to make a corridor using the weighted standard deviation instead of the

coefficient of variation in order to acquire better results. The corridor of the two extreme situations as given in the previous section can therefore be rewritten into the following equations<sup>12</sup>:

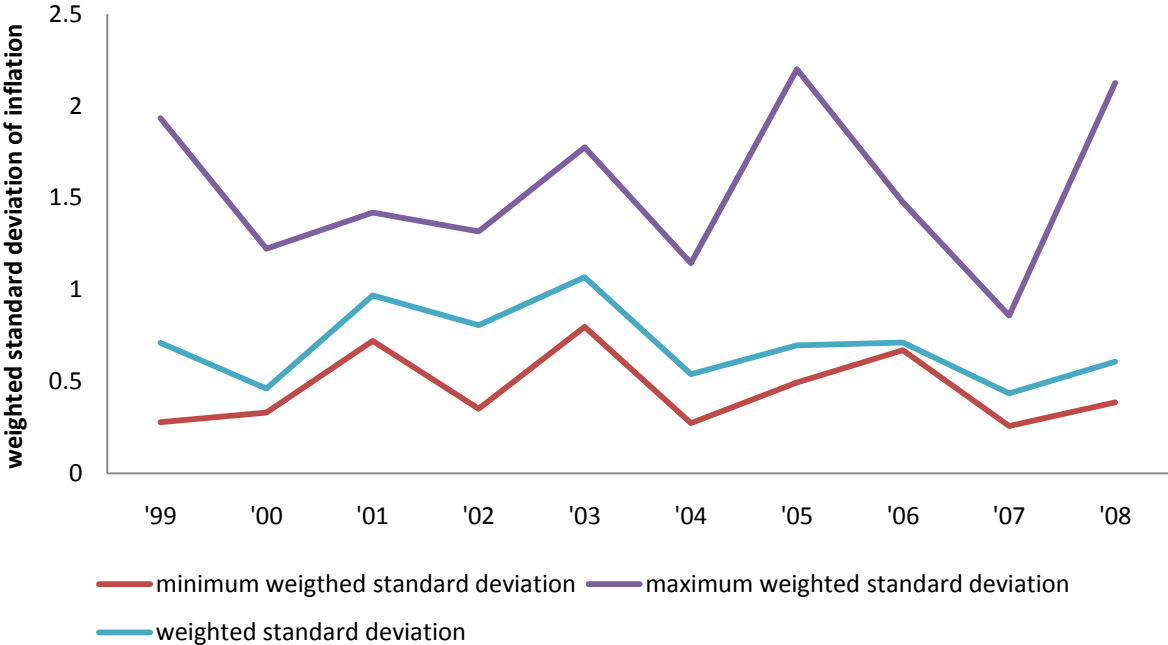
$$S_{min} = \sqrt{w^{min}(\pi_t^{min} - \tilde{\pi}_t)^2 + w^{max}(\pi_t^{max} - \tilde{\pi}_t)^2 + (1 - (w^{min} + w^{max}))(\pi_t^* - \tilde{\pi}_t)^2}$$

$$S_{max} = \sqrt{\alpha (\pi_t^{min} - \tilde{\pi}_t)^2 + (1 - \alpha)(\pi_t^{max} - \tilde{\pi}_t)^2}$$

where  $S_{min}$  and  $S_{max}$  represent the lowest and highest possible inflation spread (measured by the weighted standard deviation),  $\pi_t^{min}$  and  $\pi_t^{max}$  equal the lowest respectively the highest inflation of that year,  $\tilde{\pi}_t$  and  $\pi_t^*$  stand for the average weighted inflation rate respectively the adjusted inflation rate and where  $\alpha$  and represents the economic weight of the group of countries with the lowest inflation rate.

The two previous equations result in an inflation corridor as presented in the next figure:

**Figure 7 - Inflation corridor: weighted standard deviation**



<sup>12</sup> For the derivation of the formulas of the corridor see Appendix IV.

When Figure 5 and 7 are compared it can be concluded that in both the figures the actual inflation lies closer to its theoretical minimum than to its theoretical maximum. In figure 5 however, the actual inflation is more parallel with its theoretical minimum than in figure 7. In figure 7 there is more sudden movement of the actual inflation towards its maximum value present than in figure 5. This is for example the case in the years 2002 and 2003. In those years the actual coefficient of variation is parallel to its theoretical minimum which is in contrast to the actual weighted standard deviation, which is not parallel to its theoretical minimum. This means that when calculating inflation differentials by using economic weights, inflation tends to be more volatile. This can be explained by the fact that when big countries face a sudden inflation change, this will immediately lead to a sudden change in average inflation because bigger countries have a larger share in average inflation. In general, inflation differentials are close to their theoretical minimum, but there are some years in which big countries cause sudden changes. The impact of this result on the appropriateness of the current monetary policy can be found in the outcome that measuring inflation differentials by the weighted standard deviation suggests that there is some separation of inflation groups, but this separation is not persistent. This means that it is possible that two big countries face opposite inflation in one year and will face approximately the same inflation two years later. This is valuable information that has to be taken into account in the process of designing policy recommendations for EMU member states by the ECB or other institutions of the European Union.

### **5.3 Policy recommendations**

Results from previous sections show what type of countries deviate from average inflation and explain the different causes inflation differentials can have in a monetary union. The results are as follows:

1. Most countries have inflation rates that are around average. There are however a few countries that deviate from this average inflation rate.
2. The countries that deviate from average inflation are countries with relatively small economies.
3. The bigger countries (according to the size of their economies) make average inflation more volatile.
4. On a national level the degree of openness, the level of labour mobility, the amount of non-tradables and the differences in unit labour costs are of influence on inflation differentials. These results can be used as general guidelines for appropriate monetary policy and will therefore not be discussed separately.

From the previous results the following policy recommendations can be made:



### 5.3.1 Ad 1

Since there are only a few countries that deviate from average inflation, it is not appropriate for the ECB or other European institutions to implement (uniform) monetary policy which facilitates the deviating countries since all the non-deviating countries would suffer from that. The ECB can in this situation either design specialised country-specific policy or count on efficient and optimal national policies and thereby design no specialised monetary policy at all. It is therefore very difficult to make general policy recommendations for all the possible deviating countries. To answer the question if a response of the ECB to a deviating country is (or is not) appropriate depends on the particular circumstances in which the deviating inflation rates occur. Particular circumstances are for example appearing in the deviating country Greece. Since Greece particularly deviated with respect to inflation in the observed period and since Greece is currently going through economic depression it can illustrate what kind of measures a deviating country, the ECB or another European institution can take in order to restore equilibrium. An example of particular circumstance in Greece is that the country has a deficit of 12,5% of GDP, which is a lot higher than the allowed 3% as prescribed by the SGP. Besides that, Greece suffers from a high level of unemployment and from an unstructured labour sector. This leads to an unattractive labour market with a low level of labour mobility as a consequence. In Chapter 3 I concluded that a low level of labour mobility leads to deviating inflation rates, a circumstance that is not desired by the country.

The European Union and the ECB have a few options in how to deal with deviating countries like Greece. The first option seems a bit harsh, but is still worth mentioning. In order to protect the rest of the EMU member states from the negative influence of deviating countries like Greece, it should be able that countries could get expelled from the EMU. Suggestions that this is the best outcome for Greece were ruled out by Jean Claude Trichet (the chief of the ECB) in an official statement given in January 2010. In stead of pushing deviating countries in trouble out of the EMU it is better to design a rescue plan for them. This rescue plan should most of the time focus on the labour market since that is a very influential sector concerning inflation differentials according the outcomes of Chapter 3. The Stability and Growth Program for Greece is an example of a rescue plan that is recently being made. In this program major changes will be made in the field of public finances, taxation and budget drafting. An important point of this program is that EU member states can agree on an intervention by the European Commission or the ECB in case of a sign of derailment. This is in accordance to my previous results which suggest that it is better for the ECB to stick to the uniform monetary policy when particular countries deviate from average inflation and only engage in national monetary policy through specialised channels when that is needed.

### **5.3.2 Ad 2**

There are not many countries that deviate from average inflation and the countries that do tend to deviate have small economies. Therefore it is important that the ECB designs its policy keeping the price level of the euro zone as a whole as its reference. This does not mean that the ECB should ignore smaller and consequently less important regions or countries. It is important that the ECB understands and monitors the underlying factors of deviating inflation rates throughout the whole euro zone. When the ECB gathers and analyses all the important information concerning price stability in the EMU countries, policy makers will be able to understand the source and development of different economic shocks that can lead to inflation differentials. With this kind of information taken into account the ECB can then formulate its optimal policy. Besides this, information about the possible causes of price instability and inflation differentials in small countries can be of crucial importance since many area wide shocks that result in deviating inflation rates across all the EMU countries, have their roots in specific smaller countries or regions. It is therefore important that the ECB acts as an observing institute with respect to the smaller countries.

Besides the observing function of the ECB it is also desirable that the ECB takes on a more active role to help the smaller countries that deviate from average inflation. This should not be done by the direct monetary policy instruments that affect the euro zone as a whole, but should be done by facilitating the needed adjustment of factors that cause inflation differentials. The ECB can provide support to smaller countries by guiding the allocation of resources like labour and capital in an optimal way. My earlier model suggests that labour is the resource that causes most deviations, so the ECB should give advice and support in restructuring the labour market and act as a control mechanism to check if the advice is optimal integrated. Another thing the ECB could do is setting a tolerable safety margin in which small countries can deviate from average inflation and warn or advise deviating countries when they cross a certain line. When countries do not take the given advice in to account or when they do not integrate it in to their national policies, the ECB must be able to set sanctions on this kind of behaviour. In that way the small countries are prevented from big problems. Setting a safety margin like this does not imply that after crossing the safety margin the ECB should expect immediate re-establishment of the desired inflation rate. In the short term the ECB should be flexible to small countries and leave space for gradual improvement of their bad situation. In the short term the ECB should in my opinion advice that the labour market must be restructured in order to protect deviating countries from importing inflation since that are important causes for the deviating inflation rates and price instability in the small countries according to my previous model.

### **5.3.3 Ad 3**

Economically important countries do not deviate much from average EMU inflation. They do however have a negative influence on the average inflation rate by making it volatile. Now and then the

inflation rate of a big country suddenly changes to a large extent, which has a direct effect on the average inflation in the euro zone as a whole. Such changes are unpredictable but repeated which leads to a volatile inflation rate. Small countries, which are the countries that deviate most from average inflation, are harmed by this volatility since they thereby lack a reference point of inflation to live up to. Small countries that are in the process of returning back to average inflation can start from scratch if the average inflation rate all of a sudden changes. It is therefore important that average inflation in countries with bigger economies should be kept stable. The Stability and Growth Pact is an agreement through which this can be ensured. The Stability and Growth Pact has as a main goal to stabilize the euro and to create stable conditions in the euro zone. This leads to the fact that countries are prevented from exerting inflationary pressure on the rest of the euro zone. The two most important rules from the pact is the rule that a country can not have an annual budget deficit higher than 3% of GDP and the rule that no country can have a national debt that is higher than 60% of GDP. The problem is that bigger countries like Germany and France who are able to preserve stability in the EMU, are not always sticking to these rules. In 2006 for example, the public debt for these two countries exceeded 60% of their GDP, with France having a debt of 64,7% and Germany having a debt of 66,8%. When countries like this are breaking the rules, sudden changes in inflation are possible and this will make it harder for the smaller countries to reach average inflation. The European Commission and the Council of ministers should therefore take measures to prevent this from happening. These two bodies should focus on the big countries and be more flexible to smaller countries when criteria from the Stability and Growth Pact are being broken. First of all it is very important that the European Commission starts fining big countries like Germany and France when they cross one of the two rules mentioned before. Until now, big countries never got fined because sanctions were never approved by the Council of Ministers. Approval never took place because the big countries that were up for possible punishment had a lot of influence and much votes in the procedure against themselves. The procedure brought forth by the Council of Ministers should change in a way that countries that are not sticking to the rules should be excluded from voting in this procedure. Another reason why countries with big economies often break the rules of the SGP lies in the fact that they do not care to be “blamed and shamed” by other countries. Bigger countries are less independent and do not care about their image in the rest of the EMU. To solve this problem the European Commission and the Council of Ministers should set higher fines for bigger countries in order to give them an incentive to stick to the rules. A last thing that should be kept in mind by the European Commission when monitoring the budget deficit and the national debt is the fact that bigger (and therefore richer) countries invest a lot of time and money in creative accounting which leads to the impression that a certain country is following the rules when it as a matter of fact does not. The European Commission should provide inspectors in order to monitor and punish this kind of activities.

## 6. Conclusion

Inflation differentials in a monetary union like the EMU can cause severe problems for countries with deviating inflation rates. This is caused by the fact that EMU member states are subject to the uniform monetary policy that is set by the ECB. This uniform monetary policy is amongst others based on the average inflation rate of the euro zone as a whole. Countries with deviating rates are negatively affected by this monetary policy because it is based on economic assumptions which are not valid. Countries with lower than average rates for example, will face monetary policy that is too tight which will harm them. The focus in this paper is on the question if inflation differentials in the euro zone are indeed of such impact that they should lead to specialised monetary policy.

The results indicate that there seems to be some support for inflation convergence in the observed period 1999-2008. The actual need of specialised monetary policy is tested by constructing an (adjusted) inflation corridor. The outcome of this corridor suggests that most countries have inflation rates around average. The countries that do deviate are countries with small economies which tend to have a high degree of openness, a low level of labour mobility, a high share of non-tradables in total production and deviating unit labour costs according to my estimated regression model. The previous information can lead to different policy recommendations to the ECB and other European institutions. First of all it has to be stated that the ECB should not put an end to the idea of constructing uniform monetary policy since only a few countries deviate from average inflation. Deviating countries should however be controlled and observed to prevent further problems. Next to this there are also different specialised channels through which the smaller deviating countries can be helped. An example of this is that the ECB could set safety margins in which these countries can freely move without being immediately restricted. Besides this, specialised rescue plans could be designed to prevent the most deviating countries from withdrawing from the EMU. Another option is that the ECB could provide support to smaller countries by guiding the allocation of resources and by doing that keeping the focus on labour and trade.

The fact that the larger economies of the EMU tend to make inflation more volatile is a result from the adjusted inflation corridor which could be subject of further investigation. In this paper I argue that the bigger countries should guarantee price stability for the whole euro zone. This could be enforced through the Stability and Growth Pact. Until now, the SGP has not yet been used to punish countries that violate the basic rules of this pact. Research should be done in which way the SGP could be optimally and efficiently enforced in order to maintain price stability in the euro zone in the future.

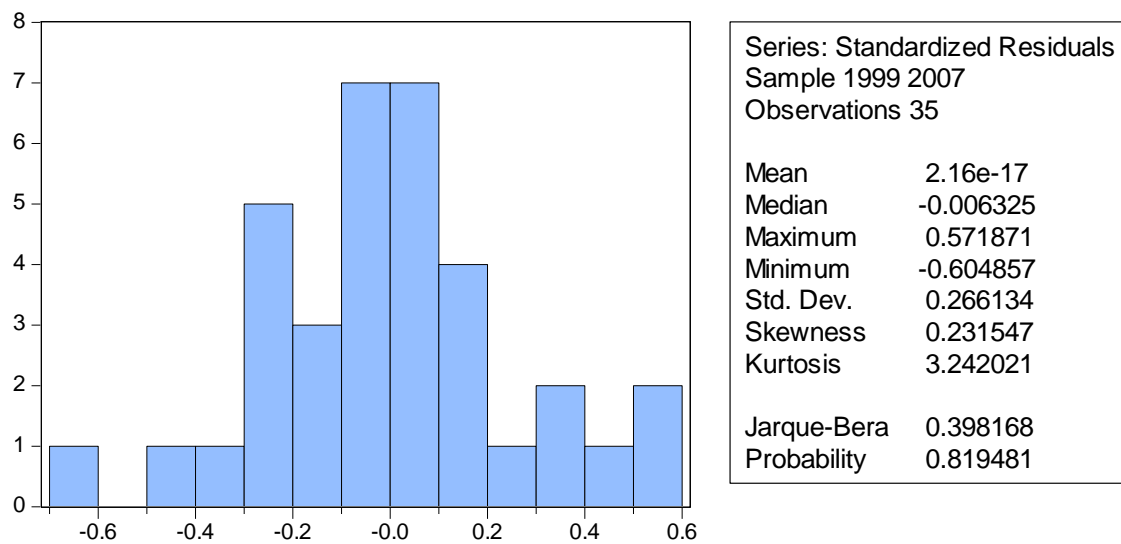
## 7.1 Appendix I

Ordinary Least Squares (OLS) as a method for estimating a model can only be used if the data satisfy the following assumptions:

- The data represent a linear relationship.
- The data are from a normal distribution.
- There is a constant variance (homoskedasticity).
- There is no sign of serial correlation.

I assume the first assumption holds. The results of the tests of the remaining assumptions are presented by the following figures:

**Figure 8 - Normality test: Jarque-Bera**



**Note: The Jarque-Bera test result is a goodness-of fit measure of departure from normality and can be used to test the null hypothesis that the data are normally distributed.**

### Conclusion of the test

The test statistic of 0.398 and the probability of 0.819 lead to the conclusion that the data form a normal distribution.

**Table 3 - Homoskedasticity test: Harvey**

F-statistic	2.002221	Prob. F(8,26)	0.0866
Obs*R-squared	13.34250	Prob. Chi-Square(8)	0.1006
Scaled explained SS	13.62545	Prob. Chi-Square(8)	0.0921

**Note: The F-statistic used in the Harvey test can be used to test the null hypothesis that all the random variables have the same constant variance.**

Conclusion of the test

The F-statistic and the associated probability suggest that the null hypothesis can be rejected at a significance level of 10%. I therefore assume some level of heteroskedasticity in the data which will be corrected for in the model.

**Table 4 - Serial correlation: Breusch-Godfrey**

F-statistic	0.792952	Prob. F(2,24)	0.4640
Obs*R-squared	2.169424	Prob. Chi-Square(2)	0.3380

**Note: The Breusch-Godfrey test is a robust test on autocorrelation in the residuals and it can be used to test the null hypothesis that there is no serial correlation.**

Conclusion of the test

The F-statistic and the associated probability suggest that the null hypothesis is far from being rejected. This leads to the conclusion that there is no serial correlation in the used data.

## 7.2 Appendix II

**Table 5 – Regression output**

Dependent Variable: INFLATION  
 Method: Panel EGLS (Cross-section weights)  
 Date: 10/19/09 Time: 11:36  
 Sample (adjusted): 1999 2007  
 Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.493672	0.859741	-2.900490	0.0095
Capital mobility	0.003372	0.001694	1.990526	0.0619
Degree of openness	1.187298	0.260823	4.552116	0.0002
Labour mobility	-3.000086	0.388314	-7.725937	0.0000
Non-tradables	1.706068	0.502730	3.393605	0.0032
Productivity growth	0.045865	0.030477	1.504894	0.1497
Price rigidity	-0.338450	0.266225	-1.271296	0.2198
United labour cost	0.245077	0.088501	2.769209	0.0126
Wage rigidity	-1.714372	2.920428	-0.587028	0.5645

### Weighted Statistics

R-squared	0.979857	Mean dependent var	1.904346
Adjusted R-squared	0.961951	S.D. dependent var	3.718158
S.E. of regression	0.365766	Sum squared resid	2.408128
F-statistic	54.72461	Durbin-Watson stat	1.529125
Prob(F-statistic)	0.000000		

Note: the regression output is based on the Generalized Least Squares method for estimation and on the Fixed-Effect Model in pooling the data.

## 7.3 Appendix III

Inflation differentials in this part are measured by the coefficient of variation, which is given by the following formula:

$$C = \frac{1}{\bar{\pi}_t} \times \sqrt{\frac{\sum(\pi_{i,t} - \bar{\pi}_t)^2}{N}}$$

where  $\bar{\pi}_t$  stands for average euro inflation in year t,  $\pi_{i,t}$  equals the inflation rate of country i in year t and where N represents the number of countries.

This equation has to be rewritten in order to obtain the formula for the lowest possible coefficient of variation and the highest possible coefficient variation. In the first case, variation is mainly caused by the country with the lowest inflation ( $\pi_t^{min}$ ) and by the country with the highest inflation ( $\pi_t^{max}$ ) of that year. All the other countries (N-2) have an inflation rate that would equal average inflation in a situation without deviating inflation rates. This inflation rate  $\pi_t^*$  can be obtained by re-writing the following equation of average inflation:

$$\bar{\pi}_t = \frac{\pi_t^{min} + \pi_t^{max} + (N - 2)\pi_t^*}{N}$$

Which leads to:

$$\pi_t^* = \frac{\bar{\pi}_t N - \pi_t^{min} - \pi_t^{max}}{N}$$

Taken all the previous into account brings me to the following equation representing the variation in inflation in the situation where only two countries deviate from average inflation:

$$C_{min} = \frac{1}{\bar{\pi}_t} \times \sqrt{\frac{(\pi_t^{min} - \bar{\pi}_t)^2 + (\pi_t^{max} - \bar{\pi}_t)^2 + (N - 2)(\pi_t^* - \bar{\pi}_t)^2}{N}}$$

In the second situation there are two groups of countries each at the other side of average inflation. The first group, which is a proportion  $\alpha$  of all the countries, has the lowest inflation rate. The second group, which is a proportion  $1 - \alpha$ , has the highest inflation rate. The size of  $\alpha$  can be obtained after rewriting the equation of average inflation which is:



$$\bar{\pi}_t = \frac{\alpha_t N \pi_t^{min} + (1 - \alpha_t) N \pi_t^{max}}{N}$$

Rewriting gives:

$$\alpha = \frac{\bar{\pi}_t - \pi_t^{max}}{\pi_t^{min} - \pi_t^{max}}$$

This brings me the following equation representing the variation in inflation when there are two groups of countries each at the other end of observed average inflation:

$$C_{max} = \frac{1}{\bar{\pi}_t} \times \sqrt{\frac{\alpha_t N (\pi_t^{min} - \bar{\pi}_t)^2 + (1 - \alpha_t) N (\pi_t^{max} - \bar{\pi}_t)^2}{N}}$$

## 7.4 Appendix IV

Inflation differentials in this part are measured by the weighted standard deviation, which is given by the following formula:

$$S = \sqrt{\sum w_{i,t} (\pi_{i,t} - \tilde{\pi}_t)^2}$$

where  $\tilde{\pi}_t$  stands for the weighted average euro inflation in year t,  $\pi_{i,t}$  equals the inflation rate of country i in year t and where  $w_{i,t}$  represents the economic weight of country i in year t.

This equation has to be rewritten in order to obtain the formula for the lowest possible weighted standard deviation and the highest possible weighted standard deviation. In the first case, deviation is mainly caused by the weight of the country with lowest inflation ( $w_t^{min}$ ) and by the weight of the country with highest inflation ( $w_t^{max}$ ) of that year. The bigger the countries are (in terms of their economic weight  $w_{i,t}$ ), the more they influence average inflation. All the other countries ( $1 - w_t^{min} - w_t^{max}$ ), have an inflation rate that would equal average inflation in a situation without deviating inflation rates. This inflation rate  $\pi_t^*$  can be obtained by re-writing the following equation of the weighted average inflation:

$$\tilde{\pi}_t = w_{min} \pi_t^{min} + w_{max} \pi_t^{max} + (1 - w_{min} - w_{max}) \pi_t^*$$

This leads to:

$$\pi_t^* = \frac{\tilde{\pi}_t - w_{min} \pi_t^{min} - w_{max} \pi_t^{max}}{(1 - w_{min} - w_{max})}$$

Taken all the previous into account brings me to the following equation representing the deviation of inflation in the situation where only two countries deviate from average inflation and where economic weight is taken into account:

$$S_{min} = \sqrt{w^{min}(\pi_t^{min} - \tilde{\pi}_t)^2 + w^{max}(\pi_t^{max} - \tilde{\pi}_t)^2 + (1 - (w^{min} + w^{max}))(\pi_t^* - \tilde{\pi}_t)^2}$$

In the second situation there are two groups of countries each at the other side of the average inflation. The first group, which has a total economic weight of  $\alpha$ , has the lowest inflation rate. The second

group, which has a total economic weight of  $1 - \alpha$ , has the highest inflation rate. The size of  $\alpha$  can be obtained after rewriting the equation of weighted average inflation which is:

$$\tilde{\pi}_t = \alpha \pi_t^{min} + (1 - \alpha)\pi_t^{max}$$

Rewriting gives:

$$\alpha = \frac{\tilde{\pi}_t - \pi_t^{max}}{\pi_t^{min} - \pi_t^{max}}$$

The prior information included brings me the following equation representing the variation in inflation when there are two groups of countries each at the other end of observed average inflation:

$$S_{max} = \sqrt{\alpha (\pi_t^{min} - \tilde{\pi}_t)^2 + (1 - \alpha)(\pi_t^{max} - \tilde{\pi}_t)^2}$$

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