Macroeconomic asymmetry in the Eurozone before and after the Global Financial Crisis: an appraisal of the role of the ECB

Juan E. Castañeda (Institute of International Monetary Research, University of Buckingham)
José Luis Cendejas (Universidad Francisco de Vitoria)

Abstract: The launch of the euro in 1999 was assumed to enhance macroeconomic convergence among EMU economies. We test this hypothesis from a comparative perspective, by calculating different indices to measure the degree of macroeconomic dispersion within the Eurozone, the UK and the USA (1999 – 2019). We use common factor models to produce a single index for each monetary area out of different measures of dispersion. These indices can be used to inform on the degree of optimality of a monetary area. Our results show that macroeconomic dispersion in the Eurozone increased notably even before 2007 and it took significantly longer to return to pre-crisis levels, as compared to the UK and the USA. The paper shows the critical role played by the ECB's asset purchases programmes in reducing macroeconomic divergences among EMU member states since 2015.

Keywords: indices of dispersion, asymmetry, macroeconomic convergence, optimal currency areas, common factors, ECB's asset purchase programmes

1. Introduction: convergence and asymmetry under a monetary union

There is a vast literature on the theory of optimal currency areas (OCA) emerging from the seminal contributions by R. Mundell and M. Fleming in the 1960s, which was followed by a renewed interest in the subject during the years running up to and immediately after the launch of the European Monetary Union (EMU) in the 1990s (see Bordo and Jonung, 2003 and Bordo, *et al*., 2013). OCA theory discusses the rationale for a set of economies to surrender their own national currencies and adopt a common currency, as well as the conditions for the common monetary area to succeed in the event of a lateral shock affecting some member states disproportionally. One of the key elements for the success of a common monetary area is that the member economies display a similar macroeconomic pattern throughout the cycle; including a convergent business cycle behaviour and stability in prices and public finances. This is so that a common monetary policy - a single policy interest rate set up by a single central bank – will suit all member economies across the area.

The emphasis in the OCA literature has traditionally been on the assessment of the initial conditions and criteria for the member economies to form a monetary union, as well as for new candidates to join in the future. This approach was followed by the European Union (EU) in the preparations and the eventual launch of EMU in the 1980s and 1990s, in particular by setting so-called 'convergence criteria' for joining the Eurozone[1]. This approach seems to disregard changes in convergence among member states once the monetary area is already running. However, changes in convergence among member states are important to monitor as they are key to inform member states

[1] These criteria still apply to the EU countries not yet in the Eurozone, which need to submit a convergence report at least once every two years (see European Commission, 2021).

and EU level of the economic policies compatible with the sustainability of the monetary area.

Why do changes in convergence matter? Firstly, the greater the degree of divergence among member states the more difficult it will become to run an effective (single) monetary policy to fit them all. This is particularly relevant in times of great crises, when timely and appropriate fiscal and monetary policies responses are key in addressing a crisis episode. And secondly, changes in macroeconomic convergence also inform of the performance and optimality of the new monetary area. The definition of the optimality of a monetary union is quite an elusive metric, often affected by political and institutional factors which are very difficult to measure. These non-economic factors play a critical role in understanding the establishment of a monetary union in the first place and its success afterwards. In our paper, we do not set up a benchmark on what "optimal" means. Instead, we measure dispersion in macroeconomic and monetary trends among the member economies of a monetary union. These trends will inform on the optimality of the monetary union if only indirectly. If a divergent pattern emerges, our measurements will reveal the malfunctioning of the monetary area, be it because of its weak institutional design or the running of unstable policies, either by the monetary union as a whole or by some member states.

With the establishment of the so-called 'Fiscal Compact' (European Commission, 2017) and the 'Macroeconomic Imbalances Procedure' (European Commission, 2016) in the aftermath of the 'euro crisis', the European Commission is now monitoring the macroeconomic performance of the member states more closely, against predetermined benchmarks. Even so, the Commission does not provide a measurement of macroeconomic asymmetries among member states nor a synthetic index of dispersion. This is precisely one of the gaps we focus on in our research; the calculation of an index

of macroeconomic dispersion in three monetary areas, such as the Eurozone, the UK and the USA to assess changes in trends since 1999. Therefore, our analysis will be able to inform on macroeconomic dispersion patterns within these area[2] during the expansionary phase of the business cycle (1999 – 2007), in the Global Financial Crisis years (2008 – 09) and during the post-crisis and recovery years (2010 – 2019). The calculation of this index will be key to assess macroeconomic dispersion patterns in the Eurozone and their comparison with those in the UK and the US. We will also identify the main determinants of such patterns.

The Eurozone and the USA are economic areas of similar size in terms of their contribution to the world economy's GDP and their population, while the UK, with its pound sterling, is one the oldest running monetary unions. The differences between them are important to highlight from the start. Both the USA and the UK are well-formed monetary unions[3] with full banking and financial market unions along with fiscal union. However, since its inception, the USA has adopted a federal political structure that more closely resembles the long-term goal of the Eurozone project, along with the design of EMU. By contrast, the UK has traditionally been a more centralised country, with a relatively short experience in the devolution of limited political and economic competencies to the four nations within the UK in recent years. These important differences should be considered when assessing the macroeconomic and monetary trends observed in these three economies since 1999, the year of the launch of the euro. Critically,

[2] It is also important to distinguish between a monetary union and a currency union. As Capie and Wood (2003) put it, a monetary union refers to the adoption of a single common currency for all member states, while a currency union refers to the member states keeping their own currencies in circulation yet linking them by adopting a common standard, so they can all be exchangeable at the pre-determined parity (for example, under the Classical Gold Standard regime). OCA literature emerged in relation to fully-fledged monetary unions. In our paper, we will develop different indices that can be applied to both policy scenarios.

[3] Or 'completed monetary unions', as used in the jargon when analysing the Eurozone's architecture and institutional design (see De Grauwe, 2012 and De Grauwe and Moesen, 2009). See Rockoff (2003) for an analysis of the optimality of the US as an optimal currency area.

they also explain the limitations we have encountered in the creation of a common dataset for them all.

The objectives of our paper are twofold. Firstly, we will assess changes in convergence in EMU before, during and after the Global Financial Crisis. This will allow us to determine whether EMU countries converged or not in the years running up to the crisis, and thus to assess whether EMU economies were ready by 2007 to absorb a crisis, let alone one of the major financial crises in recent history. An increase in macroeconomic dispersion is the expected outcome in the midst of a major crisis such as the Global Financial Crisis; however, a more functional (thus optimal) monetary area would display the policies and institutions for macroeconomic dispersion to return to pre-crisis levels in a swiftly manner. In this line, the second objective of our paper will be to determine whether the scope and timing of the policies and interventions (or lack of) made by EU institutions during the 2008-09 crisis were adequate to address the crisis and ameliorate dispersion among member states. A key element in this discussion will be the analysis of the role and policies undertaken by the ECB, particularly in times of great crises.

In well-established monetary unions, national central banks have had to surrender their independence and support the government finances and policies in times of great crises (see Capie and Wood, 2013). Historically, this has effectively meant the readiness of the central bank to accommodate monetary policy decisions to the needs of the Treasury, quite often involving the purchase of the debt of the national government in both primary and secondary markets at very low interest rates. In the case of EMU, during the Global Financial Crisis there was not a coherent set of institutions ready to replicate such fiscal and monetary policies in times of a great crisis. And, critically, there was not the political will to abide by the 'original euro rules' as agreed in the Maastricht Treaty either. This policy scenario created a vacuum that delayed the necessary policy response

to the crisis. In this context, we will use the indices of dispersion calculated in sections 3 and 4 below to identify the policies in the EMU that contributed the most to the amelioration of the surge in dispersion after the Global Financial Crisis. In particular, we will focus our attention on the role played by the ECB, and test whether the lack of policies aimed at achieving monetary stability explain greater dispersion patterns in the Eurozone before and in the aftermath of the Global Financial Crisis.

The remainder of the paper is as follows: In section 2, we explain the methodology used in the calculation of both the measures of dispersion for each one of the economic indicators used and of the synthetic indices of dispersion. In Section 3, we use the estimated indices to analyse and compare dispersion patterns in the Eurozone with those of the UK and the USA. These indices will also be used to identify the policies that have contributed the most to reduce divergence in the Eurozone in the aftermath of the 'euro crisis'. In Section 4, three overall indices for the monetary areas considered are analysed. Section 5 concludes with a summary of our findings and a brief note on policy implications with regards to the Eurozone.

2. The measurement of macroeconomic asymmetry within a monetary union

There is an extensive literature on the measurement and trends in economic integration in the Eurozone that focuses on individual aspects. De Grauwe and Sénégas (2004) analyse how the use of national information about inflation and unemployment in the design of the common monetary policy allows the heterogeneity induced by asymmetrical transmission of the common monetary policy to be tackled, something that the EMU enlargement processes help to accentuate. König and Ohr (2013) elaborate a composite indicator measuring the extent of economic integration within the EU that shows the existence of large heterogeneities between the member states as well as a strong

clustering of its members. Campos *et al*. (2017) provides evidence to show that the business cycle has becomes more homogeneous among EMU economies. However, Franks *et al*. (2018) and Europe Economics (2013) show that cycle convergence has not increased among the original Eurozone 12 member states, but mainly between the new Eurozone member states and the rest of the Eurozone. Glick (2017) focuses on trade flows among EMU economies and also shows a positive impact in intra-EU trade after the adoption of the single currency. Lopez and Papell (2011) studied inflation differentials since the implementation of the Maastricht Treaty, and show convergence trends that accelerated after the launch of the euro. Lagoa (2017) shows inflation convergence after 2002 and explains the role of unit labour costs differentials in it. In ECB (2011) an increase in inflation dispersion is observed after 2010 due to the application of country-specific policies to restore competitiveness in the economies most affected by the euro crisis. In our paper, we do not follow this partial approach, but rather calculate a composite index of dispersion for the Eurozone since 1999. Castañeda and Schwartz (2017, 2020) attempt at producing an overall index of dispersion but it is only based on the calculation of the standard deviation of 12 indicators. Martínez and Navarro (2016) use a principal component analysis to produce a synthetic indicator on the effects of monetary policies in the Eurozone. We apply here a similar method to produce synthetic indicators of macroeconomic dispersion for the Eurozone, the UK and the USA.

2.1 The measurement of dispersion

To calculate the synthetic indices of dispersion, we start with two dispersion measures, $\delta_{j,t}$ and $\sigma_{j,t}$. The root mean square dispersion has the following general expression:

$$\delta_{j,t} = \left(\frac{1}{N} \sum_{i=1}^{N} \left(y_{i,j,t} - \gamma_{j,t} \right)^2 \right)^{1/2} \quad (1)$$

where $y_{i,j,t}$ is the value of the j-th variable for the i-th geographic unit at the moment t; $\gamma_{j,t}$ is the reference value for the said variable that can vary over time; and N is the number of geographic units considered, in our case the geographic units integrated in each of the monetary unions.[4] When the reference value, $\gamma_{j,t}$, is the arithmetic mean of $y_{i,j,t}$, $\bar{y}_{j,t} = \frac{1}{N} \sum_{i=1}^{N} y_{i,j,t}$, equation (1) is the standard deviation,[5] $\sigma_{j,t}$. We can express the dispersion variables $\delta_{j,t}$ and $\sigma_{j,t}$ as index numbers with respect to a base year, $t = 0$, therefore we have that $d(\delta_{j,t}) = 100 \frac{\delta_{j,t}}{\delta_{j,0}}$ and $d(\sigma_{j,t}) = 100 \frac{\sigma_{j,t}}{\sigma_{j,0}}$. This is so we can produce the same measure of dispersion to all our indicators of asymmetry, irrespective of their units. The index $d_{j,t}$ lacks units of measurement and indicates the relative dispersion of the j-th variable with respect to the base year,[6] while $\delta_{j,t}$ and $\sigma_{j,t}$ measure the absolute dispersion and are measured in the same units as $y_{i,j,t}$. Standard deviation, $\sigma_{j,t}$, is a measure of dispersion that takes the arithmetic mean of the respective geographic units as reference value. As an alternative measure of dispersion, we also calculate $\delta_{j,t}$ taking

[4] The geographical units considered have been the following: for the EMU ($N = 19$), with changing composition: Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovenia, Slovakia, Finland; for the UK ($N = 12$): North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland, Northern Ireland; for the US ($N = 51$): the fifty US States plus the District of Columbia; and in the corresponding variables, the Federal Reserve Banks Districts ($N = 12$). The data sources have been: Eurostat and the European Central Bank for the Eurozone; the Office for National Statistics (UK), https://www.ukfinance.org.uk/ and the Bank of England for the UK; US Census Bureau, Bureau of Economic Analysis, US Bureau of Labor Statistics, https://www.usgovernmentspending.com/, Federal Deposit Insurance Corporation and FRED database for the US.

[5] As previously calculated in Castañeda and Schwartz (2017 and 2020).

[6] We will employ occasionally this simpler notation to refer to both $d(\delta_{j,t})$ and $d(\sigma_{j,t})$.

as the reference value that attributed to the respective aggregate by the relevant national statistics office.[7] In the latter case, we will see that in several instances the different weight that the respective geographic units have on their corresponding aggregate will have a significant impact in the measurement of dispersion. The difference between $d(\delta_{j,t})$ and $d(\sigma_{j,t})$ informs us of the degree of heterogeneity in the sizes of the different geographical units included in each monetary area.

Thus, for example, the growth rate of the GDP of the euro area is a weighted average of the growth rates of the GDP of the economies that comprise it. Consequently, by using $d(\delta_{j,t})$, the economies with the highest GDP will have a greater influence on the aggregate and therefore also in the value of the deviations of the smaller geographic units. On the contrary, with $d(\sigma_{j,t})$ as the measure of dispersion, the same weight is given to all the geographic units integrated in the aggregate, irrespective of the size of their economies. We could say that, for economic policy purposes, it is *as if* all geographic units were considered equal by the decision-making authority, even though they are weighted differently in the behaviour of the aggregate. This distinction matters also from the political economy perspective in a multi-country monetary union such as the Eurozone. As proven in the euro crisis, EMU member states were not willing to let an economy exit the euro, regardless of the size of its GDP as compared to the overall Eurozone economy. EMU member states, the ECB and EU institutions sent a clear message reaffirming their commitment to maintaining EMU membership during the crisis. Effectively, the unwillingness to apply the 'no-bail out' clause included in the foundational treaty of the euro means that the potential building up of imbalances within

[7] For example, depending on the corresponding measure, the reference value $\gamma_{j,t}$ may be the growth rate of the GDP of the Eurozone, the UK or the US, the public deficit ratio respect to GDP of the Eurozone, the UK or the US, or the inflation rate of the Eurozone, the UK or the US.

EMU - and thus of asymmetries among member states - would likely lead to greater mutualisation of risks among member states at some stage. Therefore, the application of these two methods to calculate dispersion is plainly justifiable, as each offers a different perspective on EMU member states' asymmetries and their potential impact on the running and stability of the euro.

2.2. Individual and synthetic indices of macroeconomic dispersion

Following Castañeda and Schwartz (2020), we have measured asymmetry in these three monetary unions using 11 macroeconomic and monetary indicators, which we have broken down into four categories: (1) Business cycle, measured by GDP growth, per capita GDP growth and the unemployment rate; (2) Public finances, measured by the government deficit and public debt ratios to the GDP; (3) Competitiveness, measured by changes in the CPI and unit labour costs; and (4) Monetary dispersion, measured by changes in the amount of money broadly defined, credit to the private sector as a ratio of the GDP, the current trade balance as a ratio of the GDP and inter-region/state central bank balances, when applicable (i.e. Target balances for the Eurozone and Fedwire Inter-district settlement balances for the US). Table 1 shows the indicators used to measure dispersion in these four categories in the Eurozone, the UK and the US.

The information provided by $d(\delta_{j,t})$ and $d(\sigma_{j,t})$ can be summarised, through common factors, in a smaller number of variables (the synthetic indices) that collect the four relevant dimensions useful for assessing the symmetry of a monetary union: cyclical synchrony, public finances, competitiveness and monetary dispersion. From these synthetic indices, we can produce a summary index for each of the three monetary unions, which will be used to compare their evolution since 1999.

[Insert Table 1 here]

Common factors show the underlying common variations resulting from the existence of common patterns in $d_{j,t}$. They are obtained by synthesizing in few variables the common information gathered through a wider set of variables. Let $z_t = (d_{1,t}, d_{2,t}, ..., d_{n,t})'$ be a vector of n variables (the dispersion indices previously calculated). The vector z_t can be reduced to a simpler structure of m unobserved variables called factors, $f_t = (f_{1,t}, f_{2,t}, ..., f_{m,t})'$, with $m < n$. To do this, suppose that each of the indices $\tilde{d}_{j,t}$ (in deviations respect its mean) for $j = 1,2,...,n$, can be written as

$$\tilde{d}_{j,t} = \beta_{j,1} f_{1,t} + \beta_{j,2} f_{2,t} + ... + \beta_{j,m} f_{m,t} + v_{j,t} \qquad (2)$$

where $\beta_{j,k}$, with $k = 1,2,...,m$, are the factor loadings, $f_{k,t}$ the factors, and $v_{j,t}$ an idiosyncratic or specific error. Once the factor loadings are estimated, using principal components (see details in Tsay, 2005: 426-429), the factors $f_{k,t}$ can be obtained. The results of the estimation of the factor models (the individual indices $d(\delta_{j,t})$ and $d(\sigma_{j,t})$ used in their calculation, the estimated factor loadings and the value of the communality) are shown in Table 2. The communality, $c_j^2 = \sum_{k=1}^{m} \beta_{j,k}^2$, expresses the percentage of variation of each $d_{j,t}^X$, for $X = EMU, UK, US$, collected by the common factor(s) or, in other words, the relative weighting of each of the estimated factors. To finish, as previously done, $f_{k,t}$ is written as an index number, $\tilde{f}_{k,t} = 100 \frac{f_{k,t}}{f_{k,0}}$, obtaining the synthetic indices represented in Table 3.

[Insert Tables 2 and 3 here]

3. What do the synthetic indices of macroeconomic dispersion tell us about convergence in the Eurozone since 1999?

3.1 The business cycle

In order to capture the information provided by $d_{j,t}^{X}$ wherever possible we have specified more than one synthetic indicator per dimension in some cases (see Table 2). Thus, for the cyclical synchrony we have obtained two synthetic indices: $f_{1,t}^{X}$, obtained from the dispersion of the GDP growth series, and $f_{2,t}^{X}$, obtained from the dispersion of the unemployment rates (Figures 1 to 3 in Table 3). This is due to the fact that, in the dispersion of unemployment rates, a hysteresis phenomenon can be identified and thus the increase in the unemployment rate during the crisis of 2008/09 took place over a shorter time span than its subsequent decline. From the perspective of the measures of dispersion, for the UK and the US, there are hardly any differences when using $d(\delta_{j,t})$ or $d(\sigma_{j,t})$.[8] On the contrary, in the Eurozone the differences between both measures are significantly higher as a result of the greater heterogeneity in rates of growth in the different geographical units of this monetary area. Considering annual growth rates, either of total GDP or of per capita GDP, as expected there is a significant increase in dispersion levels from the outbreak of the Global Financial Crisis in 2009 until 2015 in all monetary areas. However, it is not until 2015 when the trend in GDP dispersion starts to fall significantly in EMU, as compared to 2011 and 2012 in the UK and the US, respectively. These patterns are even clearer when assessing the increase in the dispersion of

[8] At the request of the reader, we will be pleased to share the corresponding figures for $d(\delta_{j,t})$ and $d(\sigma_{j,t})$ which, due to space restrictions, are not included in this work.

unemployment rates. In both the UK and the US, dispersion started to fall earlier than in EMU and by the end of the sample, the UK and the US had reduced their dispersion to levels even lower than those at the beginning of the 2000s. Meanwhile, in the Eurozone it took more than 10 years for dispersion in unemployment rates dispersion just to revert to pre-2008 crisis levels.

3.2 Public finances

As regards public finances it has also been necessary to obtain two differentiated factors, $f_{3,t}^{X}$ and $f_{4,t}^{X}$, due to the different nature (flow and stock variables) and evolution of the deficit and public debt (Figures 4 to 6 in Table 3). In all the above mentioned common factors, factor loadings corresponding to the factors of both cyclical synchrony, $f_{1,t}^{X}$ and $f_{2,t}^{X}$, and public finances, $f_{3,t}^{X}$ and $f_{4,t}^{X}$, are statistically significant at 1% in the corresponding regressions, according to Eq. 2. The communality of these four common factors is also generally high, or even close to unity in some cases.[9]

Regarding the public finance indices $d_{j,t}$, it should be noted that for the Eurozone, the dispersion indices $d(\sigma_{j,t})$ are higher than $d(\delta_{j,t})$, although they run in parallel. This shows the greater differences in public finance performance among the member states in the Eurozone, particularly explained by the sharp deterioration in public finances in some of the smaller EMU economies during the 'euro crisis', such as Ireland, Portugal, Greece and Cyprus. Overall, the dispersion of the government deficit ratios, increased quite notably after 2008, peaking in 2010 and 2013, which coincides with the effects of

[9] For the public finances of the US, we take the dispersion measures $d^{US}(\sigma_{4,t})$ and $d^{US}(\sigma_{5,t})$ as synthetic indices, having as reference value the arithmetic mean of the deficit and debt of the States, respectively (excluding, therefore, the deficit and debt of the Federal government). This is so we make it more comparable to the measures taken as regards public finance dispersion in the UK and EMU.

firstly the Global Financial Crisis and then the 'euro crisis'; while the dispersion of the public debt ratios shows a substantial increase between 2009 and 2011 and a more moderate upwards trend thereafter. As expected, deficit dispersion increases in recessive years and decreases in expansionary years, particularly in a monetary area such as the EMU that has been strongly affected by so-called lateral or asymmetric shocks in the last two major crises. However, when deficit dispersion is calculated as the standard deviation, $d^{EMU}(\sigma_{4,t})$, even in the expansionary phase of the cycle (1999-2007), EMU member states become more divergent, with a 38% increase in deficit dispersion in these years. This result effectively shows a greater degree of asymmetry among more fiscally diverse member states, which shows a more questionable efficacy of the EU fiscal rules before the outbreak of the Global Financial Crisis.

It is worth noting the considerable reduction in the dispersion of deficit ratios in 2019 compared to those prevailing at the beginning of the EMU (see Figure 4 in Table 3). In the midst of the 'euro crisis' EMU member states approved new mechanisms to enhance the fiscal and macroeconomic coordination of their economies. This was in addition to the implementation of 'internal devaluation' policies in some of the most affected economies by the crisis. With the so-called 'Fiscal Compact' in 2011 and the establishment of the 'Macroeconomic Imbalances Procedure' (MIP) in 2012, member states set up new procedures and standards to ameliorate fiscal and macroeconomic dispersion across member states.

As regards dispersion in debt ratios, it has remained at a high level since 2011. The very uneven performance of the Eurozone economies regarding their public finances is clearly showed in both dispersion indices. Of course, a stock variable such as the debt ratio displays a greater degree of persistence, and the reduction in deficit dispersion will only gradually be reflected in lower debt dispersion levels over time.

This contrasts with what is observed in the indices of the UK, $d_{4,t}^{UK}$ and $d_{5,t}^{UK}$, which correspond to the net fiscal balance and the public debt interest payments,[10] both as percentages of the GDP. For the UK there are hardly any differences between the two reference values - either the average or the aggregate. The effects of the 2008/09 recession years are noticeable in both variables: the dispersion of the net fiscal balance in the UK, $d_{4,t}^{UK}$, has progressively reduced after reaching a peak in 2009; while the dispersion in debt interest payments by the different UK geographic units included in our sample, $d_{5,t}^{UK}$, has shown an upwards pattern since 2009.

The information on the deficit and debt ratios for the US, $d_{4,t}^{US}$ and $d_{5,t}^{US}$, is highly affected by the calculation of the dispersion indices, either by using the arithmetic mean or the aggregate value as a reference value in Eq. (1). This is because the aggregate includes the deficit and debt of the US Federal government that far exceed in size those of State governments. In the EMU area, there is no equivalent entity to the US Federal government of a comparable size[11] This is important to note when assessing the information provided by the dispersion indices for the US. Deficit and debt dispersion figures, $d_{4,t}^{US}$ and $d_{5,t}^{US}$, will offer different information depending on whether we consider as reference values either the average value of the States (which excludes Federal deficits and debt), or the deficits and debt of the Federal government. In the former case, the dispersion indices measure the heterogeneity in public finance performance among States; while in the latter case, we are measuring the dispersion of the States' debt and deficit figures with respect to the Federal government's. In Figure 6 of Table 3, we can see the

[10] We have used debt interest payments rather than debt ratios because of the unavailability of the latter at the regional level in the UK. See Table 1.

[11] The EU central budget spending amounts around 1.0% of the EU GDP, whereas the US Federal budget spending amounts to 22% of the US GDP (see Hagelstam *et al*., 2017, p. 13).

changes in the dispersion in the deficit and debt ratios across the States: dispersion in deficit ratios has returned to 1999 levels and debt dispersion displays a declining pattern since 2009, which in 2019 are even lower than in 1999. Following the significant fiscal stimulus and other policy actions made by the US Treasury at the Federal level, it has been the Federal Government's deficit and debt ratios that have experienced significant variations during and after the outbreak of the Global Financial Crisis.

3.3 Competitiveness

For the calculation of the dispersion indices on competitiveness, $d_{6,t}^{X}$ and $d_{7,t}^{X}$, we have considered both changes in the Consumer Price Index (CPI) and labour cost indicators. The differences observed when using the arithmetic mean or the aggregate as reference values are due to the way in which the aggregate is calculated.[12] The dispersion indices of the three monetary areas show some coincidences ($d_{6,t}^{UK}$ and $d_{7,t}^{US}$) or very similar values ($d_{6,t}^{EMU}$ and $d_{7,t}^{EMU}$) in the measures of dispersion, regardless of the reference value used.[13]

Dispersion in labour costs in EMU soared well before the outbreak of the Global Financial Crisis. As we will discuss below, this was accompanied by a greater dispersion in the member states' current account balance from 2004 to 2007. In hindsight, this result may well have been taken as an early warning of the building up of macroeconomic imbalances within EMU before the crisis; an issue that was also reflected in increasing

[12] For example, in the Eurozone, the Harmonized Index of Consumer Prices (HICP) for the whole area is the result of the calculation of the weighted average of the CPIs in the Eurozone member economies (weighted by the relative size of private consumption in each country compared to the figure for the Eurozone as a whole).

[13] For the US, both measures of dispersion coincide. This should be due to the fact that the Bureau of Labor Statistics has calculated the aggregate value for the US precisely as an arithmetic mean of the four geographical units considered (North-East, Midwest, Western and Southern regions).

Target balances from 2004. Dispersion in inflation in the Eurozone fell by 45% from 1999 to 2006. After reaching a peak in the midst of the crisis (2008-09), dispersion in inflation has continued to fall in the last few years, showing a significant convergence trend since 2010. In 2019 inflation dispersion figures were nearly 70% lower than those at the time of the launch of the euro in 1999. A similar analysis applies to dispersion in inflation rates in the UK but not in the US, where inflation dispersion levels are still far above pre-2008 crisis levels.

In relation to the synthetic indices of competitiveness, for the Eurozone it has been necessary to take into consideration two factors due to the different behaviour of the measures of dispersion of labour costs and of inflation. Both the signs of factor loadings and the time patterns, slightly decreasing for $f_{5,t}^{EMU}$ and increasing for $f_{6,t}^{EMU}$, allow the former to be attributed to inflation and the latter to labour costs. Observing the corresponding figures in Table 3 (Figures 7 to 9), we can see that the increase in the dispersion of labour costs in the Eurozone is much greater than in the UK or the US, and this is especially noticeable from 2005 to 2007. For the UK and the US, we have estimated a single competitiveness factor in each case. The representativeness of these factors, $f_{5,t}^{UK}$ and $f_{5,t}^{US}$, is lower than that obtained for the Eurozone. The factor loadings are statistically significant at 1% with two exceptions: i) $f_{5,t}^{UK}$, significant at 5% level with respect to $d^{UK}(\delta_{7,t})$ (dispersion of inflation in UK geographical units with aggregate UK inflation as a reference); and ii), $f_{5,t}^{US}$ not significant with respect to $d^{US}(\sigma_{6,t})$ (US average wages, annual growth, with the arithmetic mean of the States as a reference).

3.4 Monetary dispersion

As regards monetary dispersion, we have been largely limited by the absence of similar indicators for the geographical units of the three monetary unions in the time period considered (see Table 1). When collecting broad money growth (as measured by the monetary aggregate M3 in the Eurozone), a relatively new monetary area such as the Eurozone, made up of 19 economies which used to have their own national currencies, still collects information on each member state's contribution to M3. This is not the case in the UK or in the US. For the US we have substituted the rate of changes in households' bank deposits for regional money figures. Similarly, while the ECB records the Eurozone central banks' balances under Target, the Eurozone's real-time gross settlement system and the US collects this information among the 12 districts of the Federal Reserve system (though not at the State level), the UK has no equivalent data.

Monetary dispersion indices in the Eurozone merit a more detailed analysis, in particular as regards the surge in Target balances' dispersion since 2008 and during the 'euro crisis'. However, the indices show the accumulation of imbalances and greater dispersion among EMU member states during the expansionary phase of the cycle, which became more notable from 2003 to 2007. Asymmetry in both credit growth and monetary growth among EMU member states dominates in the years running up to the Global Financial Crisis. These asymmetries were reflected in greater dispersion in the member states' current account balances[14] and also in Target balances; from 2004 to 2007, dispersion in Target imbalances increased 156%. Despite the spike in dispersion, at that time member states were able to finance their current account deficits through

[14] Just before the outbreak of the crisis, in 2007 Spain, Greece and Ireland were running a -9.6%, -13.9% and -6.5% current account deficit to their GDPs, respectively; while Germany and the Netherlands run 6.75% and 5.8% surpluses, respectively. Aizenman (2018) shows how the members of a currency union with closer financial links may accumulate asymmetric balance-sheet exposure over time, thus becoming more susceptible to sudden-stop crises. Debtor countries that rely on financial inflows to fund structural imbalances may be exposed to devastating sudden-stop crises as it has been verified during the Eurozone crisis.

international markets, characterised by abundant liquidity and very low borrowing costs (Bernanke, 2005) and loose monetary policies (Taylor, 2009). This created the appearance of the sustainability of such imbalances within EMU.[15] Dispersion in credit to the private sector continued to increase until the end of the 'euro crisis' in 2014. During the crisis' years, the member states in crisis were not able to access international credit markets as easily as before (and not at all for some of them) and had to rely significantly more on the credit facilities provided by the ECB. This is illustrated by the exponential growth of Target imbalances across member states since 2008. The surge in Target imbalances from 2015 to 2018 also reflects - if only partly – the implementation of the ECB's Asset Purchases Programme (see Westermann, 2018). Similar patterns can be observed in the US inter-federal banks' settlement system (Fedwire balances) but with lower dispersion levels.

Two common factors, $f_{7,t}^{EMU}$ and $f_{8,t}^{EMU}$, have been obtained from the monetary dispersion measures for the Eurozone (Figure 10 in Table 3). Factor loadings have been statistically significant at 1% with three exceptions: i) that corresponding to $f_{7,t}^{EMU}$ in $d^{EMU}(\delta_{9,t})$ (dispersion of the credit to the private sector) which is significant at 5% level; ii) $f_{8,t}^{EMU}$ not significant with respect to $d^{EMU}(\delta_{10,t})$ and $d^{EMU}(\sigma_{10,t})$ (dispersion of the current account balances for both reference values); and iii), $f_{8,t}^{EMU}$ not significant with respect to $d^{EMU}(\sigma_{11,t})$ (dispersion of Target balances with respect to the mean position of the EMU economies). Consequently, $f_{7,t}^{EMU}$ shows information on monetary dispersion obtained from the four monetary indicators used: M3 growth, credit to the private sector (albeit with a negative sign), current account balances and Target balances. On the other

[15] It was not until the outbreak of the crisis in 2008 when the application of internal devaluation policies in the most affected economies resulted in a notable reduction in current account deficits across the Eurozone, and thus a fall in dispersion.

hand, $f_{8,t}^{EMU}$ collects information exclusively of M3 growth or credit to the private sector. The factor $f_{7,t}^{EMU}$ shows a decreasing trend since 2007, similar to what happened with the dispersion of current account balances, while $f_{8,t}^{EMU}$ began to grow since 2005, stabilized at high levels and then decreased sharply in 2016. Its trend is quite similar to that of the credit to the private sector. It would seem that, in explaining the increase in monetary dispersion in the Eurozone, both factors would have had a different weight before and after the start of the recession. Before 2007/08, the asymmetry in current account balances and growth in the quantity of money would be dominant, whereas after 2007/08, differences in the EMU economies concerning credit to the private sector would become more important.

For the UK, due to insufficient number of observations in $d_{8,t}^{UK}$ and $d_{9,t}^{UK}$ (household loans and overdrafts, and lending to Small and Medium Enterprises), a synthetic index of monetary dispersion, $f_{6,t}^{UK}$, has been obtained as the arithmetic mean of $d^{UK}(\delta_{8,t})$, $d^{UK}(\sigma_{8,t})$, $d^{UK}(\sigma_{9,t})$, $d^{UK}(\delta_{10,t})$ and $d^{UK}(\sigma_{10,t})$. For this reason, until 2009 $f_{6,t}^{UK}$ is similar to the dispersion of the trade balances for the UK's geographical units. For the US, the monetary dispersion is synthesized in two factors, $f_{6,t}^{US}$ and $f_{7,t}^{US}$ (Figure 12 in Table 3). Factor loadings have been significant at 1% with two exceptions: i) $f_{7,t}^{US}$ not significant with respect to $d^{US}(\delta_{9,t})$ and $d^{US}(\sigma_{9,t})$, dispersion measures that correspond to credit to the private sector (net leases and loans) taking any of the two references used (there is hardly any difference between both); and ii), $f_{7,t}^{US}$ is significant at 5% level with respect to $d^{US}(\delta_{10,t})$ and $d^{US}(\sigma_{10,t})$, dispersion measures that correspond to credit to the private sector (real estate loans). From these results we can see how the factor $f_{6,t}^{US}$ collects information from all the monetary dispersion measures used

(except the trade balance, not included in the synthetic index because it is not available for the entire sample period). In particular, the increase in the values of the two measures of dispersion of credit is well illustrated in $f_{6,t}^{US}$. This phenomenon occurs around 2004 and from 2009 on. Since 2012 the dispersion in real estate loans has been slowly falling. However, $f_{7,t}^{US}$ does not collect the information on the measures of credit dispersion, thus not displaying this pattern. Instead $f_{7,t}^{US}$ shows a broader fluctuation in dispersion caused by the deposits from 2007 to 2010, and since then by the Fedwire Inter-district Settlement. It is interesting to note the reduction in dispersion shown by $f_{7,t}^{US}$ since the recession years of 2007/08.

4. Assessment of asymmetry trends in EMU, UK and US, 1999-2019. The determinants and the costs of convergence in the Eurozone since 2015

Figure 13 shows the overall indices of dispersion, I_t^X, for $X = EMU, UK, US$ that have been calculated as the arithmetical mean of the previously estimated synthetic indices, $f_{k,t}^X$ (all standardized so that they vary on the same scale).[16]

Firstly, we observe an increase in the overall dispersion of the Eurozone in the years running up to the Global Financial Crisis, which does not apply as much to the US economy and does not apply at all to the UK economy. Asymmetries within EMU were building up even in the expansionary phase of the cycle, therefore putting the Eurozone in a weaker position to absorb a major crisis such as the Global Financial Crisis. In 2007, overall dispersion in the Eurozone was 42% higher than in 1999, when neither the crisis nor the recession had yet begun.

[16] This does not mean that the 1999 dispersion values were optimal or desirable; they are just a statistical artefact used to compare trends in dispersion in the three monetary areas since 1999.

Secondly, in 2008 dispersion in all three areas accelerate quite rapidly, however the deceleration begins at different times for the different areas: in 2010 in the UK; in 2011 in the US; and, critically, not until 2015 in the Eurozone. The persistence of high asymmetry levels in the Eurozone, reaching a peak in 2015 (60% higher than in 1999), shows the impact of the euro crisis. Since 2015, asymmetry in the Eurozone has fallen quite substantially, even reaching pre-crisis levels since 2016. As regards the US and the UK monetary areas, there has been a more gradual and downward trend since 2011, in both cases falling lower than 1999 levels. This may be taken firstly as a signal of the malfunctioning of the institutional structure of the Eurozone, rendering it ill-equipped to address the crisis, and secondly, the time taken to develop new policies and institutions to deal with the effects of the crisis.

What explains these results? As shown by the indices, particularly the monetary and competitiveness indicators, Eurozone member states followed quite divergent paths prior to 2007. In particular, broad money growth (2000 – 2003) and credit to the private sector growth, unit labour costs and current account balances display major divergences between 2004 and 2007.[17] This shows that monetary, spending and costs patterns within the monetary union were not sustainable nor convergent among member states even before 2007, which made it more difficult – if not virtually impossible - for a single monetary policy to achieve macroeconomic stability for every member state in the area.

In the aftermath of the Global Financial Crisis, the Eurozone member states made the decision to keep the euro membership intact and not let any member state leave the euro. This effectively meant to put on a halt the 'no bail out clause' of member states and

[17] Giannellis and Koukouritakis (2017) assess whether the adjustment mechanisms in the Eurozone driven by the fiscal and monetary policies can restore real exchange rate equilibrium, as well as the competitiveness symmetry between deficit and surplus countries. They conclude that this has not been the case. Instead, in order to achieve a symmetrical adjustment and in line with our results they highlight the role that the ECB is called upon to play in this regard.

the creation of institutions both to rescue member states in crisis and secure more sound public finances, as well as developing more coordinated macroeconomic policies in the future. These new institutions and policies seem to have stabilised the level of dispersion in the Eurozone between 2010 and 2014. In this new political and policy scenario, the focus was not only on the performance of the Eurozone as whole but also on that of each member state against the average. However, as showed in the indices in section 3 above, it was not until the application of a systematic Asset Purchase Programme (i.e. so-called Quantitative Easing, QE) by the ECB in 2015 that we can observe a clear and more convergent macroeconomic pattern among member states in the Eurozone. Since 2015, there has been a significant fall in overall dispersion (from a value of 160 in 2015 to 107 in 2016), explained by much greater convergence in the rate of growth of money and credit to the private sector, and also in the business cycle and labour costs. The stability in money growth and credit all across EMU member states seems to have played a key role in securing a more convergent macroeconomic performance since 2015.

Nevertheless, QE programmes have come with a cost, as they have had a considerable impact in the Target balances, which show an accelerated dispersion among national central banks' credit and debit positions; with Spain and Italy carrying significant debit balances by the end of 2018 (-30% and -25% of their respective GDPs) and Germany and the Netherlands on the credit side (24% and 10% of their respective GDPs). Creditor countries barely receive a compensation for their surplus position in the Target system in the form of the ECB's main policy rate, which has been historically low since 2008. Therefore, implicitly they are subsidising the access to cheap borrowing by the other member states with a debtor position.

5. Monetary stability as the key goal to reduce macroeconomic divergence in the Eurozone

The dispersion indices calculated above provide an effective tool to assess trends in macroeconomic asymmetries within monetary areas which can be used both to compare their degree of convergence in 'normal times' – in other words, when there is no major crisis - and also to assess the degree of flexibility displayed to address a crisis. In case of a lateral crisis – one that affects some member states significantly more than others - asymmetric effects are expected and thus an increase in dispersion. What it is essential in the assessment of the functioning of the monetary area is the speed at which it absorbs the shock and returns to pre-crisis levels of dispersion. In this vein, the indices above can be interpreted as a signal of and a test on the effective functioning of a monetary area and ultimately, though indirectly, of its degree of optimality. The Eurozone provides a good example in the application of these indices.

In a nutshell, asymmetries within the Eurozone, in particular as regards costs and monetary indicators, did exacerbate before 2007; and the return to more convergent macroeconomic patters took longer than in the US or the UK. The correction of the large asymmetries accumulated in the Global Financial Crisis and the euro crisis years seem to be explained to a great extent by the QE programme which the ECB inaugurated in 2015 and ran until 2018. According to our results, maintaining monetary stability among EMU member states is key to contribute to a more convergent and better functioning monetary union. In a monetary union without a meaningful central budget such as the Eurozone, this means that the ECB must stand ready to action new asset purchases programmes in case needed in the future. Whether this will be a permanent addition to the ECB toolkit and require a change in its statutes is yet to be seen. The greater imbalances reflected in the Target system can be seen as the cost member states are, either explicitly or implicitly,

required to pay for such reduction in asymmetry. In view of the experience in the post-Global Financial Crisis years, the more timely reaction of the ECB to the Covid-19 crisis with enlarged QE programmes should contribute to mitigate such an increase in dispersion in the Eurozone from March 2020 onwards. This is a hypothesis that should be tested with the calculation of these indices in the coming years.

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Tables and Figures

Table 1. Indicators used in the Eurozone (€), the UK (£) and the US ($) (the numbering in each indicator is the one that is later used in the dispersion measures $d^X(\delta_{j,t})$ and $d^X(\sigma_{j,t})$ of Table 2)

Categories											
Business Cycle			**Public Finances**			**Competitiveness**			**Monetary Dispersion**		
€	£	$	€	£	$	€	£	$	€	£	$
1-Real GDP growth 2-Real per capita GDP growth 3-Unemployment rate			4-Deficit (%GDP) 5-Debt (%GDP)	4-Deficit (%GDP) 5-Debt interest payments (%GDP)	4-Deficit (%GDP) 5-Debt (%GDP)	6-HICP inflation 7-Unit Labour Costs (growth)	6-CPI inflation 7-Average earnings, growth	6-CPI inflation 7-Average weekly earnings, growth	8-Broad money growth 9-Credit Private Sector (% GDP) 10-Current account balance (% GDP) 11-Target balances	8-Households loans and overdrafts (% GDP) 9-SME lending (% GDP) 10-Trade balance (% GDP)	8-Deposits by households (growth) 9-Credit to the Private sector: net leases and loans (% GDP) 10- Credit to the Private sector: real estate loans (% GDP) 11-Trade balance (% GDP) 12-Fedwire Inter-district Settlement balance

Table 2. Factor models for the synthetic indices of dispersion

Eurozone

Model 1. Cyclical synchrony

$f_{1,t}^{EMU}$	$\beta_{j,1}^{EMU}$	% comm
$d^{EMU}(\delta_{1,t})$	0.78	0.60
$d^{EMU}(\sigma_{1,t})$	0.92	0.85
$d^{EMU}(\delta_{2,t})$	0.61	0.38
$d^{EMU}(\sigma_{2,t})$	0.90	0.82

Model 4. Unemployment

$f_{2,t}^{EMU}$	$\beta_{j,2}^{EMU}$	% comm
$d^{EMU}(\delta_{3,t})$	0.94	0.89
$d^{EMU}(\sigma_{3,t})$	0.94	0.89

Model 7. Deficit

$f_{3,t}^{EMU}$	$\beta_{j,3}^{EMU}$	% comm
$d^{EMU}(\delta_{4,t})$	0.98	0.96
$d^{EMU}(\sigma_{4,t})$	0.98	0.96

Model 9. Debt

$f_{4,t}^{EMU}$	$\beta_{j,4}^{EMU}$	% comm
$d^{EMU}(\delta_{5,t})$	0.98	0.95
$d^{EMU}(\sigma_{5,t})$	0.98	0.95

Model 11. Competitiveness

$f_{5,t}^{EMU}$, $f_{6,t}^{EMU}$	$\beta_{j,5}^{EMU}$	$\beta_{j,6}^{EMU}$	% comm
$d^{EMU}(\delta_{6,t})$	0.84	0.54	0.99
$d^{EMU}(\sigma_{6,t})$	0.82	0.56	0.99
$d^{EMU}(\delta_{7,t})$	0.84	-0.55	0.99
$d^{EMU}(\sigma_{7,t})$	0.84	-0.54	0.99

Model 14. Monetary dispersion

$f_{7,t}^{EMU}$, $f_{8,t}^{EMU}$	$\beta_{j,7}^{EMU}$	$\beta_{j,8}^{EMU}$	% comm
$d^{EMU}(\delta_{8,t})$	0.51	0.73	0.79
$d^{EMU}(\sigma_{8,t})$	0.39	0.84	0.85
$d^{EMU}(\delta_{9,t})$	-0.32	0.73	0.64
$d^{EMU}(\sigma_{9,t})$	-0.58	0.62	0.73
$d^{EMU}(\delta_{10,t})$	0.83	-0.12	0.71
$d^{EMU}(\sigma_{10,t})$	0.79	-0.19	0.65
$d^{EMU}(\sigma_{11,t})$	-0.83	-0.19	0.72

UK Sterling

Model 2. Cyclical synchrony

$f_{1,t}^{UK}$	$\beta_{j,1}^{UK}$	% comm
$d^{UK}(\delta_{1,t})$	0.95	0.91
$d^{UK}(\sigma_{1,t})$	0.93	0.87
$d^{UK}(\delta_{2,t})$	0.94	0.89
$d^{UK}(\sigma_{2,t})$	0.94	0.88

Model 5. Unemployment

$f_{2,t}^{UK}$	$\beta_{j,2}^{UK}$	% comm
$d^{UK}(\delta_{3,t})$	0.99	0.99
$d^{UK}(\sigma_{3,t})$	0.99	0.99

Model 8. Net fiscal balance

$f_{3,t}^{UK}$	$\beta_{j,3}^{UK}$	% comm
$d^{UK}(\delta_{4,t})$	0.99	0.99
$d^{UK}(\sigma_{4,t})$	0.99	0.99

Model 10. Debt (interest payment)

$f_{4,t}^{UK}$	$\beta_{j,4}^{UK}$	% comm
$d^{UK}(\delta_{5,t})$	0.99	0.99
$d^{UK}(\sigma_{5,t})$	0.99	0.99

Model 12. Competitiveness

$f_{5,t}^{UK}$	$\beta_{j,5}^{UK}$	% comm
$d^{UK}(\sigma_{6,t})$	0.71	0.50
$d^{UK}(\delta_{7,t})$	0.39	0.15
$d^{UK}(\sigma_{7,t})$	0.71	0.50

Model 15. Monetary dispersion

$f_{6,t}^{UK}$ obtained from the arithmetic mean of $d^{UK}(\delta_{8,t})$, $d^{UK}(\sigma_{8,t})$, $d^{UK}(\sigma_{9,t})$, $d^{UK}(\delta_{10,t})$, $d^{UK}(\sigma_{10,t})$ due to insuficient number of observations

US Dollar

Model 3. Cyclical synchrony

$f_{1,t}^{US}$	$\beta_{j,1}^{US}$	% comm
$d^{US}(\delta_{1,t})$	0.97	0.94
$d^{US}(\sigma_{1,t})$	0.99	0.97
$d^{US}(\delta_{2,t})$	0.98	0.96
$d^{US}(\sigma_{2,t})$	0.98	0.96

Model 6. Unemployment

$f_{2,t}^{US}$	$\beta_{j,2}^{US}$	% comm
$d^{UK}(\delta_{3,t})$	0.99	0.99
$d^{UK}(\sigma_{3,t})$	0.99	0.99

For the synthetic indices of deficit and debt we take the dispersion indices $d^{US}(\sigma_{4,t})$ and $d^{US}(\sigma_{5,t})$ previously calculated

Model 13. Competitiveness

$f_{5,t}^{US}$	$\beta_{j,5}^{US}$	% comm
$d^{US}(\delta_{6,t})$	0.53	0.29
$d^{US}(\sigma_{6,t})$	-0.16	0.03
$d^{US}(\delta_{7,t})$	0.53	0.28

Model 16. Monetary dispersion

$f_{6,t}^{US}$, $f_{7,t}^{US}$	$\beta_{j,6}^{US}$	$\beta_{j,7}^{US}$	% comm
$d^{US}(\delta_{8,t})$	-0.54	0.83	0.98
$d^{US}(\sigma_{8,t})$	-0.54	0.83	0.98
$d^{US}(\delta_{9,t})$	0.95	0.06	0.91
$d^{US}(\sigma_{9,t})$	0.95	0.06	0.91
$d^{US}(\delta_{10,t})$	0.96	0.13	0.95
$d^{US}(\sigma_{10,t})$	0.96	0.13	0.95
$d^{US}(\sigma_{12,t})$	0.80	0.33	0.75

Table 3. Synthetic indices of dispersion for the EMU, the UK, and the US

Eurozone	UK Sterling	US Dollar
Figure 1. Cyclical synchrony ($f_{1,t}^{EMU}$) and unemployment ($f_{2,t}^{EMU}$)	Figure 2. Cyclical synchrony ($f_{1,t}^{UK}$) and unemployment ($f_{2,t}^{UK}$)	Figure 3. Cyclical synchrony ($f_{1,t}^{US}$) and unemployment ($f_{2,t}^{US}$)

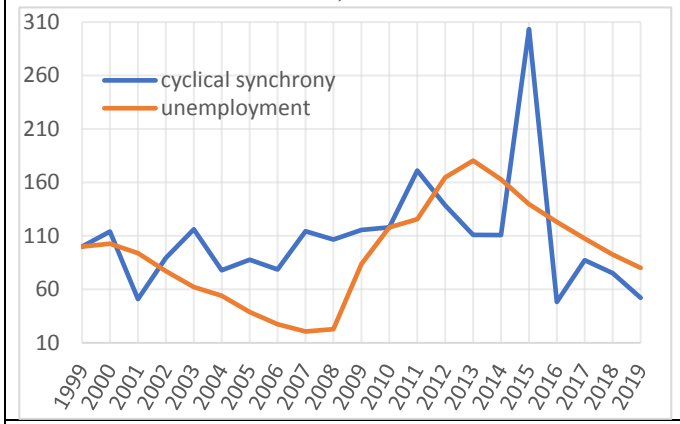
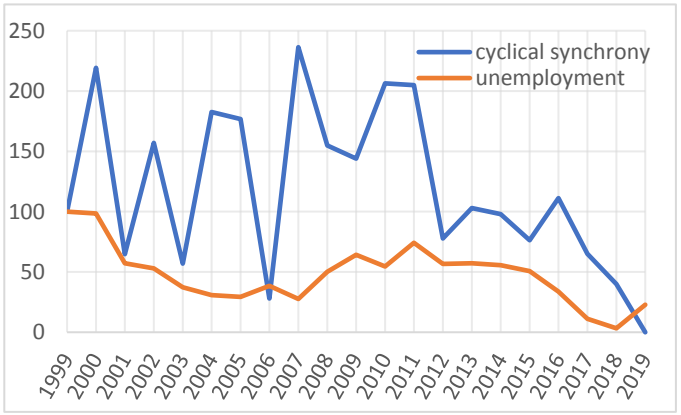
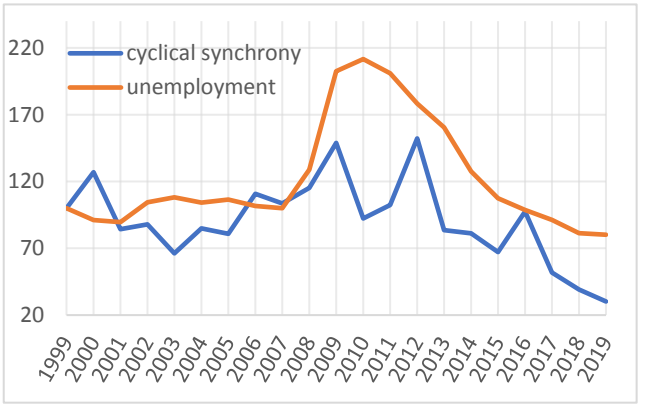

		

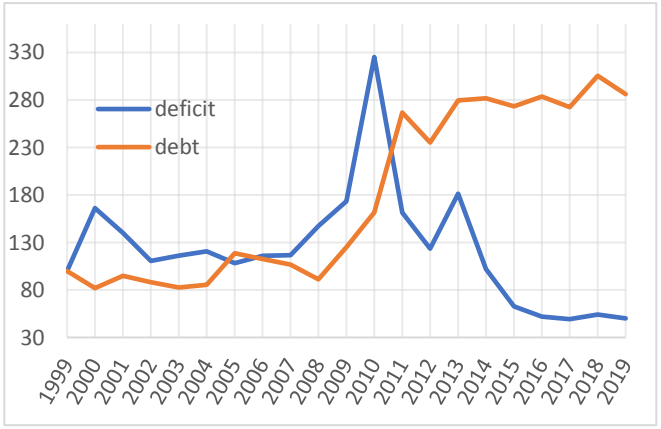
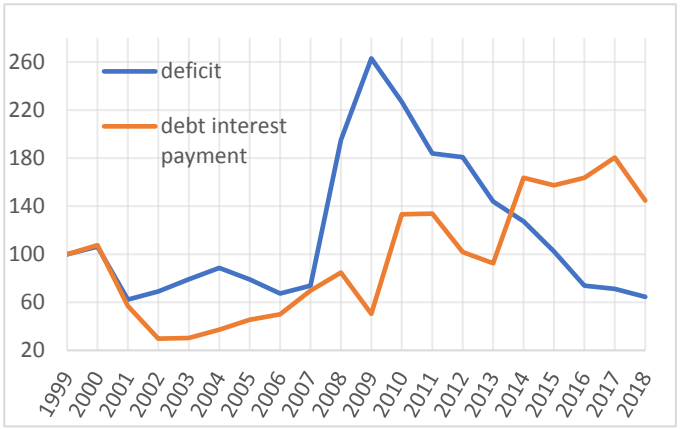
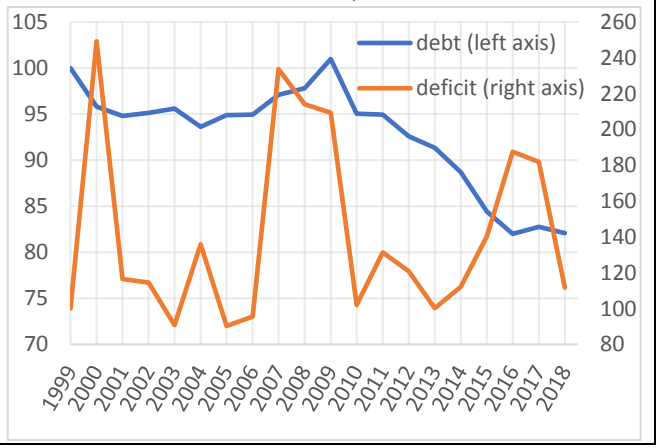
Figure 4. Public finances: deficit ($f_{3,t}^{EMU}$) and debt ($f_{4,t}^{EMU}$)	Figure 5. Public finances: fiscal balance ($f_{3,t}^{UK}$) and debt interest payment ($f_{4,t}^{UK}$)	Figure 6. Public finances: deficit ($d^{US}(\sigma_{4,t})$ and debt ($d^{US}(\sigma_{5,t})$)
		

Figure 7. Competitiveness: inflation ($f_{5,t}^{EMU}$) and labour costs ($f_{6,t}^{EMU}$)

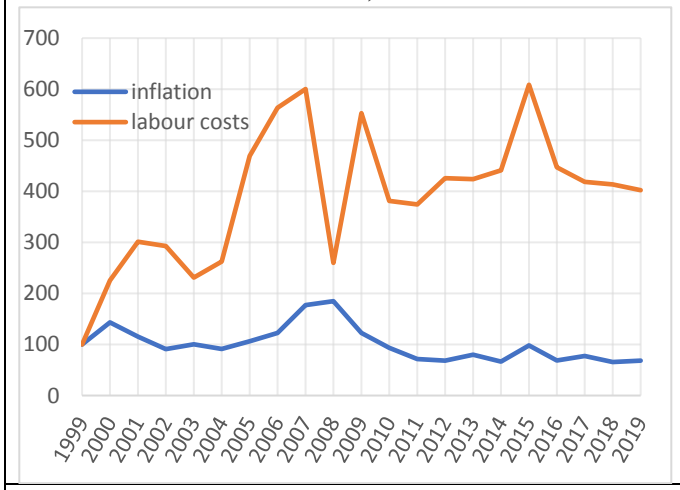


Figure 8. Competitiveness ($f_{5,t}^{UK}$)

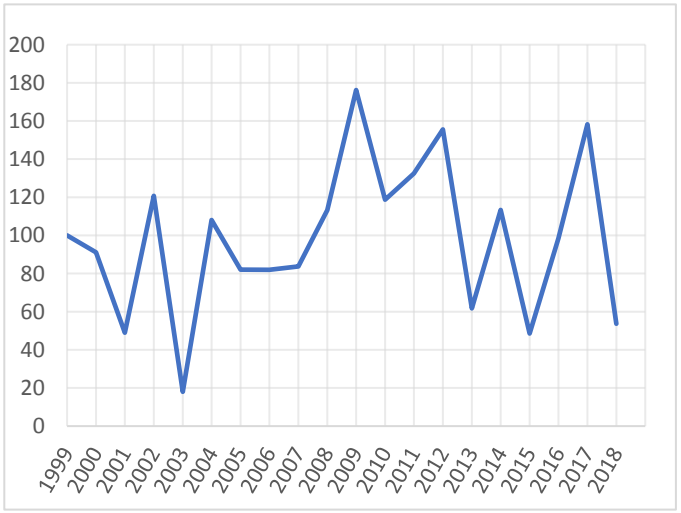


Figure 9. Competitiveness ($f_{5,t}^{US}$)

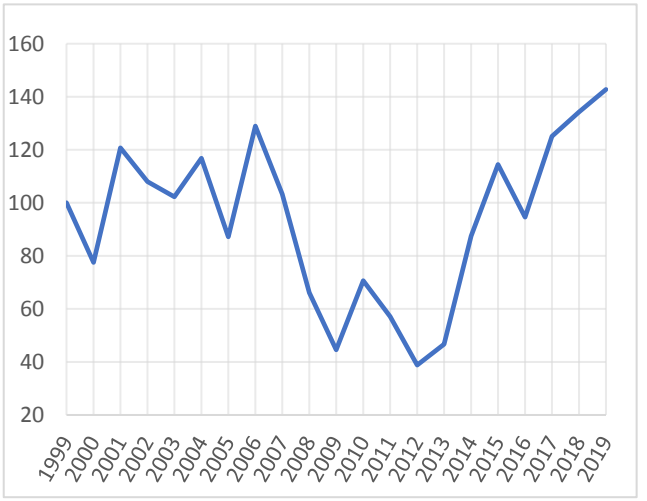


Figure 10. Monetary dispersion ($f_{7,t}^{EMU}$ and $f_{8,t}^{EMU}$)

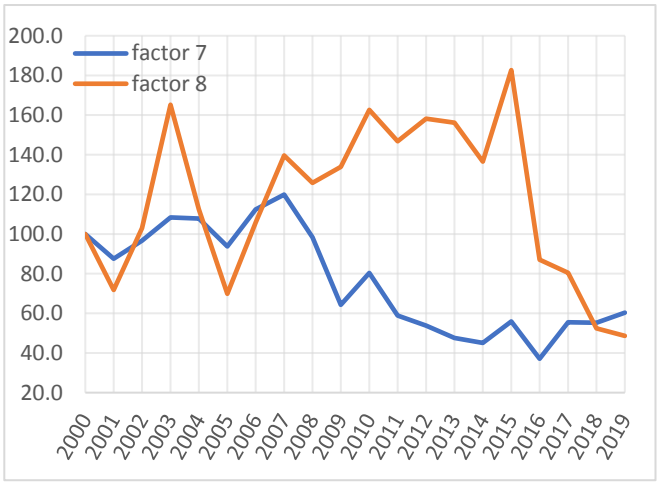


Figure 11. Monetary dispersion ($f_{6,t}^{UK}$)

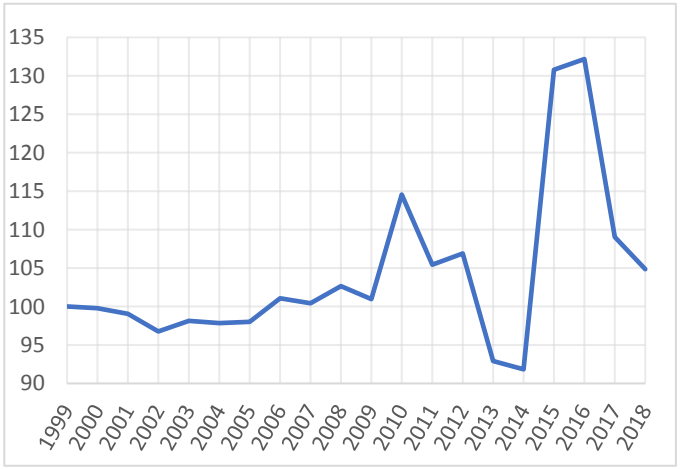


Figure 12. Monetary dispersion ($f_{6,t}^{US}$ and $f_{7,t}^{US}$)

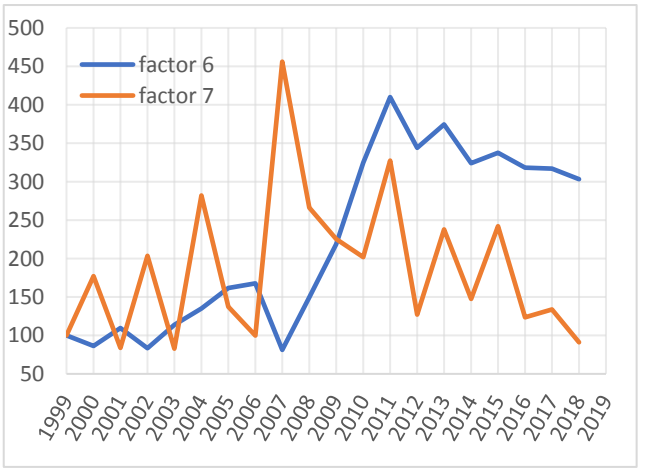


Figure 13. Overall indices for the Eurozone, the UK, and the US. 1999=100