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Title:

"The European Federation"

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ABSTRACT: In this paper, we consider whether any further ties for the European Union (EU) – leading to a federal state like the United States of America – are possible or if, in the opposite direction, the EU should be disbanded. To do so, we collect data from all 27 EU countries plus the United Kingdom (UK) since 1980 on net national debt variation, inflation variation, unemployment rate variation, and GDP growth variation. The goal of the paper is to find out which countries are most correlated with one another in terms of their responses to shocks and their macroeconomic tendencies, an approach inspired by the "Optimal Currency Area" theory made famous by macroeconomist Robert Mundell. The present study differs from that original concept in that we are not only considering common monetary policies, but also fiscal policies, internal and external security, and foreign policy alliances (based on the American federal system). If two countries or more are compatible for such common policies, we expect these countries to be similar in terms of their main macroeconomic indicators such as the variation of national debt, inflation, GDP, and unemployment over time. Therefore, we measure the correlation of those variables across countries, and group those that are most similar to one another. According to our results, it seems like a unification of the entire European nations might be illusory. However, some countries share patterns and similarities, making them good candidates pick for further ties with one another (but not those outside their group).

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Introduction

History of the European Union

European nations have a long common history, spanning peace times and terrible war periods. After what is still considered the largest conflict in modern history, World War II, European nations thought that changes were needed to prevent such events from happening again. As a general guide, they rested on the fundamental idea that you do not attack your business partner. Indeed, if all European nations shared common interests, the costs of war would outweigh the benefits. From this perspective, European states sought closer economic, political, and human ties in order to foster prosperity. Consequently, the Treaty of Paris of 1951, which followed the treaty of Brussels of 1948, created the first step toward a more integrated Europe. Indeed, the Treaty of Paris of 1951 between France, West Germany, Belgium, Luxembourg, Italy, and the Netherlands created the European Coal and Steel Community (ECSC). This first union enabled its members to further develop in terms of economic growth, and to better manage the transitions dictated by American Marshall Plan and the industries in the German Ruhr region (the most productive industrial region at the time, thanks to an abundance of coal and iron deposits), occupied by the Allied countries. Later, in 1973, the community added three other nations: Denmark, Ireland, and the United Kingdom. Greece joined in 1981, followed by Portugal and Spain in 1986, as well as East Germany after the fall of the Eastern bloc in 1990. It is only in 1993 that the Maastricht Treaty officially declared the future creation of a common currency, the "Euro," that helped create the European Union system that we know today, starting in 2002.

The Copenhagen Criteria

With the European Union initially composed of 18 countries, the Copenhagen Criteria were created to assess the viability of the integration of other countries. Some criteria would have to be meet by those countries desiring new membership in order to allow a smooth integration that will foster growth in both the union and the new country. Specifically, the Copenhagen Criteria articles require new member countries to meet three main criteria to be eligible as potential candidates for integration into the union:

- Political Criterion: this criterion requires new member countries to be stable in terms of institutions, guaranteeing democracy, the rule of law, human rights, and the protection of minorities.
- Economic Criterion: a new member country must function as a market economy and must have the capacity to cope with competitive pressure and market forces within the EU.
- Community Acquis: a new member country must be able to adopt and implement the body of EU laws and regulations by adopting legislation and administrative structures compatible with EU standards.

"Optimum Currency Area"

Nonetheless, the macroeconomist Robert Mundell did not believe these criteria were enough to assess a foreign country's ability to successfully take part in such a union. In fact, Mundell (1961) came up with the "Optimum Currency Area" theory proposing the idea that foreign states need to meet certain macroeconomic indicators to establish that they are compatible with countries within a monetary union. More precisely, Mundell (1961)

claimed a foreign country with an inflation rate too high or too low compared to the average of the countries within an existing monetary alliance would not be compatible for adopting the currency. Indeed, countries with higher inflation rates for instance are going to have faster increases in prices for goods and services compared to other countries with low inflation rates. Consequently, there is a possibility that the competitiveness of these countries is affected, since one country A with high inflation will have more expensive good and services relative to country B with low inflation. In other words, the exports of country A will become more expensive compared to other countries, leading to negative consequences for the country in terms of GDP and unemployment.

Furthermore, countries with different inflation rates might not react to external shocks in the same manner, which then makes it harder for the Central Bank to correctly adjust monetary policies since different countries have different inflation situations. Additionally, other factors are mentioned by Mundell (1961) but which are harder to measure, like labor mobility and financial integration. In fact, in the union, according to Mundell (1961), countries need a fluid labor mobility between the members to help mitigate economic shocks by allowing people to freely move to other regions to find better job opportunities. Then, financial integration between countries is a key factor as countries need to be able to exchange capital flows within the union.

Optimal Economic Unions

Currently, the EU has exclusive rights when it comes to regulating members of the Union, like the single market's competition rules, monetary policy for Eurozone, trade policy, and policies regarding marine plants and animals. In the United States of America (hereafter *the U.S.*), by contrast, the federal government has power over fiscal, monetary, and foreign

policies, as well as internal and external security. That is, the U.S. provides an example of a more encompassing economic union. But would a more complete economic union (in the spirit of the U.S.'s) be desirable for European countries?

Firstly, economic growth should increase thanks to the benefits that stem from integrated markets with a common currency; benefits like economies of scale, market efficiency, and increased trade flows. On this point, the countries of the EU have modeled themselves after the U.S. with their one integrated market and the Euro. However, a fully integrated fiscal policy is part of what enabled the U.S. to have a business success story, and the EU currently lacks this. Adopting one comprehensive fiscal policy would foster a greater coordination of all member countries' policies, enabling the central government to react during economic downturns and to better allocate resources in regions that need it the most. This missing fiscal tool prevents the European nations from navigating economic downturns and shocks more effectively and preventing them from achieving more sustainable growth.

In this project, we are going to assess the credibility of creating a federal European Union, or "European Federation," where countries not only share a common currency, but also a common fiscal policy, common internal and external security systems, and a common political system. The member states would still keep much of their independence and the right to set their own internal rules, based on the American system known as the "Supremacy Clause," the concept that federal law supersedes state law. Article VI, Clause 2 of the United States Constitution, states that "this Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the

Land; and the Judges in every State shall be bound thereby, any Thing in the Constitution or Laws of any State to the Contrary notwithstanding."

Data and Description of Variables

A pairwise correlation analysis on 28 countries with four different indicators (inflation; GDP; unemployment; and net debt) is conducted. The 28 countries are all the members of the European Union plus the United Kingdom. These countries were selected for the purpose of this research to assess any possible unification of these countries, and we include the United Kingdom for their land proximity and common history with the European Union. All-time series variables are expressed in terms of percentage changes to avoid any non-stationarity concerns, and the analysis runs yearly data from 1980 to 2022.

Macroeconomic Shocks:

The macroeconomic variables we are interested in are those that are closely associated with *macroeconomic shocks*. These shocks refer to fast and unpredictable events that are going to deeply affect the overall economy of a country. Different types of shocks include supply shocks, demand shocks, policy shocks, technology shocks, or financial shocks:

- Supply shocks occur when there is an unexpected change in the cost or availability of a key input. For instance, the petrol shocks created by the OPEC countries in the 1970's created a shortage of gas, that deeply impacted all developed economies across the globe.
- Demand shocks occur when there is an unexpected change in the demand of a product, causing an important decrease in the demand for the product, as the

financial crisis of 2008-2009 caused a huge decrease in demand in the housing

market.

- Policy shocks occur when there is an unexpected change in the monetary or fiscal

    policy of a country. A possible policy shock can happen when a central bank

    decides to increase interest rates for example, hence decreasing the confidence of

    investors in the economy, and directly affecting borrowing costs.

- Technology shocks occur when there is an unexpected innovation in technology

    that heavily affects supply or demand. The widespread use of the Internet in the

    1990's is a good example of such a shock, or the 2010's shift in consumer

    preferences in the music industry, switching from CDs to streaming.

- Financial shocks occur when there is an unexpected crash or bankruptcies in the

    financial services industry. Such shocks happened during the dot-com bubble

    burst in the early 2000's where the investment in technology crashed.

In general, shocks are anything that will impact key economic indicators in a country.

Massive shocks could be a war like WWII or a pandemic like Covid-19. Market

responses to these shocks within each economy need to be symmetric in a union, so that

institutions such as the European Central Bank can apply one single policy that is

efficient for all countries.

Inflation

As Mundell (1961) explains, inflation is a crucial indicator in a macroeconomy. Indeed,

inflation reveals the overall health, performance, and stability of an economy since it is a

fair indicator of the purchasing power of a country's population and the cost of living in

general. For instance, a high inflation rate reveals a country in which the population has a purchasing power that is eroding, meaning that their ability to buy essential goods and services is rapidly diminishing: they have to spend more money to maintain their actual standards of living. Finally, it is worth mentioning that inflation is a key indicator, or even a benchmark, for central banks' monetary policies. When inflation is high, they usually increase interest rates to rein in the economy and the overall price increase, and vice versa. When inflation is not a concern, central banks have incentives to decrease the interest rates to stimulate the economy. Since changes in inflation rates are both part of an economy's adjustment to shocks as well as part of any policymaker's response to them, similar movements in these variables are important for an economic union. In the end, a union where inflation is not under control (i.e., outside of the typically considered range of optimal rates of 1% to 3%) is a union where investors are not confident in the economy, as inflation erodes the real return on investment and real wages.

Gross Domestic Product

The Gross Domestic Product (GDP) of a country is a measure of the total output produced by this economy in a defined period, usually one year. In the pursuit of further alliance, it sounds logical that a dynamic economy cannot merge with an economy in recession. Furthermore, while countries within a union need not have similar *levels* of GDP, they should have similar *patterns* in terms of GDP variations to shocks. As with inflation, similar movements in GDP over time would mean the economies are both affected by shocks and respond to policy similarly.

Unemployment

The unemployment rate is also an indicator for allowing further ties in the EU, as parts of the EU already encounter issues related to the brain drain (both internally and externally). Why would a Romanian engineer work in Romania when he can freely go work for more than double in Germany? However, such phenomenon can create job vacancies in the home countries of these skilled workers leave the country for better opportunities. The issue here is also that it can increase the disparities between countries, as the one with the least opportunities is going to see its best workers leaving the country as well, making all this a vicious circle where the skilled worker leaves and hence create a society that does not provide good opportunity to keep its workers. In this case, employment variation can shed light on imperfect economies that could become a drag on the union. As another macroeconomic variable that is heavily influenced by the others, variations in an economy's unemployment rate can tell us a lot about how that economy reacts to different shocks. For example, a country like Lithuania was not affected at all by the dot-com crisis of the early 2000's as its economy was not taking part in that industry at all, whereas other countries like the UK, Germany, or France had greater impacts from this crisis. During an enlargement of the union, the goal is not to weaken it but to strengthen it, and the more we produce, the more wealthy and powerful we will become.

Net State Debt Variation

Finally, net government debt is a key factor to consider. Firstly, with further ties, there will be a unification of national debts. This can cause issues to northern European states like Germany, the Netherlands, or Baltic countries, that historically have low state debt,

and that now are going to have to deal with highly indebted southern states like Spain, Italy, or Greece. These issues are based on two main concerns:

- First, northern countries as the Netherlands or Germany with their lower debt have historically been able to borrow money at much lower costs than southern countries like Spain, Italy, or Greece, which are characterized by high state debt. This is due to the fact that when lending money to countries investors are expecting higher yields of return for riskier investment, and the more a state is indebted, the riskier it is considered, hence increasing its interest rate. So, a main reason for northern states to have concerns on a unification is that it will inevitably increase their borrowing costs.

- Second, the unification of debt resonates with risk sharing for northern states. Indeed, some weaker countries are more likely to be heavily impacted by shocks due to the weakened economy that they have, hence being a burden for more advanced countries that will have to give financial support to the state member in difficulty, like the Greece crisis of 2012-2014. Also, relying too much on financial support from other states can foster a situation where a country does not pass the necessary policies and reforms to mitigate risks in its economy, hence becoming a bigger burden of the future of the union.

Results

Methodology

The Pearson Correlation Coefficient provides a single number, between -1 and 1, that measures the relationship between two or more variables. If the number is close to -1, it

means that there is a strong negative correlation between the two variables, in that when one variable increases the other is very likely to decrease. A strong negative relationship is considered to be any value below -.7 by convention, while a strong positive relationship is considered to be any number above .7 by convention as well.

Letting r denote the correlation coefficient,

$$r = \frac{n\,(\sum XY) - (\sum X)(\sum Y)}{\sqrt{n\,[X2 - (\sum X)^2][n \sum Y2 - (\sum Y)2]}},$$

where:

- n is the number of data points.

- $\sum XY$ is the sum of the products of corresponding values of X and Y.

- $\sum X$ and $\sum Y$ are the sums of the X and Y values respectively.

- $\sum X^2$ and $\sum Y^2$ are the sums of the squares of the X and Y values respectively.

This coefficient is very useful in our research as it enables us to quantify the patterns of resemblance between macroeconomic indicators and different countries. When, for example, variables from two different countries are more correlated, it means that they tend to fluctuate in similar patterns over time. Hence, if they vary in the same way, that means that a potential (unified) central bank will be likely to be able to implement an appropriate monetary policy that makes sense for both countries. However, if two countries are found not correlated, that means that they will likely not react from the same way to shocks. For instance, a cybersecurity crash might not affect Estonia and Greece in the same manner,

since the economy of Greece is mainly driven by tourism while the Estonian one is mostly

driven by technology and innovation.

Empirical Results

Ticker	Countries	Ticker	Countries	Ticker	Countries
A	Austria	F	France	N	Netherlands
B	Belgium	FL	Finland	P	Portugal
BL	Bulgaria	G	Greece	PL	Poland
C	Croatia	H	Hungary	R	Romania
CY	Cyprus	I	Italy	S	Sweden
CZ	Czechia	IR	Ireland	SK	Slovakia
DK	Denmark	L	Luxembourg	SL	Slovenia
D	Germany	LA	Latvia	UK	United Kingdom
E	Spain	LT	Lithuania		
ES	Estonia	M	Malta		

Stars "*" refer to a p-value under 0.05, meaning there is strong evidence to reject the null

hypothesis that there is no correlation between two values. In other words, a p-value of

0.05 suggests that the observed results are unlikely to have occurred under the assumption

that the null hypothesis is true, with the null hypothesis being that there is no correlation.

Figure 1: GDP Growth of the 11 Tier 1 Group Countries
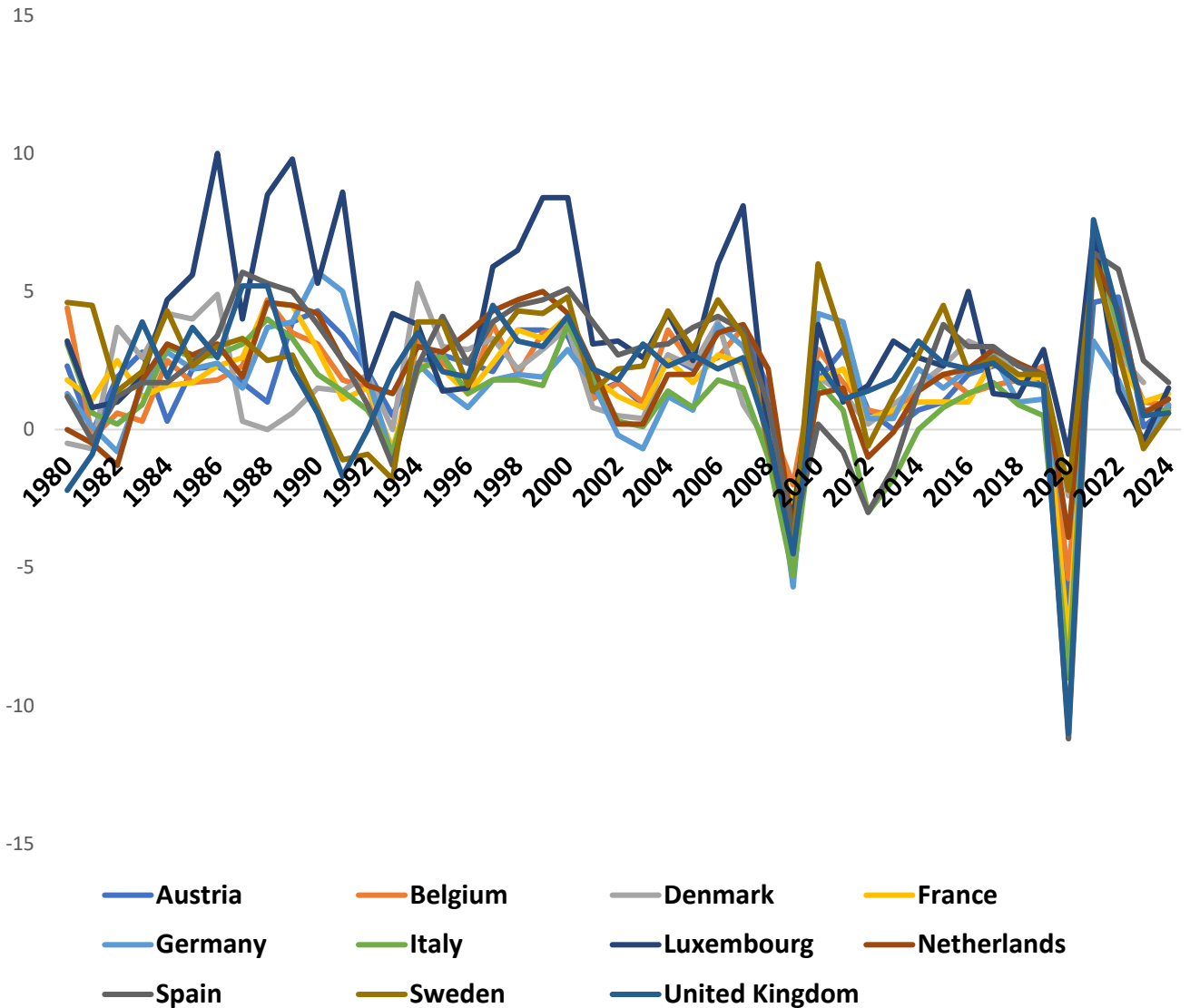
As shown in Figure 1, certain countries especially since the late 2000's have shown pretty similar patterns in terms of GDP growth, which likely translates to an important Pearson Coefficient level. However, if we add a country like Greece to this graph, we can see by the eye that their GDP growth is not fluctuating in the same manner as this larger group:

Figure 2: GDP Growth Including Greece
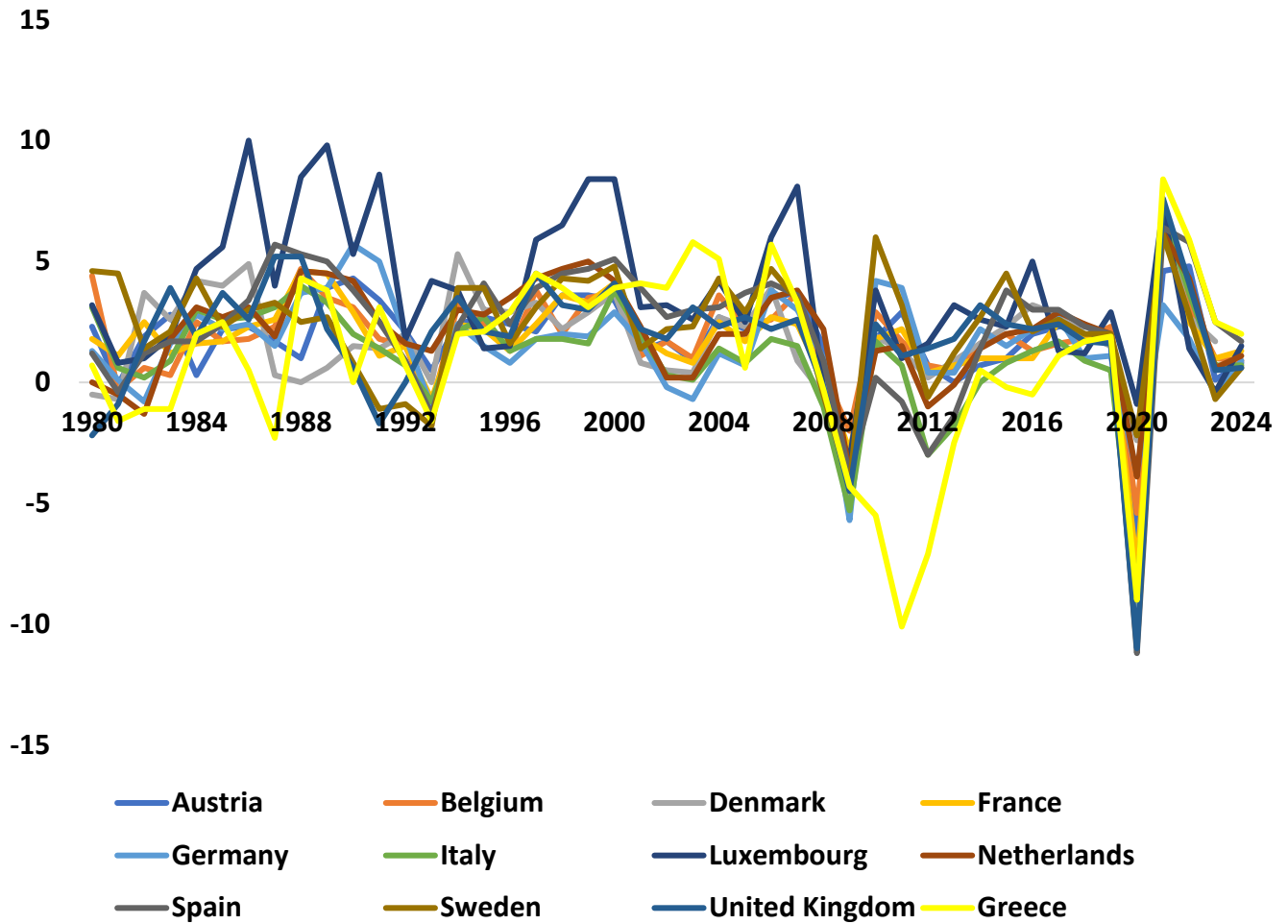
Figures 2 and 3 illustrate the difference between what we refer to as "Tier 1" countries, meaning those that correlate most closely with one another, and a country that does not. Here in Yellow, Greece has not been fluctuating the same way as other countries since the late 2000's and especially in the early 2010's where it became an outlier in this graph. In this case, we expect Greece to show a much lower Pearson Coefficient, revealing that it did not fluctuate in the same way as other countries. This can be seen by the spread of the yellow line compared to other countries both individually (Figure 2) and to the average growth of the group (Figure 3).

Figure 3: Average Tier 1 GDP Growth v. Greece GDP Growth
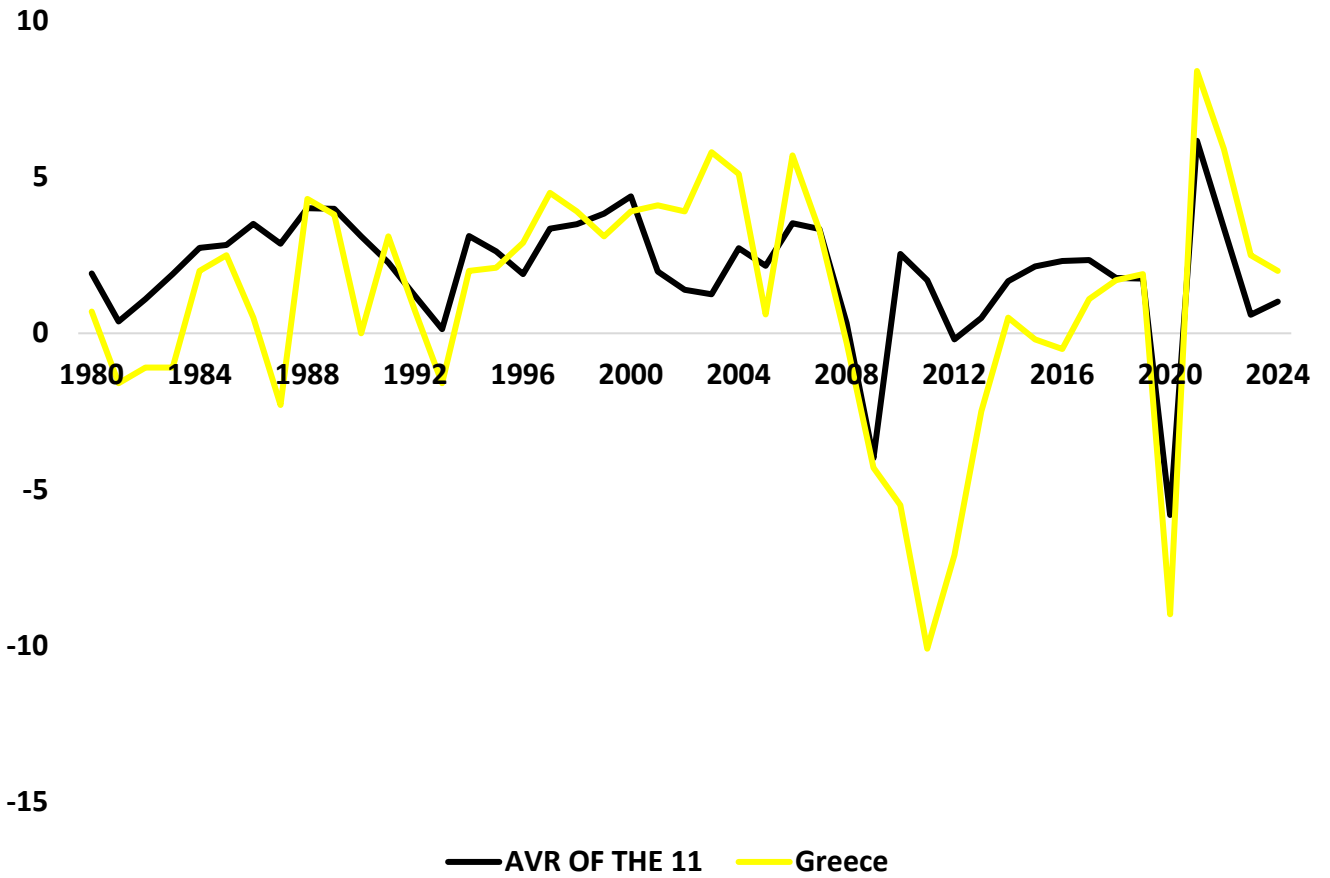
In comparison, France for instance has a notable difference compared to Greece: its spread is way smaller and sticks more closely to the average than the Greece's, as can be seen in Figure 4.

Figure 4: Tier 1 Group GDP Growth v. France GDP Growth
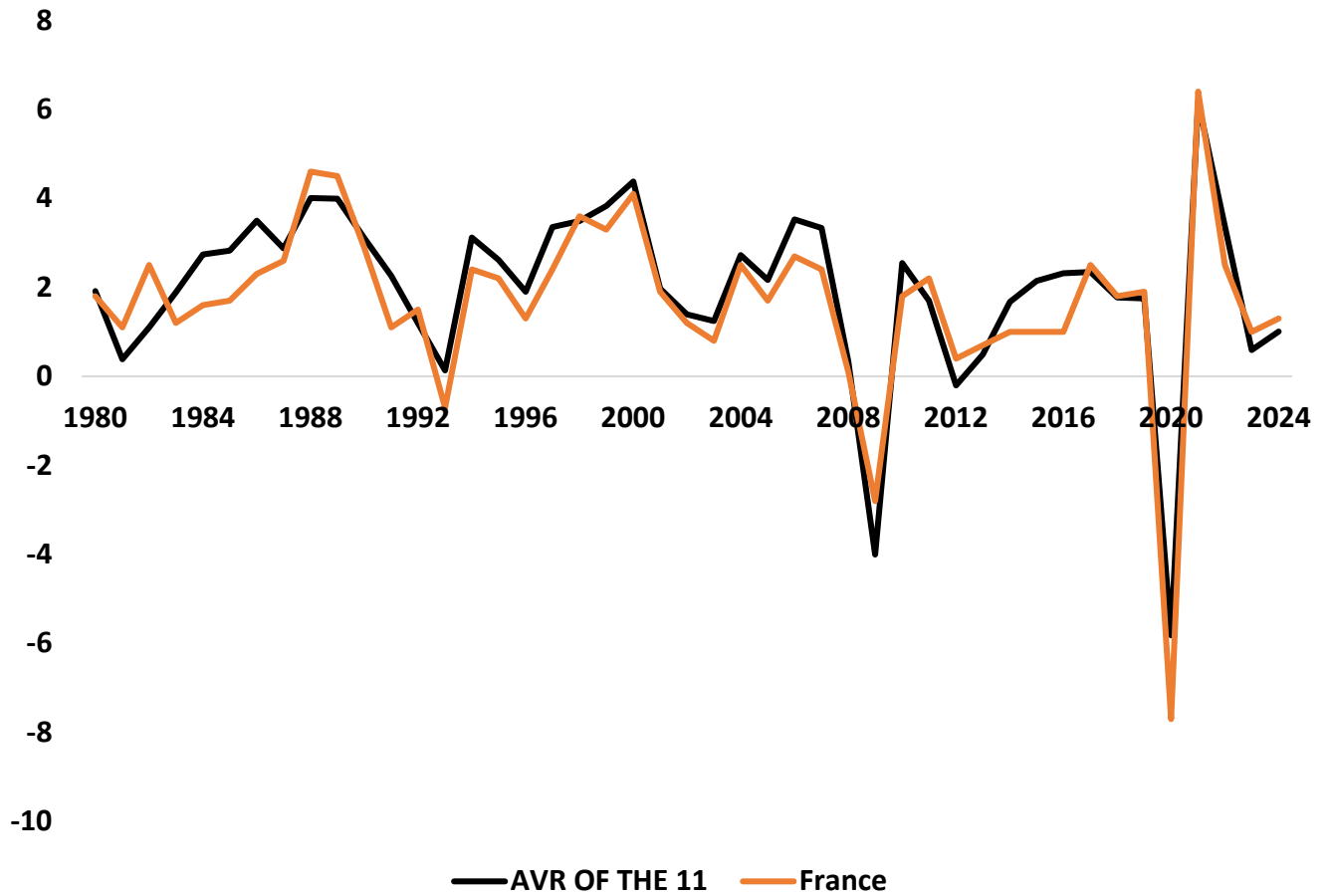
Net Government Debt

- Net Government Debt change in percentage change terms for the following countries:

	var1	A_debt	B_debt	BL_debt	C_debt	CY_debt	CZ_debt
var1	1.0000						
A_debt	−0.2826	1.0000					
B_debt	−0.3346*	0.6056*	1.0000				
BL_debt	0.4237*		0.4468*	1.0000			
C_debt	−0.4242*	0.4705*	0.4638*		1.0000		
CY_debt		0.3938*	0.5016*		0.6347*	1.0000	
CZ_debt		0.4706*	0.3486		0.4916*	0.3877*	1.0000
DK_debt		0.5898*	0.8452*		0.5566*	0.4880*	0.3483
ES_debt		0.5850*	0.8330*	0.4322*	0.4528*	0.5227*	0.4701*
FL_debt			0.3377*	0.5395*	0.4599*	0.2713	
F_debt	−0.2622	0.6411*	0.6101*		0.4977*	0.3402*	
D_debt	−0.3080*	0.5850*	0.4876*		0.5644*		0.4964*
G_debt	−0.4343*	0.4877*	0.6479*		0.6855*	0.4118*	
H_debt		0.4663*	0.5664*				0.3524
IR_debt		0.3737*	0.5137*				
I_debt	−0.3440*	0.6320*	0.7896*	0.4721*	0.5712*	0.5513*	0.3276
LA_debt		0.4249*	0.5222*		0.4645*		
LT_debt		0.4762*	0.4758*	0.4196*	0.7120*	0.4176*	0.3377
L_debt							
M_debt	−0.3313		0.4202*		0.5681*	0.4082*	0.4810*
N_debt	−0.2928	0.5234*	0.7510*			0.3184*	
PL_debt			0.5347*		0.4222*	0.4034*	0.4965*
P_debt		0.4540*	0.6402*		0.6177*	0.5108*	0.4376*
R_debt		0.3505	0.4594*	0.4616*	0.7199*	0.4350*	
SK_debt			0.3472	0.5336*	0.7658*	0.4664*	
SL_debt		0.5615*	0.5840*	0.4546*	0.6932*	0.7690*	
E_debt		0.5509*	0.7497*	0.4612*	0.5578*	0.5686*	
S_debt	−0.2780	0.3536*	0.5888*	0.4471*	0.3892	0.4604*	
UK_debt		0.4447*	0.3242*		0.4624*		

	DK_debt	ES_debt	FL_debt	F_debt	D_debt	G_debt	H_debt
DK_debt	1.0000						
ES_debt	0.6880*	1.0000					
FL_debt	0.3232*	0.6005*	1.0000				
F_debt	0.6976*	0.7441*	0.4828*	1.0000			
D_debt	0.5510*	0.5978*	0.2893	0.7502*	1.0000		
G_debt	0.6678*		0.2667	0.5258*	0.4156*	1.0000	
H_debt	0.5276*	0.6790*	0.4846*	0.4835*	0.3214		1.0000
IR_debt	0.6381*			0.3872*	0.3086*	0.4253*	0.3944*
I_debt	0.6887*	0.8771*	0.4933*	0.7276*	0.4755*	0.6457*	0.5787*
LA_debt	0.6608*	0.3563		0.4699*	0.3541	0.3786	0.3485
LT_debt	0.5378*	0.5004*	0.6537*	0.6659*	0.6169*	0.4867*	
L_debt	0.3003			0.3617*	0.4455*		
M_debt	0.3905*	0.4199*		0.5237*	0.6371*		
N_debt	0.7429*	0.5558*		0.5537*	0.4571*	0.5021*	0.4911*
PL_debt	0.4272*	0.6484*				0.3996*	0.4549*
P_debt	0.6196*	0.6010*		0.4325*	0.5157*	0.5111*	0.3910*
R_debt	0.5247*	0.3653	0.5209*	0.6304*	0.5737*	0.4704*	
SK_debt	0.3480	0.3725	0.3612			0.3244	
SL_debt	0.5891*	0.5189*	0.7281*	0.6493*	0.4102*	0.6355*	
E_debt	0.7826*	0.7162*	0.3855*	0.7371*	0.5401*	0.6076*	0.3432
S_debt	0.5370*	0.5430*	0.7354*	0.6032*	0.3929*	0.3221*	0.4553*
UK_debt	0.4872*	0.6636*	0.5463*	0.6473*	0.5537*	0.3034	0.6689*

	IR_debt	I_debt	LA_debt	LT_debt	L_debt	M_debt	N_debt
IR_debt	1.0000						
I_debt	0.3937*	1.0000					
LA_debt	0.7386*	0.3535	1.0000				
LT_debt	0.3348	0.5633*	0.5243*	1.0000			
L_debt	0.4390*		0.6119*		1.0000		
M_debt		0.3941*		0.4293*		1.0000	
N_debt	0.7545*	0.6332*	0.5974*		0.4260*		1.0000
PL_debt	0.3379	0.4214*				0.4334*	0.4203*
P_debt	0.4850*	0.4952*		0.4701*			0.5625*
R_debt	0.3279	0.4533*	0.4541*	0.8494*		0.5958*	
SK_debt		0.3430		0.7030*		0.6064*	
SL_debt	0.3450	0.6717*	0.3512	0.7716*			
E_debt	0.5489*	0.7697*	0.4714*	0.6470*	0.2920		0.6476*
S_debt		0.6048*		0.3550		0.3928*	0.3899*
UK_debt	0.5338*	0.4189*	0.5483*	0.5719*	0.5488*		0.3772*

	PL_debt	P_debt	R_debt	SK_debt	SL_debt	E_debt	S_debt
PL_debt	1.0000						
P_debt	0.3658*	1.0000					
R_debt		0.3423	1.0000				
SK_debt			0.8396*	1.0000			
SL_debt		0.6167*	0.7035*	0.5669*	1.0000		
E_debt		0.6420*	0.6296*	0.5045*	0.7884*	1.0000	
S_debt		0.3740*	0.3812*		0.6104*	0.5520*	1.0000
UK_debt	0.4609*	0.2920	0.4168*		0.5402*	0.4993*	0.4246*

For this first analysis, we notice that it is quite rare to find high correlation results for change in net government debt. The most logical reason for that is that government debt issuance is really centralized and adapted to response to internal issues that are unique in each country. Hence, we only see high correlations for eastern countries like Lithuania for instance that share high correlations numbers with Romania (.85) or Slovenia (.77).

Inflation

- Change in percentage (%) terms of inflation since 1981 for the following countries:

	Inflat~n	A_infl~n	B_infl~n	BL_inf~n	C_infl~n	CY_inf~n	CZ_inf~n
Inflation	1.0000						
A_inflation		1.0000					
B_inflation	-0.3493*	0.8181*	1.0000				
BL_inflation				1.0000			
C_inflation	-0.3246				1.0000		
CY_inflation	-0.5933*	0.7485*	0.7655*			1.0000	
CZ_inflation		0.6656*	0.5989*		0.8610*	0.6359*	1.0000
DK_inflation	-0.5621*	0.7658*	0.8574*			0.8419*	0.7174*
ES_inflation	-0.4374*				0.7998*	0.5210*	0.8677*
FL_inflation	-0.6016*	0.7578*	0.8350*			0.8473*	0.6310*
F_inflation	-0.5575*	0.7491*	0.8310*			0.8030*	0.6648*
D_inflation		0.9146*	0.7782*			0.7544*	0.6931*
G_inflation	-0.8685*	0.4864*	0.5936*		0.5806*	0.7335*	0.7249*
H_inflation	-0.4005*			0.3802*	0.3650*	0.3389*	0.8200*
IR_inflation	-0.5778*	0.7141*	0.8070*			0.8283*	0.5888*
I_inflation	-0.6810*	0.7176*	0.8130*			0.8620*	0.7642*
LA_inflation	-0.4400*				0.9314*	0.4316*	0.7281*
LT_inflation		0.5340*	0.5604*		0.6253*	0.5384*	0.7938*
L_inflation	-0.3656*	0.7766*	0.9413*			0.7737*	0.4822*
M_inflation		0.5275*	0.3877*			0.4899*	0.7857*
N_inflation		0.7906*	0.7675*			0.6600*	0.6556*
PL_inflation	-0.3256*				0.5735*		0.8475*
P_inflation	-0.7259*	0.5218*	0.6973*		0.3454	0.5679*	0.6608*
R_inflation	-0.2747			0.4893*	0.7782*		0.4216*
SK_inflation	-0.4389*	0.4319*	0.3840*		0.4867*	0.7210*	0.6078*
SL_inflation	-0.6520*				0.7522*	0.5968*	0.7055*
E_inflation	-0.7512*	0.6844*	0.8187*			0.8503*	0.6141*
S_inflation	-0.5888*	0.7117*	0.7366*			0.8119*	0.6937*
UK_inflation	-0.4428*	0.7902*	0.7293*			0.8414*	0.6586*

	DK_inf~n	ES_inf~n	FL_inf~n	F_infl~n	D_infl~n	G_infl~n	H_infl~n
DK_inflation	1.0000						
ES_inflation	0.3442	1.0000					
FL_inflation	0.9448*		1.0000				
F_inflation	0.9440*	0.3095	0.9263*	1.0000			
D_inflation	0.6691*	0.3635*	0.6863*	0.6669*	1.0000		
G_inflation	0.7295*	0.8439*	0.7890*	0.7116*	0.4429*	1.0000	
H_inflation		0.7644*			0.3105*	0.4330*	1.0000
IR_inflation	0.9353*	0.3213	0.8870*	0.9388*	0.6501*	0.6866*	
I_inflation	0.9413*	0.6329*	0.9372*	0.9535*	0.6493*	0.8324*	
LA_inflation		0.9595*			0.4003*	0.7891*	0.6002*
LT_inflation	0.6199*	0.9483*	0.5051*	0.5676*	0.5673*	0.7358*	0.7573*
L_inflation	0.8059*		0.8003*	0.8243*	0.7888*	0.5492*	
M_inflation	0.4566*	0.5486*	0.3648*	0.3803*	0.5900*		
N_inflation	0.6477*		0.5846*	0.5525*	0.8111*		
PL_inflation		0.9219*	0.2610			0.4017*	0.4759*
P_inflation	0.7075*	0.5915*	0.7689*	0.7342*	0.4036*	0.8246*	
R_inflation		0.5980*				0.2550	0.7075*
SK_inflation	0.5843*	0.6239*	0.4186*	0.5275*	0.4743*	0.7096*	0.7135*
SL_inflation		0.8835*			0.3844*	0.8994*	0.7909*
E_inflation	0.9109*	0.6033*	0.9069*	0.9084*	0.6178*	0.8968*	
S_inflation	0.8443*	0.3839*	0.9053*	0.8281*	0.6405*	0.8251*	0.2935
UK_inflation	0.8640*		0.8868*	0.8337*	0.7396*	0.7197*	

```
              IR_inf~n I_infl~n LA_inf~n LT_inf~n L_infl~n M_infl~n N_infl~n

IR_inflation    1.0000
 I_inflation    0.9425*  1.0000
LA_inflation             0.4480*  1.0000
LT_inflation    0.3909*  0.6968*  0.9052*  1.0000
 L_inflation    0.8133*  0.7982*           0.4082*  1.0000
 M_inflation    0.4961*  0.3901*  0.4014*  0.5304*  0.4216*  1.0000
 N_inflation    0.6444*  0.5421*           0.4634*  0.7315*  0.5872*  1.0000
PL_inflation                      0.7894*  0.7960*
 P_inflation    0.6764*  0.7613*  0.5230*  0.5044*  0.6716*           0.3457*
 R_inflation                      0.8262*
SK_inflation    0.7297*  0.7311*  0.6013*  0.3477   0.4488*  0.7256*  0.4935*
SL_inflation    0.3302   0.5826*  0.8922*  0.5525*           0.5679*
 E_inflation    0.8993*  0.9617*  0.4396*  0.5838*  0.8024*  0.3170*  0.4982*
 S_inflation    0.8017*  0.9014*  0.4228*  0.5258*  0.6812*  0.3072*  0.5050*
UK_inflation    0.8014*  0.8794*           0.6077*  0.6798*  0.4445*  0.6202*


              PL_inf~n P_infl~n R_infl~n SK_inf~n SL_inf~n E_infl~n S_infl~n

PL_inflation    1.0000
 P_inflation    0.3483*  1.0000
 R_inflation    0.2661            1.0000
SK_inflation    0.7181*  0.7682*  0.5367*  1.0000
SL_inflation    0.9153*  0.6812*  0.8774*  0.8208*  1.0000
 E_inflation             0.8380*           0.7090*  0.5842*  1.0000
 S_inflation    0.3936*  0.6903*           0.5089*  0.4504*  0.8574*  1.0000
UK_inflation    0.2518   0.5279*           0.3349            0.8103*  0.9189*
```

In this second analysis, we notice that changes in percentage terms of inflation are substantially more correlated than changes in the issuance of net government debt. This can be explained by the politics of free trades in the EU and the common monetary policy that was implemented in the EU since 2002, with the first introduction of the Euro currency.

Unemployment

- Unemployment change in percentage (%) since 1981 for the following countries:

	years	A_unem~t	B_unem~t	BL_une~t	C_unem~t	CY_une~t	CZ_une~t
years	1.0000						
A_unemploy~t	-0.2612	1.0000					
B_unemploy~t		0.6276*	1.0000				
BL_unemplo~t	-0.3821*			1.0000			
C_unemploy~t	-0.3103			0.5170*	1.0000		
CY_unemplo~t		0.4120*	0.3602*	0.4107*		1.0000	
CZ_unemplo~t		0.4763*	0.4675*	0.5949*	0.6065*	0.5013*	1.0000
DK_unemplo~t		0.4260*	0.3378*	0.3232			0.5652*
ES_unemplo~t		0.4225*		0.4375*	0.3555	0.3540	0.6579*
FL_unemplo~t		0.3477*	0.3884*	0.8513*		0.4014*	0.4712*
F_unemploy~t	-0.3211*	0.5657*	0.7094*	0.3408*		0.3818*	0.5595*
D_unemploy~t	-0.4299*	0.6572*	0.6635*				0.4641*
G_unemploy~t	-0.3707*	0.4735*	0.3895*	0.4171*	0.4439*	0.5441*	0.3361
IR_unemplo~t		0.3645*	0.3776*			0.3182	0.3542
I_unemploy~t			0.5223*			0.4365*	0.3507
LA_unemplo~t	-0.3029	0.4773*	0.3246			0.4485*	
LT_unemplo~t		0.3765		0.5000*	0.4491*	0.3972	0.6884*
L_unemploy~t	-0.2952	0.7248*	0.7573*			0.3944*	0.4513*
M_unemploy~t		0.3416*	0.3478*		0.4029*		0.6620*
N_unemploy~t		0.5732*	0.6317*			0.3611*	
PL_unemplo~t	-0.4503*	0.4278*		0.7948*	0.6167*	0.5903*	0.5981*
P_unemploy~t			0.5392*			0.4549*	
R_unemploy~t		0.3683*	0.5959*	0.4291*			0.5740*
SK_unemplo~t			0.3770*	0.6901*	0.7896*	0.5377*	0.7893*
SL_unemplo~t							
E_unemploy~t		0.4091*	0.5498*			0.4055*	0.3383
S_unemploy~t		0.5338*	0.5082*	0.7644*		0.3581*	0.3965*
UK_unemplo~t		0.5561*	0.4858*	0.5690*		0.3955*	0.5070*
Euro_area_~t	-0.3125	0.6454*	0.7482*	0.5150*		0.5619*	0.6091*

	DK_une~t	ES_une~t	FL_une~t	F_unem~t	D_unem~t	G_unem~t	IR_une~t
DK_unemplo~t	1.0000						
ES_unemplo~t	0.7547*	1.0000					
FL_unemplo~t	0.2836	0.6530*	1.0000				
F_unemploy~t	0.4931*	0.5356*	0.3705*	1.0000			
D_unemploy~t	0.2687			0.4553*	1.0000		
G_unemploy~t	0.4709*			0.5084*	0.4411*	1.0000	
IR_unemplo~t	0.7038*	0.6651*		0.5092*		0.3170	1.0000
I_unemploy~t		0.3360		0.6306*		0.4642*	0.4017*
LA_unemplo~t	0.4566*	0.5581*	0.5216*	0.4913*	0.3514		0.3738*
LT_unemplo~t	0.8590*	0.9520*	0.6925*	0.5366*			0.7884*
L_unemploy~t	0.5198*	0.4381*	0.3179*	0.6546*	0.7439*	0.5232*	0.4696*
M_unemploy~t		0.4512*	0.2954	0.2897	0.5058*		
N_unemploy~t	0.4244*			0.4405*	0.6687*	0.5342*	0.3058
PL_unemplo~t	0.3575*	0.3509	0.7064*			0.3891*	
P_unemploy~t				0.4232*	0.2553	0.3116*	0.4292*
R_unemploy~t	0.4259*	0.6049*	0.5422*	0.5788*	0.5319*	0.3223*	0.3470*
SK_unemplo~t	0.5020*	0.6327*	0.4735*	0.3894*		0.4499*	
SL_unemplo~t	-0.3183	-0.4248*			-0.4323*	0.4174*	-0.3232
E_unemploy~t	0.5980*	0.6565*	0.3377*	0.6456*	0.3267*	0.5315*	0.8160*
S_unemploy~t	0.4229*	0.5718*	0.9000*	0.4480*	0.4508*	0.3322*	0.3066
UK_unemplo~t	0.5955*	0.6338*	0.5653*	0.5349*	0.4463*	0.4682*	0.7014*
Euro_area_~t	0.6903*	0.6433*	0.6233*	0.8509*	0.5017*	0.6286*	0.6686*

	I_unem~t	LA_une~t	LT_une~t	L_unem~t	M_unem~t	N_unem~t	PL_une~t
I_unemploy~t	1.0000						
LA_unemplo~t	0.3060	1.0000					
LT_unemplo~t	0.4150*	0.9595*	1.0000				
L_unemploy~t	0.3655*	0.4020*	0.4484*	1.0000			
M_unemploy~t		0.3565*	0.5510*	0.4582*	1.0000		
N_unemploy~t	0.3166*			0.8130*		1.0000	
PL_unemplo~t			0.3663				1.0000
P_unemploy~t	0.3454*			0.5628*	0.3294*	0.5498*	
R_unemploy~t	0.3025	0.3416	0.7692*	0.5476*	0.4619*		
SK_unemplo~t	0.3337		0.6703*		0.4637*		0.6651*
SL_unemplo~t			-0.4377*		-0.3510		
E_unemploy~t	0.6134*	0.4971*	0.7675*	0.6204*	0.2660	0.4454*	
S_unemploy~t		0.5959*	0.6773*	0.5399*	0.3752*	0.3328*	0.6169*
UK_unemplo~t		0.3646*	0.6746*	0.6033*	0.4449*	0.3746*	0.4433*
Euro_area_~t	0.7654*	0.5005*	0.6983*	0.7930*	0.4853*	0.6138*	0.4348*

	P_unem~t	R_unem~t	SK_une~t	SL_une~t	E_unem~t	S_unem~t	UK_une~t
P_unemploy~t	1.0000						
R_unemploy~t	0.3763*	1.0000					
SK_unemplo~t		0.5226*	1.0000				
SL_unemplo~t				1.0000			
E_unemploy~t	0.4786*	0.5889*	0.3244		1.0000		
S_unemploy~t		0.6121*		-0.4830*	0.4523*	1.0000	
UK_unemplo~t	0.3637*	0.4633*	0.3478	-0.3650	0.6570*	0.6353*	1.0000
Euro_area_~t	0.6615*	0.6590*	0.5465*		0.8318*	0.6591*	0.6264*

In this third analysis, we notice that unemployment fluctuations in terms of percentage change is closely related to geographical locations of countries. It seems like countries that share common borders tend to show similar patterns in terms of unemployment rates change. For example, Lithuania and Latvia shows a Pearson correlation of 0.96. Similarly, France and Belgium show a Pearson correlation of 0.71.

Gross Domestic Product

- Gross Domestic Product change in percentage (%) since 1981 for the following countries:

	Y_GDP_~h	A_GDP_~h	B_GDP_~h	BL_GDP~h	C_GDP_~h	CH_GDP~h	CZ_GDP~h
Y_GDP_Growth	1.0000						
A_GDP_Growth		1.0000					
B_GDP_Growth		0.7970*	1.0000				
BL_GDP_Gro~h				1.0000			
C_GDP_Growth					1.0000		
CH_GDP_Gro~h	-0.3846*	0.5862*	0.5978*			1.0000	
CZ_GDP_Gro~h		0.7082*	0.6470*	0.6388*		0.6258*	1.0000
DK_GDP_Gro~h		0.6379*	0.5770*			0.4539*	0.6355*
ES_GDP_Gro~h		0.5252*	0.5207*				0.5811*
FL_GDP_Gro~h	-0.2632	0.5386*	0.6225*	0.3806*		0.5455*	0.6006*
F_GDP_Growth		0.8566*	0.9000*			0.6387*	0.6385*
D_GDP_Growth		0.7671*	0.7159*			0.4688*	0.6738*
G_GDP_Growth		0.5623*	0.6276*			0.5300*	0.5159*
H_GDP_Growth		0.3339*	0.4114*	0.5612*		0.3220*	0.6818*
IR_GDP_Gro~h	0.2659	0.2906	0.3897*				0.3603
I_GDP_Growth	-0.2858	0.8201*	0.8832*			0.7196*	0.6851*
LA_GDP_Gro~h		0.5220*	0.5314*	0.4554*		0.3075	0.6048*
LT_GDP_Gro~h							
L_GDP_Growth	-0.3349*	0.5576*	0.6215*			0.3486*	0.4126*
M_GDP_Growth		0.5208*	0.5840*			0.3240*	0.4737*
N_GDP_Growth		0.8241*	0.8435*			0.6197*	0.6139*
PL_GDP_Gro~h	0.3881*	0.2595	0.2676				0.5748*
P_GDP_Growth	-0.3202*	0.7321*	0.7321*			0.6597*	0.5417*
R_GDP_Growth				0.6922*			0.7338*
SK_GDP_Gro~h	-0.3724*	0.6259*	0.5785*	0.4249*		0.5233*	0.7914*
SL_GDP_Gro~h		0.8092*	0.7790*			0.7446*	0.7632*
E_GDP_Growth		0.8208*	0.8241*			0.6938*	0.7108*
S_GDP_Growth		0.5647*	0.7089*	0.4524*		0.4655*	0.6640*
UK_GDP_Gro~h		0.7073*	0.7298*			0.4496*	0.6430*
Oil_Change		0.5433*	0.5069*			0.2723	0.5064*

	DK_GDP~h	ES_GDP~h	FL_GDP~h	F_GDP_~h	D_GDP_~h	G_GDP_~h	H_GDP_~h
DK_GDP_Gro~h	1.0000						
ES_GDP_Gro~h	0.5545*	1.0000					
FL_GDP_Gro~h	0.5191*	0.7341*	1.0000				
F_GDP_Growth	0.6223*	0.5118*	0.6296*	1.0000			
D_GDP_Growth	0.5556*	0.5992*	0.4467*	0.7122*	1.0000		
G_GDP_Growth	0.4822*	0.3718*	0.4184*	0.6122*	0.3169*	1.0000	
H_GDP_Growth	0.4719*	0.6382*	0.6464*	0.4809*		0.3717*	1.0000
IR_GDP_Gro~h	0.4175*	0.3849*	0.3093*	0.3070*		0.3953*	0.4421*
I_GDP_Growth	0.6722*	0.4995*	0.6426*	0.9152*	0.7279*	0.6625*	0.4408*
LA_GDP_Gro~h	0.5110*	0.8561*	0.6405*	0.4982*	0.5110*	0.4857*	0.6309*
LT_GDP_Gro~h		0.5339*					
L_GDP_Growth	0.4460*	0.6081*	0.4726*	0.6105*	0.6627*	0.4879*	
M_GDP_Growth	0.3149*			0.5608*	0.4475*	0.3667*	
N_GDP_Growth	0.6507*	0.4983*	0.6472*	0.8137*	0.7735*	0.6745*	0.3483*
PL_GDP_Gro~h	0.3439*	0.3563	0.3502*			0.2743	0.4600*
P_GDP_Growth	0.3549*	0.3324	0.4750*	0.7720*	0.5862*	0.5765*	
R_GDP_Growth	0.2951		0.4071*				0.6700*
SK_GDP_Gro~h	0.5251*	0.5510*	0.6764*	0.5176*	0.6294*	0.4348*	0.4736*
SL_GDP_Gro~h	0.8009*	0.6130*	0.8231*	0.7658*	0.7193*	0.7371*	0.7734*
E_GDP_Growth	0.5788*	0.4532*	0.5854*	0.8801*	0.6146*	0.7743*	0.4808*
S_GDP_Growth	0.6064*	0.6291*	0.7859*	0.6728*	0.5567*	0.3832*	0.6927*
UK_GDP_Gro~h	0.6521*	0.5286*	0.5895*	0.8322*	0.5241*	0.5501*	0.6200*
Oil_Change	0.2675	0.3779*	0.3591*	0.4746*	0.3632*		0.3844*

```
                  IR_GDP~h I_GDP_~h LA_GDP~h LT_GDP~h L_GDP_~h M_GDP_~h N_GDP_~h
─────────────────┼──────────────────────────────────────────────────────────────
IR_GDP_Gro~h │    1.0000
I_GDP_Growth │    0.3349*  1.0000
LA_GDP_Gro~h │    0.3670*  0.4190*  1.0000
LT_GDP_Gro~h │                      0.4086*  1.0000
L_GDP_Growth │             0.6005*  0.5021*           1.0000
M_GDP_Growth │    0.3845*  0.5542*                             1.0000
N_GDP_Growth │    0.4585*  0.8568*  0.4514*           0.7055*  0.5137*  1.0000
PL_GDP_Gro~h │    0.2840                                                0.4158*
P_GDP_Growth │    0.3186*  0.8092*  0.3335            0.4925*  0.5768*  0.7509*
R_GDP_Growth │                      0.3514
SK_GDP_Gro~h │             0.5666*  0.5440*           0.3932*  0.4006*  0.5484*
SL_GDP_Gro~h │    0.4668*  0.8242*  0.5499*           0.6671*  0.5110*  0.8701*
E_GDP_Growth │    0.4049*  0.8935*  0.5145*           0.5664*  0.5396*  0.8290*
S_GDP_Growth │    0.4881*  0.7077*  0.5712*           0.4469*  0.3144*  0.6036*
UK_GDP_Gro~h │    0.3053*  0.7873*  0.4536*           0.4775*  0.5325*  0.7132*
  Oil_Change │             0.4358*                                     0.4239*


                  PL_GDP~h P_GDP_~h R_GDP_~h SK_GDP~h SL_GDP~h E_GDP_~h S_GDP_~h
─────────────────┼──────────────────────────────────────────────────────────────
PL_GDP_Gro~h │    1.0000
P_GDP_Growth │             1.0000
R_GDP_Growth │    0.3935*           1.0000
SK_GDP_Gro~h │    0.6028*  0.4204*  0.5246*  1.0000
SL_GDP_Gro~h │    0.6808*  0.7487*  0.5357*  0.7328*  1.0000
E_GDP_Growth │    0.3199*  0.8110*           0.5547*  0.8048*  1.0000
S_GDP_Growth │             0.4674*  0.3622*  0.6313*  0.7149*  0.5931*  1.0000
UK_GDP_Gro~h │    0.5125*  0.5433*  0.3113*  0.5425*  0.7429*  0.8166*  0.5995*
  Oil_Change │             0.3352*  0.3165*           0.4894*  0.3714*  0.4131*
```

After this fourth analysis, we notice similar patterns in terms of change in percentage of GDP growth and inflation. We can also find similarities between fluctuations in terms of net debt issuance from government and unemployment rates as they do not show as much correlation as inflation and net debt.

Interpretation

According to the results shown previously, it seems like three different groups of countries in the EU may be compatible for further ties.

Tier 1 Group

The first group that catches our attention is what we call the "Tier 1 Group", composed of the following countries: Spain, France, Belgium, Luxembourg, Italy, Denmark, the Netherlands, Germany, Austria, Sweden, Ireland, Malta, and the United Kingdom. This group stands out over the others because they present relatively high Pearson Correlation levels between them, making them a logical pick for a union. In particular, it was easier to find similar pattern in terms of inflation rates and GDP growth than unemployment and debt levels. But still, we are able to distinguish three distinct groups. As mentioned before, we are looking for countries that are correlated in order for them to fluctuate in the same direction, so that to ease the implementation of fiscal and monetary policies that will be the best and most efficient for the countries. Consequently, the Tier 1 Group is the first group of countries potentially compatible together according to the four coefficients calculated above. This means that the countries cited above are likely to react from the same manner to different external shocks because we found that they previously already reacted in the same way in the past 40 years.

Tier 2 Group

Tier 2 Group is composed of the following countries: Finland, Estonia, Latvia, Lithuania, Poland, Croatia, and Romania. This group of countries seems compatible for further ties as they are likely to react from the same manner to different external shocks because we found that they previously already reacted in the same way in the past 40 years.

Other countries not listed here will be listed in the Tier 3 Group: Bulgaria, Hungary, Czechia, Slovakia, Slovenia, Cyprus, and Greece. These countries have not shown any similar pattern in terms of fluctuations of their indicators, meaning that they are not compatible with any countries. Hence, these countries should not belong to the current model of the European Union as they are making it less efficient for the alliance as a whole, and for them.

"Optimum Merger Coefficient"

From these four indicators we can be determine an "Optimum Merger Coefficient," that would consist of computing the mean value of the four correlation coefficients, to find a number between -1 and 1 that would be the total compatibility of two different countries. Let's say Country X and Country Y have correlations of .74, .87, .68, and .88, for all four indicators discussed above, then they will have an "Optimum Merger Coefficient" of .7925, meaning that their key macroeconomic indicators fluctuated pretty much the same way since 1980. What we are looking for in a merger are two economies that will react to different shocks in a similar way. In this case, if two countries have a mean correlation of .7925, that means that they are very likely to be compatible for further ties. More precisely, the Optimum Merger Coefficient between France and Germany in the Tier 1 group is .65. Similarly, the Optimum Merger Coefficient between Lithuania and Romania in Tier 2 group is .81. In Tier 3 group, I mentioned that countries are not compatible with any other economies. To illustrate it, a good example is the Optimum Merger Coefficient between Bulgaria and Slovenia, which is .43. On the other hand, if we take two countries from

different Tier groups, like Spain and Poland for instance, we notice that similarly to the Tier 3 group, these countries seem not to be compatible as they have an Optimum Merger Coefficient of .52, which shows low correlation of both their economies.

Conclusion

To begin with, we would like to specify that this paper does not pretend to solve the European Integration Issue but to nuance it. Indeed, it might be unrealistic to have a full union of all countries currently in the EU due to the fact that many countries are not compatible for that at the moment. In fact, too many countries are simply not reacting the same way in terms of GDP growth, inflation, debt borrowing, and unemployment while going through the business cycle and downturns in the economy. However, some groups of countries seem to be correlated enough to form a union in the same idea of the current one of the U.S., with common fiscal and monetary policies in particular.

Still, it is worth mentioning that it is not our goal to criticize the EU, as it still provided a lot of countries with a crucial help. This can be seen from Figure 5 below, that shows the evolution of inflation rates before and after the launch of the Euro currency in 2002. We see in the graph that prior to that major policy unification, many countries experienced bouts of what would conventionally be considered "high" inflation, with rates that spiked way over 10% annually. However, we can also see on the graph that starting in the early 2000's, the implementation of the EU helped most countries to have controlled and stable inflation rates way under 10% in normal times (except 2008 and 2020 crisis).

Figure 5: Impact of the European Union in the Early 2000's on Inflation Rates Changes
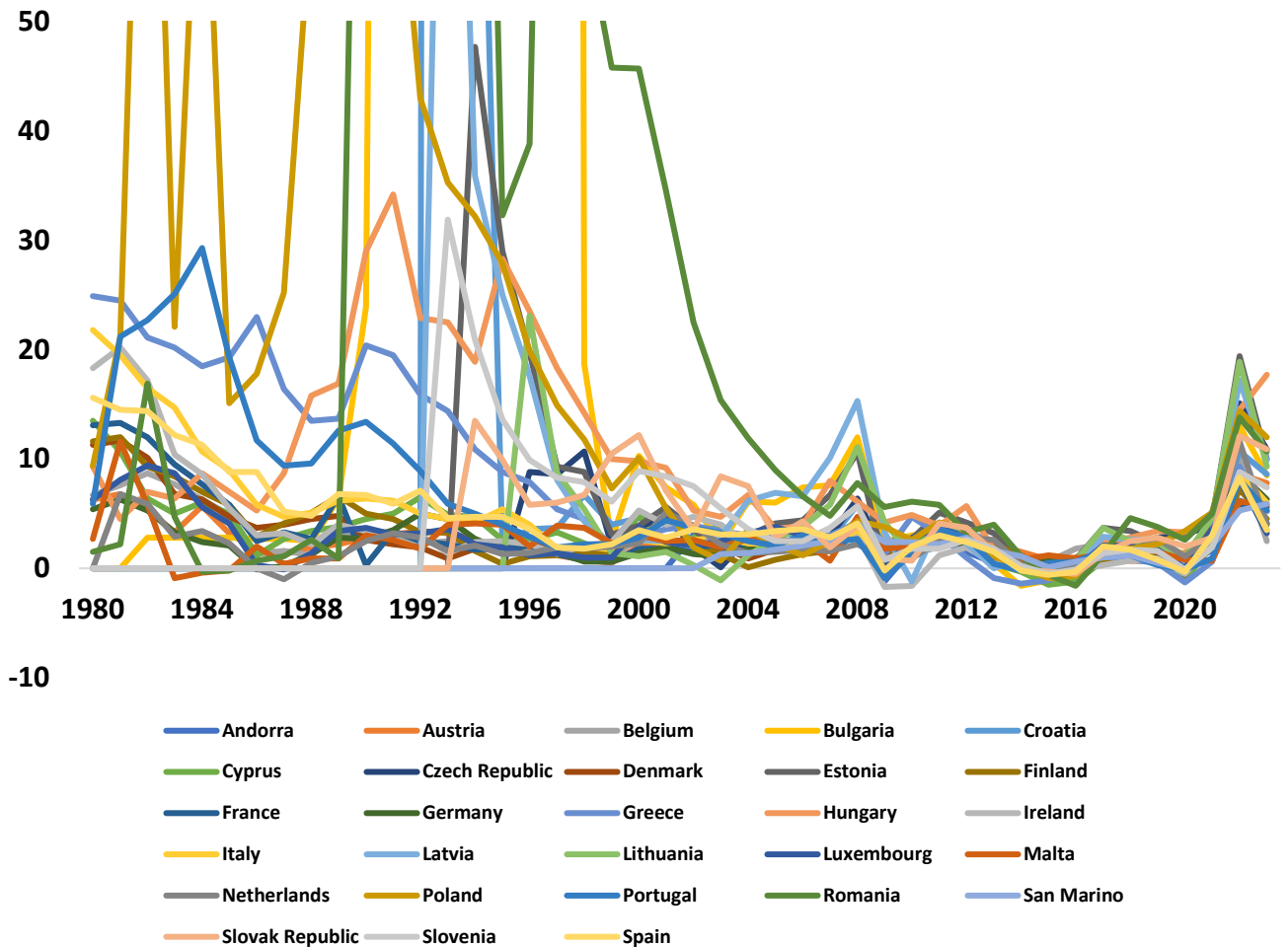
According to our research, we found out that first and most generally, a full federation of all countries in Europe is fundamentally inadvisable, this is especially true if we take into account the consequences the COVID-19 pandemic had on several macroeconomic indicators, especially inflation, which broke the historical patterns of controlled inflation in the northern countries in Europe. However, we identified few groups of countries that may be compatible for further ties in their economy. From this perspective, Tier 1 countries may be able to form a federation on the U.S. model, by creating a common fiscal policy, internal and external security by the creation of a common army, and politically with a

central government. Subsequently, Tier 2 countries should stay in the EU system as it currently stands right now, though without the Tier 1 countries. Finally, Tier 3 countries like Bulgaria or Hungary are just not compatible for any type of alliance. According to our results, they should be removed of the EU and be treated as other countries like Ukraine or Turkey. It may be wise to maintain privileged commercial ties and (no-)tariff arrangements to maintain economic interactions, but nothing beyond that unless those countries exhibit major changes in terms of economic performance in the future.

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