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HETEROGENEITY OF INFLATION PROCESSES IN EUROPEAN MONETARY UNION

Heterogenost inflatornih procesa u Evropskoj monetarnoj uniji

Abstract

Paper analyses the extent to which inflation processes in Eurozone member countries are heterogeneous. Eurozone is composed of 19 different countries, are they similar enough to share the common currency? Significant heterogeneity of inflation processes makes the management of common monetary policy very complicated, since it poses contradicting demands, so it will not suit all members. Growing inflation has been very significant problem in the world since the beginning of 2021 and events in the first quarter of 2022 brought even higher, unprecedented rise in inflation rates. How might that influence the management of common monetary policy? Should we fear of new debt crisis in EMU? It was expected that Monetary union will support the integration of labor, product and capital markets, which will further reduce the heterogeneity of inflation processes. Literature review showed significant achievement in inflation convergence when comparing period before and after the advent of Monetary union, however problems occurred in later stages. Our analysis indicates significant departure of inflation process in majority of member countries from EMU average and among themselves. There is no statistically significant convergence of inflation rates, while there is a unit root in the series of standard deviations of inflation differentials. Coefficient of variations shows large differences in inflation rates in a single period, variability of inflation between members is very high, and variations of inflation seem insufficiently correlated. Inflation rates show significant persistence measured by autocorrelation coefficients, and there are differences among member countries showing that their inflation transmission processes differ.

Keywords: *inflation rate, inflation processes, inflation convergence, European monetary union, inflation persistence, common monetary policy*

Sažetak

U radu se analizira u kojoj meri su inflatorni procesi u zemljama članicama evrozone heterogeni. Evrozona se sastoji od 19 zemalja, da li su one dovoljno slične da dele zajedničku valutu? Značajna heterogenost inflatornih procesa komplikuje upravljanje zajedničkom monetarnom politikom jer postavlja kontradiktorne zahteve, tako da ona neće odgovarati svim članicama. Rastuća inflacija je veoma značajan problem u svetu od početka 2021. godine, a događaji u prvom kvartalu 2022. godine doneli su još veći rast stopa inflacije u svetu. Kako bi to moglo uticati na upravljanje zajedničkom monetarnom politikom? Da li treba da se plašimo nove dužničke krize u EMU? Očekivalo se da će Monetarna unija podstaći integraciju tržišta rada, proizvoda i kapitala, što bi dodatno smanjilo heterogenost inflatornih procesa. Pregled ranijih istraživanja pokazuje značajan nivo konvergencije stopa inflacije kada se uporedi period pre i neposredno nakon osnivanja Monetarne unije, međutim problemi se javljaju u kasnijem periodu. Naša analiza je ustanovila značajno odstupanje procesa inflacije u većini zemalja članica od proseka EMU, kao i između njih. U seriji standardnih devijacija inflatornih diferencijala postoji jedinični koren, što znači da nije ostvarena statistički značajna konvergencija stopa inflacije zemalja članica. Koeficijent varijacije za jedan period pokazuju velike razlike u stopama inflacije između članica, takođe zemlje karakteriše visoka i nejednaka varijabilnost inflacije u čitavom posmatranom periodu, a varijacije inflacije ne pokazuju visoku koreliranost. Takođe inflaciju karakteriše značajna postojanost merena koeficijentima autokorelacije, a među zemljama članicama postoje razlike koje pokazuju da se njihovi procesi transmisije inflacije razlikuju.

Ključne reči: *stopa inflacije, inflatorni procesi, konvergencija inflacije, Evropska monetarna unija, postojanost inflacije, zajednička monetarna politika*

Introduction

One of the most important topics today is inflation. At the end of 2021, the inflation rates in developed economies began to grow and reached values that these countries have not experienced in recent history. Most central banks explained that it is only a matter of transient price growth, due to the huge increase in the prices of energy, especially gas and oil, heating and food. The ECB announced that it does not expect further price growth in 2022, so there is no need for major changes in monetary policy. On the other hand, in European monetary union in January 2022, the growth of prices was higher than expected, fueling the suspicion that it may be a more permanent increase in prices. Similar is in other countries. Having in mind that the balance sheets of central banks have drastically increased since 2008, for example the Fed's balance sheet has increased more than 10 times [9], the ECB's balance sheet 6 times [7], the amount of money in circulation has drastically increased. So is it indeed a one-off/transient growth of inflation or it is more permanent phenomenon?

The problem is even more complex in Eurozone, since it is composed of countries which differ significantly. For Eurozone countries to enjoy benefits of membership in Monetary union, it is important to reach a sufficient level of economic performances convergence. That particularly relates to inflation rates and inflation processes. Inflation in member countries must be stable, low and sustainable in long term. Divergence of inflation rates leads to divergence in interest rates, while nominal rates are the same, but real interest rates will be different. It may cause the divergence in real business cycles. Also higher inflation rates together with fixed exchange rate has as a consequence loss in competitivenes, and thus current account problems and disbalances in Monetary union. If inflation processes are significantly heterogeneous, that means that inflation transmission mechanisms differ, so there will be different response to same shocks and monetary policy measures, which leads to further economic divergence. For a country that significantly departures from EMU average, common monetary policy will bring more economic problems and costs than benefits.

Significance of inflation convergence/ homogeneity

In January 1999, eleven[1] European countries formed European monetary union. They gave up their national, independent monetary policy and national currencies. In 2001 Greece managed (at least formally) to satisfy accession criteria and joined Eurozone. These are 12 old members, and very often when analyzing convergence, authors use data for those old members to understand what was going on. Removal of exchange rates on one side and higher price transparency on other side, should have boosted higher competition and trade among members. Integration of financial markets should have led to lower, unique prices and more efficient allocation of resources. Thus it was expected that the single market would increase the productivity, the member countries will converge and became fully integrated. EMU should have fostered economic integration, capital flows, more balanced growth and development, less developed countries should catch-up more developed members. Events in previous decade showed that this paradigm failed.

Since 2007, new wave of enlargement begun with Slovenia entry, followed in 2008 by Cyprus and Malta, than Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015. Croatia has ambition to become the 20th member as of beginning of 2023. So monetary union is composed of 19 member countries with different economic and political structures, different economic history, that follow different economic development models, and have different size (geographical, population, economic). But there is no political or fiscal union, nor fully integrated markets, while very important differences exist in the labor markets. This all causes significant differences in inflation rates and processes among member countries.

For members it is very significant to reach nominal convergence. They do not have any more national monetary policy that is focused on countries' specific needs. European central bank manages monetary policy for the Euro zone as a whole. It cannot adjust it to target the specific needs of high or low-inflation countries or countries with higher-

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1   Germany, France, Italy, Spain, Austria, Netherlands, Belgium, Finland, Portugal, Ireland and Luxemburg

or lower than average rate of growth. This means it will not suit all member countries, so they will have economic consequences. If a country has higher than average inflation, it will lose competitiveness. Its export will be more expensive and will start to decrease and import will rise. Domestic producers of tradable goods will lose markets and will have to close the production. So goods that were previously produced in a country, now will be imported. With lower export revenues payment problems would arise. Such countries will have to borrow to pay higher import and their debt and current account deficits will increase. Beside, with higher inflation rate, real interest rate will be lower. (ECB sets main refinancing rate at the same level for the Eurozone as a whole). Lower interest rate might trigger new investment cycle increasing demand in the country and thus further raising inflation rate and moving the country away from the business cycles in the rest of Monetary union. It might happen that a specific country is in the phase of growth, while others enter into a phase of falling economic activity, and vice versa. In such cases costs of membership in monetary union will be higher than benefits. Such scenario is already seen in the case of Greece, Portugal, Ireland, Italy and Spain at the end of 2000s and beginning of 2010s.

Literature Review

Monetary union from the start was not an optimal currency area (OCA). OCA literature stresses the conditions for sucessful membership in Monetary union, so that a country has long-term net benefits from its membership. Popović [13] showed that even these conditions were not satisfied, but it was expected that monetary union environment, common currency and monetary policy will facilitate convergence of economic results. When it commes to inflation, it was expected that member countries would "import" monetary stability from Germany. The anouncement and start of Monetary union brought significant reduction of differences between interest rates of the first member countries. However the problems began to rise very soon and the outbreak of financial crisis led to further nominal divergence. Average inflation rate in peripherial countries (mostly from South Europe) was constantly higher than

in core countries (mostly from North Europe) untill the outbreak of crisis [8] (Boskovic at al 2013). After that the trend reversed, since peripherial countries had to undertake deflationary adjustment programs.

Aucremanne at al. [2] showed that the establishment of EMU and the single monetary policy influenced inflation dynamics in member countries. ECB brought unprecedented price stability in Eurozone, and to some extend even the decrease in inflation persistence, thanks to monetary policy focused on price stability and thus lower inflation expectations. However, maintaining low inflation persistence in the future requires that ECB is completely oriented towards low inflation goal, but more relaxed monetary policy can lead to rise in inflation expectations and higher inflation persistence. On the other side, price-level convergence happened before EMU, and it seems that EMU did not lead to further convergence. This issue probably should be treated by structural reforms in product and labor markets, depending on underlying causes.

Auray & Eyquem [3] showed that there was significant convergence of inflation rates among countries that formed EMU in 1999, when comparing average inflation rates in the period before financial crisis and before the advent of Monetary union. However, that convergence was not finished in later stages, leading to significant differences in real interest rates. Peripheral countries (mostly from South Europe) witnessed significant reduction of borrowing costs, while they remained relatively constant in core countries (mostly North members). Since ECB rates are the same for the whole euro area, higher inflation in peripherial countries meant substantial reduction in the real rates, from around 2% to 0.42% after the introduction of euro.

Tilford & Odendahl [12] stressed that elimination of exchange rate risk facilitated destabilizing capital flows from core to peripheral countries, further decreasing borrowing costs. That motivated households, companies and governments to spend more and borrow to finance that spending, which increased demand and led to higher differences in inflation rates in booming countries. Unfortunately that capital was not used to finance productive investments, but rather real estate and consumption. In Greece government was overspending, but in Spain and Ireland the private sector. And that suited creditor countries

like Germany or Netherlands. Their growth was based on the export and relied on increased indebtedness of other countries. That caused serious imbalances in Eurozone.

Abdih, Lin & Paret [8] (2018) found that the inflation in Eurozone is highly persistent, which postpones the responsiveness of inflation to changes in economic conditions. Inflation process (for core inflation) is more backward-looking than in the US. Reason is probably slow transmission process from labor market changes to prices (due to wage dynamics, price setting and labor market rigidities). Forward-looking inflation expectations also have significant influence, although lower than backward-looking inflation. According to authors, low inflation rates in Eurozone since 2011 are significantly influenced by high unemployment. Since inflation is very persistent it takes a time for negative shock to fade out. A potential rise in long-term inflation expectations can lead to rise in inflation rate.

Moretti [1] analyzed the determinants of inflation divergence in period 1999-2007. On the sample of 11 euro zone countries she found that product market deregulation had significant influence on inflation rate but not inflation persistence, and labor market regulation contributed to the inflation persistence and significantly decreased responsiveness of inflation to the output gap. Labor market regulation has important influence on slower adjustment of inflation rate to real shocks, while product market deregulation notably decreases inflation rate. She also found that private credit flows have statistically significant positive effect on inflation rate.

Barigozzi, Conti & Luciani [4] studied asymmetry in response of member states to the common monetary policy. Since members of Monetary union have different economic structures, legislation, fiscal policies and public debt, their response to changes in monetary policy might differ, complicating monetary policy decision making. They found that the monetary transmission mechanism across Eurozone is more homogenous after the introduction of euro, however the difference between North and South Europe still exists when it comes to responsiveness of prices and unemployment. Such differences are the consequence of country specific issues and could not be tackled by a common monetary policy, but rather national fiscal policies, regulation and structural reforms. Response of inflation

after the advent of Monetary union and introduction of euro is less asymmetric, thanks to integration and higher competition across Eurozone, which made the response of prices to interest rate changes more homogenous. However some asymmetry still remained when it comes to Mediterranean countries, due to less flexible prices and lower market competition. Structural and socio-economic characteristics of individual countries probably caused the asymmetries in labor markets. Countries with more rigid labor market structure (like Italy), make domestic unemployment less responsive to the common monetary policy. On the other side, it seems there are no significant deviations in the responsiveness of member countries' output to the single monetary policy. Remaining differences could not be addressed with the tools of monetary policy, but by national reforms.

According to Lagoa [10] the inflation differentials in Eurozone is one of the factors that explains sovereign debt crisis. Countries with positive inflation differentials suffered from weaker competitiveness and economic growth, while lower real interest rates led to the accumulation of debt. Different inflation rates are largely the consequence of differences in rise of unit labor costs, but also the result of the lack of policy coordination and adequate mechanisms in case of asymmetric shocks. According to the author, managing inflation expectations and controlling labor costs are crucial for inflation convergence. Inflation heterogeneity caused divergent changes in the real exchange rates, but also changes in exchange rates led to divergent inflation dynamics.

Coudert at al. [6] studied heterogeneity within the euro area by measuring the distance between the equilibrium exchange rates' paths. Since countries in monetary union do not have their national currencies any more, their exchange rate path must be in line with one of other countries. Otherwise, unsustainable internal and external imbalances might arise, which would make functioning of monetary union more problematic. Authors found out that member countries in the period before the advent of monetary union were separated clearly into two groups. The first group constitutes mainly of core euro area countries- Germany, France, Belgium, the Netherlands and Ireland which exchange rate paths were

pretty homogenous. The second group is less homogenous, constituted of Austria, Finland, Spain and Italy, while Portugal and Greece have different exchange rate paths (especially Greece, which was an outlier). With the time the differences between and within groups rose, reflecting building up of macroeconomic imbalances in EMU and rising a question whether member countries have sufficient level of similarities to successfully share the same currency.

Sapir [14] stressed that misalignments of real exchange rates are the most visible and problematic consequence of asymmetric shocks in EMU. They are largely the result of the differences in national wage setting and bargaining systems. Those differences are especially large between core and periphery countries. That is why measures are necessary to ensure that wage developments follow productivity developments.

Methodology

We wanted to understand how much inflation processes in European monetary union differ. The best scenario would be full nominal convergence, when inflation rates are very similar, but also when countries are hit with the same shocks, with very similar effects in their economies. That is why we analyzed different characteristics of inflation in member countries- described by relevant statistical variables. We also analyzed autocorrelation coefficients of inflation rates for each member country and EMU, to understand how persistent inflation is- how much time it takes for a temporary shock to inflation to disappear. Unit root test on the series of standard deviations of inflation rates helps to understand if there is a tendency for differences in inflation rates to diminish over time. For each period we analyzed only member countries in that period. This means that in the analysis for the period between January 1999 and December 2001, we included data for 11 countries which were in that period the members. In 2001 Greece entered EMU, so for the period from January 2000 to December 2006 we based our calculation on the sample of 12 countries. In 2007 Slovenia entered Monetary union, so our sample increased to 13, etc. Sample data for the period from January 2015 till the end of 2021 included all 19 member countries.

Characteristics of inflation processes in Eurozone

The main goal of ECB is price stability, defined as inflation below, but close to 2%, in the medium term. This statement clearly says that inflation rates higher than 2% or very low rates are not consistent with the goal of price stability. It is not so easy to assess if ECB was successful in achieving its goal. Descriptive statistics given in the Table 1. show that both average and median inflation do satisfy this criteria.

Table 1: Inflation processes in EMU countries: Descriptive statistics, January 1999-December 2021

	max	min	mean	median	sd	CV
EMU	5	-0.6	1.67	1.9	0.99	59.42
Austria	4.1	-0.4	1.85	1.8	0.87	46.99
Belgium	7.1	-1.7	1.93	1.85	1.27	65.95
Germany	6	-0.7	1.52	1.5	0.94	62.21
Finland	4.7	-0.7	1.61	1.4	1.11	68.76
France	4	-0.8	1.51	1.6	0.90	59.90
Luxemburg	6.3	-1.6	2.16	2.3	1.52	70.43
Netherlands	6.4	-0.7	1.91	1.8	1.26	65.82
Ireland	5.9	-2.9	1.65	1.6	1.98	119.98
Italy	4.3	-1	1.72	1.9	1.14	66.54
Portugal	5.1	-1.8	1.79	1.9	1.49	83.24
Spain	6.6	-1.5	2.05	2.4	1.63	79.86
Greece	5.7	-2.9	1.75	1.95	2.09	119.68
Slovenia	6.9	-1.4	1.70	1.7	1.79	105.46
Cyprus	5.3	-2.9	1.01	0.8	2.03	200.43
Malta	5.7	-0.5	1.72	1.3	1.29	74.67
Slovakia	5.1	-0.9	1.66	1.6	1.56	94.36
Estonia	12	-1.8	2.46	2.8	2.24	90.81
Latvia	7.9	-1.1	1.57	1.55	1.74	110.91
Lithuania	10.7	-1.5	2.03	2	2.17	106.96

Source: Calculation of authors, based on data from [8]

On the other side, if we look at Figure 1. which gives historical values of inflation, it is observable that in majority of periods inflation was not close to targeted level. In almost 39% of time, inflation rate in Eurozone was higher than 2%. In additionally around 37% of cases inflation was lower than 1.5% (there is no clear, precise definition what close to 2% means, we assumed 1.5% and higher). So in less than 25% of cases, inflation rate was between 1.5 and 2%. Due to a number of shocks that usually hit economies, it is not possibly to manage inflation rate at some fixed level all the time. That is why the goal is set for the medium term, not short term. Short period would require significant switches in monetary policy and would be very harmful for the economy.

In 17 periods (months) Eurozone faced deflation with negative interest rates. In the period before financial crisis, inflation rates were in 60% of the cases above the goal. Inflation reached maximum of 4.1% just before the crisis, in July. Decreasing trend started at the end of this year and inflation very soon reached the bottom of -0.6%. In the second half of 2009 inflation started to recover, reaching 3% in the last quarter of 2011, which again is the level not consistent with the goal of price stability. At the beginning of 2013 rates were brought back to their targeted level, but then the second wave of debt crises hit, lowering inflation rates until they again hit the bottom of -0.6% in January 2015. This was followed by a period of 5 years in which ECB fought with very low inflation (with the exception of some months in 2017 and 2018, but that was not sustainable). The emergence of Covid-19 crisis led to significant fall of inflation, which again turned negative in majority of the second half of 2020. Trend reversed in the beginning of 2021, when inflation started strong rising trend, reaching maximum of 5% in December. Although it was expected that inflation rate in January 2021 would be 1.9%, it reached 5.1% (ECB, 2022a).
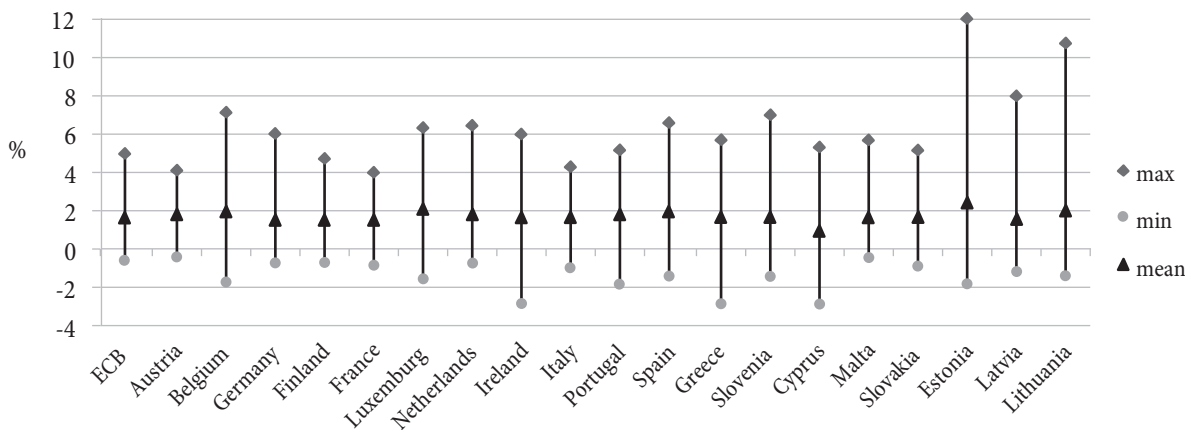
Figure 2. shows average and extreme values of inflation rates in member countries. We can observe the diversity of inflation processes among countries, and clear departure from ECB data. In majority of countries average inflation rates do not differ so much from EMU average. The exceptions are Cyprus, with average inflation of 1.01%, Luxemburg, Spain, Estonia and Lithuania with average inflation rate above 2% and significantly above EMU average. A range of inflation rates is very high, from -2.9% in Greece, Ireland and Cyprus to 12% in Estonia and 10.7% in Lithuania. The problem is in the fact that extreme values of inflation were not realized in same or close periods, which indicate that inflation processes are not much correlated.

Figure 1: Inflation rates (HICP), EMU

Source: [8]

Figure 2: Average and extreme inflation rates in EMU countries, January 1999-December 2021

Source: Calculation of authors, based on data from [8]

Standard deviation (Table 1) shows volatility of inflation rates- on average how dispersed are the data around the mean. Table 1. shows significant differences among member countries, reaching even 2.24 for Estonia, 2.17 for Lithuania, 2.09 for Greece and 2.03 for Cyprus.

We calculated the coefficient of variations (CV), as another measure of dispersion of observed variable. It is the ratio of the standard deviation to the mean and is expressed in percentages. Variable with lower CV is less dispersed (has lower relative variability) than the variable with the higher CV. From the Table 1. it is observable that data for individual countries are very volatile.

We calculated also coefficient of variations for each month, to understand how much are members' inflation rates dispersed around the mean for that month. Results are even worse. For around 10% of time periods CV is between 20 and 30% (there are no periods with CV of inflation rates lower than 20%!). In around 45% of cases, CV is between 30 and 50%, in around 21% it is between 50 and 100%, and in remaining 23% of months CV is higher than $\lvert 100\% \rvert$. The differences are extremely high! For instance, in December 2021, while inflation rate in Estonia was 12%, in Malta it was 2.6% and EMU average was 5%. In April 2010, inflation rate in Greece was 4.8%, while in Ireland it was -2.4% and EMU average was 1.6%. And these are not unique examples of differences between the levels of inflation rates in one period. So the inflation processes among EMU members are very heterogeneous. That significantly complicates the management of common monetary policy, since member countries have very different needs. It means that a single monetary policy will not be appropriate for the large part of monetary union. European central bank manages monetary policy at the average level, HICP for Eurozone (which is the goal of ECB) is calculated as the weighted average of HICP for each member country. Weights are calculated as the ratio between the consumption costs of a given country and the total costs of consumption in EMU. So monetary policy is more oriented towards the largest economies (GDP of Germany constitutes around 30% of EMU GDP, France GDP around 20%, Italy and Spain together make 25% of EMU GDP), and it will less suit other smaller economies with inflation rates significantly departuring EMU average.

The end of 2021 and the beginning of 2022 brought even larger dispersion of members inflation rates, and it seems that current events promise further rise of differences.

Analysis of heterogeneity of inflation processes in EMU countries- Unit root test

To statistically check heterogeneity of inflation process in Eurozone, we conducted a unit root test on a series of inflation differentials. The logic of analysis is the following. We already explained how important is for the member states' inflation rates to gradually converge towards average EMU inflation. So for each period and for each country, we calculated inflation differentials as the difference between the inflation rate in a given country and the HICP for EMU. After that, we calculated the average inflation differentials for the group of countries that were EMU members in that period. If there was a convergence of inflation rates, the average differences between the observed countries and in relation to the average of Monetary union, will decrease, which means that the average inflation differentials will tend to zero. The variance of the series of average inflation differentials will also tend to zero. If that happened, the series of average inflationary differentials will not have a unit root.

On the other side, if the analysis shows that there is a unit root in the series, it means that the series does not oscillate around some value (it does not tend to that value). That would mean that our series of inflation differentials does not have a constant mean and finite variance. So there was no convergence of inflation rates, as the theory expected. Inflationary processes in the member states are not homogeneous enough, which is a great challenge for the European Central Bank.

When conducting described analysis we faced a problem. The differences in inflation rates in one period are very significant and for some countries inflation differentials were negative, for some positive. So when we calculated average inflation differentials, those differences tended to cancel each other, thus obtained results were not appropriate measure of dispersion if inflation rates in a given month. That is why we chose to conduct described analysis on the series of standard deviations for each month. This series is more appropriate, while it gives a

measure of how the data are dispersed around the mean, and it cannot be negative. Results of our analysis are shown in the Table 2:

Table 2: Unit root test in levels for the series: Standard deviation of inflation rates in Eurozone countries

Null Hypothesis: X has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.391439	0.5866
Test critical values:	1% level	-3.453997	
	5% level	-2.871845	
	10% level	-2.572334	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(X)
Method: Least Squares
Date: 02/16/22   Time: 13:00
Sample (adjusted): 1999M02 2021M12
Included observations: 275 after adjustments

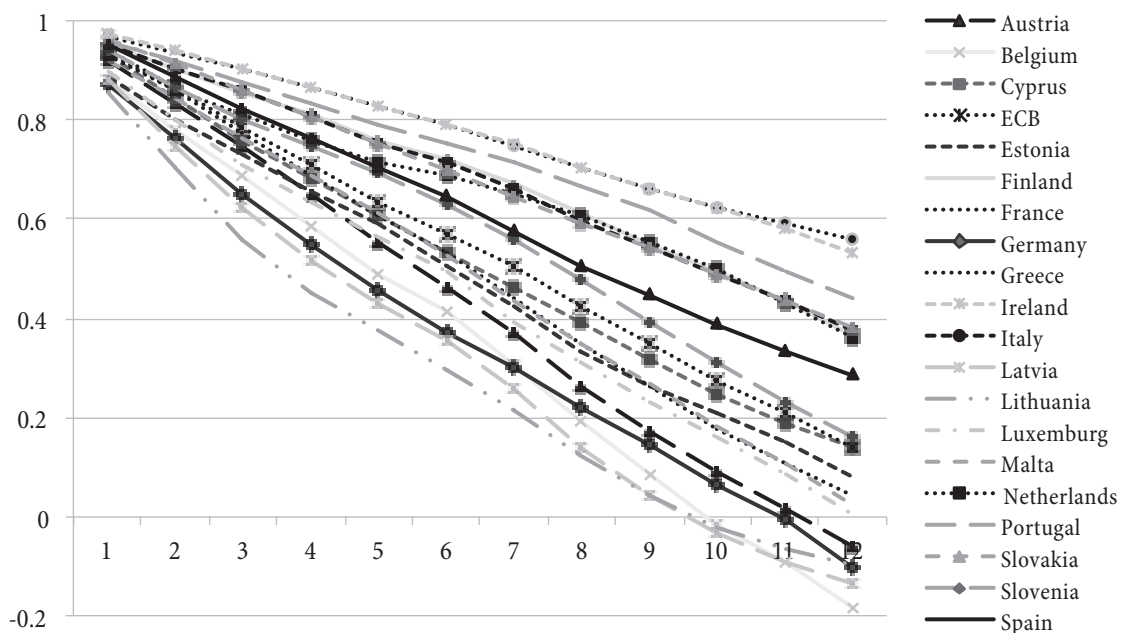| Variable	Coefficient	Std. Error	t-Statistic	Prob.
X(-1)	-0.043478	0.031247	-1.391439	0.1652
C	0.046309	0.030450	1.520814	0.1295
R-squared	0.007042	Mean dependent var		0.004976
Adjusted R-squared	0.003405	S.D. dependent var		0.111184
S.E. of regression	0.110995	Akaike info criterion		-1.551419
Sum squared resid	3.363325	Schwarz criterion		-1.525115
Log likelihood	215.3201	Hannan-Quinn criter.		-1.540862
F-statistic	1.936103	Durbin-Watson stat		1.915845
Prob(F-statistic)	0.165225			

Source: Calculation of authors in Eviews, based on data from [8]

Obtained results show that there is a unit root in the series of standard deviations. The decision was made on the basis of Augmented Dickey-Fuller test, which tests the null hypothesis that a time series has a unit root. ADF τ statistics was found to be equal to - 1.39, while the critical value (with intercept) was $\tau^k = -2.87$ at 5% confidence level. Also p=0.5866, so the probability of rejecting correct null hypothesis is very large. Thus, we cannot reject the null hypothesis that the series X has a unit root. Our analysis showed that there was no statistically significant convergence of inflation rates in Eurozone.

In addition, we wanted to analyze the differences in inflation persistence, so the duration of shocks to inflation rates. When inflation rate is hit by a shock which increases it for 1%, how long does it take for that shock to fade out? For those purposes we calculated autocorrelation coefficients of member countries' inflation rates. Larger coefficients for longer lags mean higher inflation persistence and vice versa. Results of analysis are presented in the figure 3:

Obtained results show that inflation processes are characterized by a significant persistence. The first autocorrelation coefficient is large for all countries and the following coefficients slowly decrease. So it takes more time for a shock to fade out. Figure 3. also shows significant heterogeneity of correlograms among countries. Inflation is persistent the most in Greece, Ireland, Italy,

Figure 3: Autocorrelation coefficients of EMU countries inflation rates

Source: Calculation of authors based on data from [8]

Portugal and Spain, while the persistence is the lowest in Slovenia, Germany, Latvia, Belgium and Austria. Why are those differences significant? For instance, if member countries are hit with the same shock, in Latvia the shock to inflation will fade out after 9 months, in Greece and Ireland it will still significantly influence inflation after 9 months, and will not fade out even after 1 year. So the countries do not respond in the same way to one-time shocks. Inflation transmission processes are very different. This additionally complicates the conduct of the single monetary policy.

Concluding remarks

The issue that has occupied economists since the advent of EMU is whether member countries are sufficiently alike to share the common currency. That motivated us to analyze how homogenous inflation processes among member countries are. It was expected that the advent of Monetary union and the introduction of euro would lead to higher integration of labor, product and capital markets, which will further reduce the heterogeneity of inflation processes in Eurozone. So it is significant to analyze country specific inflation dynamics, as well as at the level of Monetary union.

Our analysis showed significant departure of inflation process in majority of members from EMU average and among themselves. There is no statistically significant tendency of inflation differentials to move towards zero. Differences in inflation rates in a single period are very high, measured by coefficient of variations. In the same period, there are countries with very high inflation and countries with negative inflation rate. Also variability of inflation between member countries is very high. Some of them have pretty stable level of prices, while for others HICP is much more volatile. Besides, countries reached extreme values of inflation in different periods, which indicates insufficient correlation of their inflation processes. Inflation rates in general show significant persistence measured by autocorrelation coefficients, but also there is significant difference among member countries showing that their inflation transmission processes differ.

Large and persistent heterogeneity in inflation processes makes the management of common monetary policy very complicated, since it poses contradicting demands, and such monetary policy will not suit all member countries. This issue is very current in the light of the latest developments. Inflation is growing significantly, will it further increase the level of heterogeneity of inflationary processes in EMU? Given that the countries with the highest inflation rates in the monetary union are losing competitiveness and their economic cycles are deviating from the rest of the monetary union, should we fear a new debt crisis in the EMU? Was for some of member countries the decision to join the Monetary union premature, since they were not ready for the single monetary policy? Will they in the long term have lower economic benefits than the costs?

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