DE GRUYTER OPEN

DOI: 10.1515/ijme-2017-0016

International Journal of Management and Economics
Volume 53, Issue 3, July–September 2017, pp. 7–25; http://www.sgh.waw.pl/ijme/

Dariusz K. Rosati[1]
Collegium of World Economy,
Warsaw School of Economics, Poland

Asymmetric Shocks in the Euro Area: Convergence or Divergence?

Abstract

The degree of structural divergence in the Euro Area is examined on the basis of the frequency and distribution of observed asymmetric shocks over the period 1996–2015. An asymmetric shock is defined as an opposite sign difference between the deviation of an individual country's GDP growth rate from a trend and the deviation of the EA-wide GDP growth rate from a trend. Two measures of asymmetric shocks are introduced, one based on exponential trend values and another on moving-average trend values. Geographical distribution of observed ("revealed") shocks shows that EA member countries differ in terms of structural convergence, with a higher number of asymmetric shocks in countries that joined the EA at a later date. The distribution of asymmetric shocks over time shows two peaks in the number of shocks around 2002 and 2011, but no clear tendency towards more divergence is detected. As actual data may not provide a full picture of asymmetric shocks (given that countries with sufficient fiscal space could have neutralized their negative impact on GDP growth rates) a hypothesis on the existence of "non-revealed" negative asymmetric shocks is examined. Testing for correlation between public debt levels and GDP growth rate deviations confirms the existence of "non-revealed" asymmetric shocks in low-debt countries. In general, the observed differences in the number of asymmetric shocks in EA member countries (and their increases over time) may actually reflect different fiscal policy reactions in individual countries as well as the impact of financial and debt crises, and are not necessarily an indication of widening structural divergence across the EA.

Keywords: Euro Area, convergence, asymmetric shocks
JEL: F45

Introduction

The debt crisis in the Euro Area (EA) in 2010–2012 and subsequent efforts to reignite growth in indebted EA member countries have revived the discussion on whether the EA is an optimum currency area and to what extent insufficient convergence between member countries could have been a reason for the crisis. When the project to establish a currency union in Europe was launched in 1990 s, it was widely recognized that prospective member countries differed significantly in terms of economic development levels, economic structure, as well as the stance of their fiscal and monetary policy. According to the theory of optimum currency areas [Mundell, 1961, 1969, 1973; McKinnon, 1963; De Grauwe, 2000], member countries of a successful currency union should display a sufficient degree of real convergence, structural convergence and nominal convergence, respectively. The lack of necessary convergence left prospective member countries vulnerable to country-specific – or asymmetric – shocks [Bayoumi, Eichengreen, 1992; Sørensen, Yosha, 1998; Arreaza et al., 1998; Buti, Sapir, 1998; De Haan et al., 2007; Jonung, Drea, 2009; Estrada et al., 2012; Buti, Turrini, 2015]. Moreover, some economists warned that deepened regional specialization encouraged by the removal of trade and investment barriers and the introduction of a single currency would lead to more agglomeration of economic activities across the EA and more structural divergence across EA member countries, making them even more vulnerable to country-specific shocks [Krugman, 1991, 1993; Krugman, Venables, 1993].

Opposite views were also expressed. Some authors argued that the common currency and ensuing further deepening of trade and financial integration, as well as national policy coordination within the currency union, would accelerate convergence on all three fronts (real, structural and nominal) and gradually make member country economies more similar and less vulnerable to asymmetric shocks [European Commission, 1990; Frankel, Rose, 1998; Bayoumi, Eichengreen, 1992; Rose, 2000].

Empirical evidence on convergence in the EA is mixed, however. For instance, Mongelli and Wyplosz [2008] found that there has been a significant nominal convergence in the EA since the introduction of the euro, especially in terms of inflation levels and fiscal balances. They also show that income differentials between EA member countries have gradually declined. There is, however, less evidence on real and structural convergence. For instance, Estrada, Galí, López-Salido [2012] show that EA member countries generally converged until the financial crisis hit in 2008, and then diverged, especially with respect to labor markets and competitiveness levels. Also, Buti and Turrini [2015] provide evidence for strong real and structural convergence between 1999 and 2007.

One popular indicator of structural convergence between member countries of a currency union is the presence and frequency of asymmetric shocks. Some studies, using GDP growth rate differentials between member countries as a yardstick, suggest that the number of asymmetric shocks in the EA actually increased, rather than decreased [IMF, 2013; Pisani-Ferry, 2012]. But simple GDP growth rates differentials are a rather crude measure of dispersion of individual growth rates, and may not be a good indicator of asymmetric shocks. Consequently, they may not be a good gauge of the degree of structural convergence or divergence. Thus, alternative measures of asymmetric shocks are needed. Two such measures are proposed in the paper.

An important underlying assumption for monetary integration is that asymmetric shocks in a currency union – if and when they occur – can and should be addressed by national fiscal policy. In the absence of national monetary policies, member countries should be able to sufficiently increase government spending and/or reduce taxes to stimulate the economy in times of negative demand and/or supply shocks. For this, a sufficiently large "fiscal space" in a national budget should be readily available. The concept of "fiscal space", which derives from an empirical study by Bohn [1998], has been recently further developed by, among others, Ostry et al. [2010] and Ghosh et al. [2013].

In the EA context, member countries with low debt and ample fiscal space would be able – in principle – to react to negative shocks, thus preventing their GDP growth rates from falling. In those cases, asymmetric shocks cannot possibly be detected directly from drops in GDP growth rates because these potentially negative effects should have been effectively neutralized by active fiscal policy. We would call these shocks "non-revealed" asymmetric shocks. But in other EA member countries with very limited or no fiscal space (because of their high debt), fiscal policy could not be used to react to asymmetric shocks. In these cases, asymmetric shocks would have gone unabated, producing declines in their GDP growth rates. We would call these shocks "revealed" shocks. If the very existence of "non-revealed" shocks is confirmed for low-debt countries, the true number of asymmetric shocks in these countries may have actually been higher than measured by the "revealed" shocks only. This implies, first, that there may be less divergence between the high-debt and the low-debt countries, and second, that some "revealed" asymmetric shocks in high-debt countries may actually be symmetric shocks successfully neutralized in low-debt countries, but not neutralized in high-debt countries.

The main purpose of this paper is to assess to what extent the EA member countries have been subject to asymmetric shocks in the run-up to, and after the establishment of, the currency union, and to see whether the frequency of those shocks has been changing over time and across the EA. This will help answer the question whether EA member countries have generally converged or diverged since integration of their monetary policies. The other purpose, in this last context, is to check whether a higher number of revealed asymmetric shocks in individual member countries may have been related to the lack of fiscal shock-absorbing capacity in those countries[2].

The remaining part of the paper is organized into four sections. In the next section, the author introduces measures of asymmetric shocks based on deviations of individual country GDP growth rates (from trend) of opposite sign to those of EA-wide growth rates deviations (from trend). The third section presents empirical evidence of the existence of asymmetric shocks in 19 EA member countries in 1996–2015. In the fourth section the relationship between the asymmetric shocks and the "fiscal space" is examined on the basis of public debt data, in order to check the hypothesis on existence of "non-revealed" asymmetric shocks. The last section states our conclusions.

Alternative Measures of Asymmetric Shocks

There is no established methodology of identifying and measuring asymmetric shocks. One possible approach is to take deviations of the actual, observed GDP growth rates from trend for individual EA member countries, and decompose these deviations into a common, EA-wide component and an individual country-specific component. The first component of the growth rates deviation from trend can be assumed to represent symmetric, EA-wide shocks while the second component may be assumed to represent asymmetric, country-specific shocks. This methodology has been applied, *inter alia*, by the International Monetary Fund [IMF, 2013].

The starting point is to estimate GDP exponential trend equations for individual countries and for the euro area as a whole.

$$y_{i,t} = y_{i,0}\left(1+\widehat{\mathrm{r}}_i\right)^t \quad i = 1,2,\ \ldots,\ m,\ t = 1,2,\ \ldots,\ n \tag{1}$$

where $y_{i,t}$ is the index of GDP level for country i in year t, and $\widehat{\mathrm{r}}_i$ is the average yearly rate of GDP growth for country i. The next step is to calculate deviations of actual growth rates from theoretical trend values. These deviations are then decomposed into symmetric – or common – shocks, and asymmetric – or country-specific – shocks. Let these components be denoted as $u_{EA,t}$, and $u_{i,t}$, respectively, and the average GDP growth rate for the whole euro area as $\widehat{\mathrm{r}}_{EA}$. Then, by definition, we have:

$$r_{i,t} - \widehat{\mathrm{r}}_i = u_{EA,t} + u_{i,t} \tag{2}$$

where:

$$u_{i,t} = r_{i,t} - \widehat{\mathrm{r}}_i - u_{EA,t} \tag{3}$$

and

$$u_{EA,t} = r_{EA,t} - \widehat{\mathrm{r}}_{EA} \tag{4}$$

Combining (2), (3) and (4) we obtain:

$$u_{i,t} = \left(r_{i,t} - \hat{r}_i\right) - \left(r_{EA,t} - \hat{r}_{EA}\right) \tag{5}$$

where $u_{i,t}$ represents the country-specific component of the deviation of the GDP growth rate from trend for country i in period t. This is how the asymmetric shock is defined in the IMF study. Equation (5) shows that these shocks can take positive or negative values.

However, defined this way, the IMF measure simply gauges the extent of dispersion in individual growth rates, rather than any real asymmetry in GDP performance. It can easily be demonstrated that not all asymmetric shocks identified with equation (5) are in fact *asymmetric*. For instance, if both expressions on the right-hand side of equation (5) are of the same sign and differ only in value, the IMF measure would signal an asymmetric shock. However, since the values of $r_{i,t}$ (country-specific shock) and $r_{EA,t}$ (EA-wide shock) are of the same sign, there is of course no "true" asymmetry, but only a difference in the respective growth rates.

Given this weakness of the IMF measure, the author proposes two alternative methods. The first alternative method starts again with taking deviations of actual growth rates from trend for individual countries and years, and comparing them with similar deviations for the EA as a whole. Then asymmetric shocks are defined as individual country growth rate deviations with *signs opposite* to those of EA deviations. For instance, if for a given year the actual growth rate for a given country was lower than the trend value for that country, while the actual EA growth rate was higher than the trend value for EA, the deviations are of the opposite sign, which means that the country was hit by an asymmetric shock. If, by contrast, the deviations are of the same sign (even if they differ strongly in size), there is no asymmetric shock. So, the definition requires that for each t and i, one of the following conditions is strictly fulfilled:

$$r_{i,t} - \hat{r}_i < 0 \wedge r_{EA,t} - \hat{r}_{EA} > 0 \tag{6a}$$

or

$$r_{i,t} - \hat{r}_i > 0 \wedge r_{EA,t} - \hat{r}_{EA} < 0 \tag{6b}$$

The individual deviations from trend can, of course, be negative or positive, so we can have a negative asymmetric shock (6a) or a positive asymmetric shock (6b). The shocks also differ in size, reflecting different factors including fiscal policy stance, and have different impacts on GDP of individual countries. So, it was decided to distinguish between "weak" and "strong" shocks: if, for a given year, the absolute difference between the deviation from trend for a given country and the deviation from trend for the whole EA takes a value between 0 and 2 percentage points, it is called a "weak" asymmetric shock, and if this difference exceeds 2 percentage points, it is called a "strong" asymmetric shock[3]. This measure will be defined as "Measure 1" of asymmetric shocks.

One important advantage of "Measure 1" is that, by contrast to the IMF measure, it is defined as an individual deviation with the *opposite sign* to that of the whole EA. This means that an asymmetric shock takes place only when the deviation from trend for an individual country is of different sign than the deviation from trend for the whole EA. Thus, "Measure 1" shows the "true" asymmetry in GDP changes.

The other alternative method is similar to "Measure 1" in that it defines asymmetric shocks as individual deviations with *signs opposite* to those of EA deviations. But contrary to "Measure 1" (and to the IMF measure), the individual deviations are this time calculated as differences between the actual GDP level index in a given member state for a given year, and the hypothetical trend level is estimated as a *moving average* of actual GDP index values. The advantage of using a moving-average smoothing model as opposed to the exponential trend model is that it allows one to eliminate the restrictive assumption about the constancy of the growth rate over time, and to take into account past, as well as future, observations to predict hypothetical values. At the same time, the moving-average model acts as a filter, allowing for smoothing away one-off shocks from the time series.

In order to calculate the deviations from the moving-average (MA) model for GDP levels, first a GDP level index is set in 1995 at 100, and then one obtains the series of hypothetical values for years 1996–2015 as five-year moving averages from actual GDP index values, according to the general formula:

$$\hat{y}_t = \frac{\sum_{s=t-q}^{s=t+q} w_s y_s}{\sum_{s=t-q}^{s=t+q} w_s} \tag{7}$$

where $\hat{y}_t$ is the hypothetical GDP index value in year t, y_s is the actual GDP index value for year s, with s taking values from $t - q$ to $t + q$, and w_s is the weight attached to y for year s. Assuming $q = 2$, and weights w_s equal to 1/5, equation (7) simplifies to (7a):

$$\hat{y}_t = \sum_{s=t-2}^{s=t+2} w_s y_s \tag{7a}$$

Next, the author calculates the individual and EA-wide deviations of actual GDP index levels from the respective moving-average levels. Asymmetric shocks are defined as deviations of actual individual GDP index levels from the moving-average trend values with the *opposite sign* to the respective deviations of EA GDP index levels from the MA trend. So, the definition requires that for each t and i, one of the following conditions is strictly fulfilled:

$$y_{i,t} - \hat{y}_{i,t} < 0 \wedge y_{EA,t} - \hat{y}_{EA,t} > 0 \tag{8a}$$

or

$$y_{i,t} - \hat{y}_{i,t} > 0 \wedge y_{EA,t} - \hat{y}_{EA,t} < 0 \tag{8b}$$

Like in the previous case, one again distinguishes between "weak" shocks – taking values between 0 and 2 percentage points – and "strong" shocks – exceeding 2 percentage points[4]. This measure will be defined as "Measure 2" of asymmetric shocks.

Empirical Results

We applied both measures of asymmetric shocks to a panel of data covering nineteen EA member countries (EA19) for the period 1996 to 2015[5]. Figures for GDP growth rates were taken from Eurostat, except for growth rates for Luxemburg and Malta for the years 1996–2000, and Slovakia for the years 1996–1997, which were taken from the World Bank. The test starts with "measure 1" of asymmetric shocks. First, GDP trend equations (1) were estimated for individual countries and for the EA19 as a whole. The average growth rates obtained and their standard deviations are shown in Table 1. Next, deviations of individual growth rates from trend and deviations of EA growth rates from trend were calculated, according to "measure 1", in order to decompose the differentials and estimate country-specific GDP changes representing asymmetric shocks (according to equations (6) and (6a)). Out of 380 total observations, 87 asymmetric shocks were identified, of which 38 were "strong" asymmetric shocks. Graph 1 shows the distribution of asymmetric shocks across EA member countries, while Graph 2 shows the distribution of asymmetric shocks in EA countries over time. Both graphs show all asymmetric shocks and all "strong" asymmetric shocks.

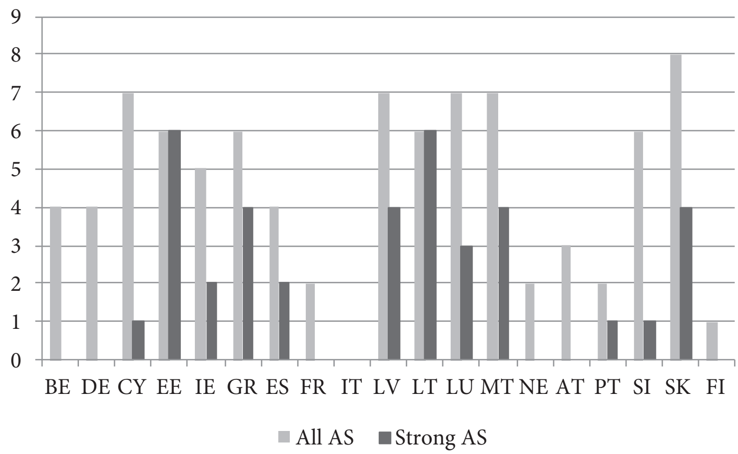
TABLE 1. Average trend values for GDP growth rates (in %) and standard deviations for the EA countries, 1996–2015

Country	Average GDP growth rate, %	Standard deviation
BEL	1.67	1.4759
DEU	1.26	2.0448
CYP	1.92	3.0371
EST	3.88	5.9495
IRE	4.58	4.3275
GRE	0.74	4.3836
ESP	1.98	2.5102
FRA	1.48	1.4887
ITA	0.45	1.9742

Country	Average GDP growth rate, %	Standard deviation
LVA	3.89	5.9028
LTU	4.02	5.3205
LUX	3.45	3.3535
MLT	3.08	2.0920
NED	1.79	2.1340
AUT	1.69	1.6719
PRT	1.09	2.3516
SLV	2.39	3.2318
SVK	3.71	33554
FIN	2.01	3.2291
EA19	1.34	1.7961

Source: Eurostat, World Bank, own calculations.

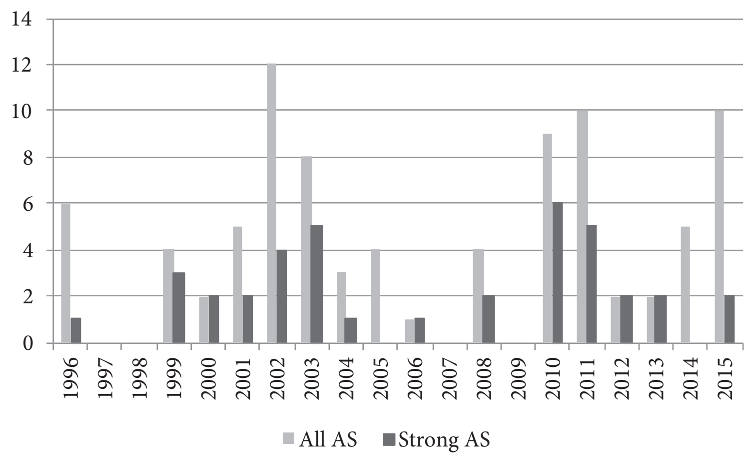
GRAPH 1. "Measure 1" asymmetric shocks (AS) in the EA, by country, 1996–2015



Source: own calculations.

As can be seen, the distribution of asymmetric shocks across EA countries is highly uneven. Italy did not register any shocks while Belgium, Germany, France, the Netherlands, Austria and Finland registered between 1 and 4 asymmetric shocks each, but no "strong" shocks. This group of countries shows the highest convergence with the EA as a whole. The low numbers of asymmetric shocks suggest that these countries most probably constitute parts of the optimum currency area on the basis of "Measure 1" criterion – they can be called the "core" countries. On the other end of the spectrum are Estonia, Greece, Latvia, Lithuania, Luxemburg, Malta and Slovakia, where asymmetric shocks have been much more frequent (between 6 and 8 in each country), including many "strong" shocks (between 3 and 6). This group clearly shows much more divergence from the EA as a whole – this group can be called "a periphery". However, it should be noted, that in case of Slovakia and the Baltic states most observed shocks took place before these countries joined the EA. The remaining countries (Cyprus, Ireland, Spain, Portugal and Slovenia) are somewhere in the middle – they have registered between 2 and 7 asymmetric shocks, but no more than 2 "strong" shocks each. It can be assumed that this group is probably a part of the optimum currency area, although to a lesser extent than the "core" group – they can be called a "semi-core" group.

GRAPH 2. "Measure 1" asymmetric shocks (AS) in the EA, by year, 1996–2015

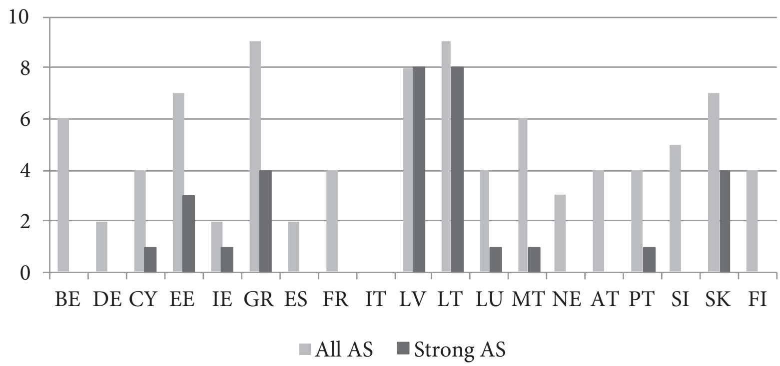


Source: own calculations.

The distribution of asymmetric shocks over time (Graph 2) shows an increase in the frequency of shocks in years 2002–2003 (20 shocks registered in two years, of which 9 were "strong" shocks), and in years 2010–2011 (19 shocks registered in two years, of which 11 were "strong" shocks). In the first episode, out of nine "strong" shocks, seven were observed in countries that were not at that time in the EA (The Baltics), and the two remaining shocks were registered in Greece. The second episode is unprecedented as it coincides with the sovereign debt crisis in the euro area in the aftermath of the global financial crisis. Out of eleven "strong" shocks in 2010–2011, seven were registered in EA member countries hardest hit by the financial crisis (the "program" countries – Greece, Ireland, Spain and Portugal) and three were registered in the Baltic countries that were not yet members of the EA. It would certainly be difficult to interpret these data as an indication of increasing structural divergence within the EA over time. The moderate increase in the number of "strong" asymmetric shocks over time is entirely due to the sharp economic decline in the "program countries". This is not, however, an indication of an increased structural divergence in the "old" EA (i.e. excluding the Baltics).

Next, we apply "Measure 2" of asymmetric shocks. Again, asymmetric shocks are defined as individual deviations with signs opposite to those of EA-wide deviations. But contrary to "measure 1" (and to the IMF measure), individual deviations are this time calculated as differences between the actual GDP level index in a given member state for a given year, and the hypothetical trend level estimated as a *moving average* of actual GDP index values. The number of asymmetric shocks identified with "Measure 2" is very similar to the number of asymmetric shocks identified with "Measure 1". Of 380 total observations, there were 90 deviations with opposite sign, out of which 32 are "strong" negative asymmetric shocks. Graph 3 shows the distribution of negative asymmetric shocks across EA member countries, and Graph 4 shows the distribution of negative asymmetric shocks over time.

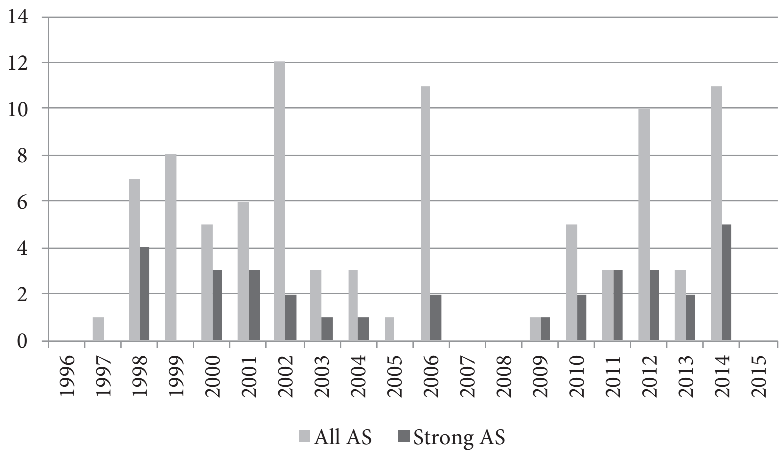
GRAPH 3. "Measure 2" asymmetric shocks in the EA, by country, 1996–2015



Source: own calculations.

In terms of the geographical distribution of asymmetric shocks, Graph 3 conveys very much the same picture as Graph 1. Again, Italy experienced no shocks at all while Belgium, Germany, Spain, France, The Netherlands, Austria, Slovenia and Finland registered between 2 and 6 asymmetric shocks each (but no "strong" shocks) in the analyzed period. This is an indication of a high degree of structural convergence. This "core" group may again be assumed to constitute an optimum currency area on the basis of "Measure 2" criterion. On the other end of the spectrum are Estonia, Greece, Latvia, Lithuania and Slovakia, with 7 to 9 asymmetric shocks each, including between 3 and 8 "strong" shocks in each country. Again, each of these countries can be assumed to belong to the "periphery" group (but it should be noted, that most asymmetric shocks in the Baltic states and Slovakia took place before these countries joined the EA). Finally, Cyprus, Ireland, Luxemburg, Malta and Portugal fall somewhere in the middle of the range, with 2 to 6 asymmetric shocks (but only one "strong" shock) were registered in each of them. This is a "semi-core" group, according to "Measure 2". The main differences between "Measure 1" and "Measure 2" classifications concern Spain (moved from "semi-core" to "core"), Luxemburg (moved from "periphery" to "semi-core") and Slovenia (moved from "semi-core" to "core"). Otherwise, the results obtained from the two measures is very similar. A summary classification of member countries by both measures is given in Table 2.

GRAPH 4. "Measure 2" asymmetric shocks in the EA, by year, 1996–2015



Source: own calculations.

Changes in the number of negative shocks over time (Graph 4) also show a higher number of asymmetric shocks in years 1998–2002 and 2010–2014, including "strong" shocks. This particular pattern may reflect the impact of the dot-com crisis during the first episode and of the financial-cum-debt crisis during the second episode. As far as the first episode is concerned, all ten "strong" shocks observed took place in countries that were not yet members of the EA (The Baltics and Slovakia). During the second episode, of fifteen "strong" shocks observed in 2010–2014, more than half (eight) took place in the Baltic states (Estonia joined the EA in 2011, and Latvia in 2014, and Lithuania in 2015), and five in the countries that were most indebted and in financial distress (Cyprus, Greece, Ireland and Portugal). Again, this distribution of asymmetric shocks over time does not provide sufficient evidence of more divergence in the EA. In fact, the observed – rather moderate – increase in the number of asymmetric shocks (both "weak" and "strong") over time can be more than explained by the shocks taking place in the "program countries".

Two conclusions can be drawn. First, EA member countries can be broadly classified into three categories. As shown in Table 2, the "core" group includes Belgium, Germany, France, Italy and the Netherlands (the EU founding member states minus Luxemburg) plus

Austria and Finland[6]. The "semi-core" group includes Cyprus, Portugal, Luxemburg, Spain and Slovenia ("semi-core")[7]. These two groups of countries display a high, or moderately high, degree of structural convergence, and can be assumed to constitute parts of an optimum currency area. The third group – the "periphery" – consists of the EA member countries with a generally much higher number of shocks – Estonia, Ireland, Greece, Latvia, Lithuania, Malta and Slovakia – where the degree of structural convergence with the EA is low, or relatively low. These countries cannot be assumed to be parts of the optimum currency area. However, given that most of these countries joined the EA only recently, they will probably converge in the future.

TABLE 2. EA member countries, categorized by the degree of convergence measured by the frequency and strength of asymmetric shocks (AS)

EA member countries, by categories	"Measure 1"		"Measure 2"	
	No. of all AS	No. of "strong" AS	No. of all AS	No. of "strong" AS
"Core" countries:				
Belgium	4	0	6	0
Germany	4	0	2	0
France	2	0	4	0
Italy	0	0	0	0
The Netherlands	2	0	3	0
Austria	3	0	4	0
Finland	1	0	4	0
"Semi-core" countries:				
Cyprus	7	1	4	1
Ireland	5	2	2	1
Spain	4	2	2	0
Luxemburg	7	3	4	1
Portugal	2	1	4	1
Slovenia	6	1	5	0
"Periphery" countries:				
Estonia	6	6	7	3
Greece	6	4	9	4
Latvia	7	4	8	8
Lithuania	6	6	9	8
Malta	7	4	6	1
Slovakia	8	4	7	4
Total number of AS	87	38	90	32

Source: own study.

Second, the data broadly show two episodes of a higher number of asymmetric shocks (including "strong" shocks) – in years 1998–2004 and in years 2010–2014. Almost all of these shocks were observed in countries that either were not yet EA members (the Baltics, Slovakia), or were most hit by financial and economic crisis (Greece, Ireland, Cyprus, Portugal, Spain – the "program countries"). A moderate increase of shocks over time that can be detected from the data is fully consistent with what happened in these two groups of countries. The results obtained demonstrate that there was no general tendency towards more structural divergence among EA member countries in the analyzed period [see also Buti, Turrini, 2015]. It can also be observed that EA member countries that joined the currency union at a later date, and with a low initial degree of structural convergence, have also been more vulnerable to economic and financial crises.

Asymmetric Shocks and the Fiscal Policy Stance

Generally, when a negative shock hits a country would normally attempt to react to it with fiscal policy expansion, spending more or taxing less. The available space for fiscal expansion depends of course primarily on the level of the country's indebtedness – the higher the debt in proportion to GDP, the lower the "fiscal space" available[8]. In principle, a country with a sufficiently large fiscal space should therefore be able to compensate for the impact of the shock. In that case, GDP growth rate should remain broadly unaffected. If, however, the country's fiscal space is limited or nonexistent, then the adversely affects GDP growth rate.

If these assumptions are correct as a general proposition, then the asymmetric shocks that were analyzed in the previous section should be considered as "revealed" asymmetric shocks, i.e. the shocks that did occur because they were not neutralized by shock-absorbing measures under national fiscal policy. So, it is plausible, that some shocks may not eventually be observed in GDP statistics precisely because their impact on GDP growth rates was compensated – partially or fully – by parallel expansionary fiscal policy. If this was the case, the number of actually observed – or "revealed" – shocks (symmetric or asymmetric) in countries with sufficiently large fiscal space could in fact have been lower relative to other countries where fiscal space was limited or nonexistent.

The "revealed" asymmetric shocks – as identified by "Measure 1" and "Measure 2" – may not therefore offer a full picture of the degree of structural convergence or divergence in the EA. In particular, if high-debt member countries with little (or no) fiscal space have registered more "revealed" asymmetric shocks, this did not necessarily indicate their stronger structural divergence. And *vice versa*, if the low-debt countries have registered less asymmetric shocks, this did indicate their stronger convergence. However, "non-revealed" shocks could not be directly observed because their impact on output was compensated by fiscal policy, leaving GDP growth rates broadly unchanged. If the existence of "non-revealed" shocks could be confirmed for low-debt member countries, this could indicate that the actual level of convergence between low-debt and high-debt EA member countries is higher than suggested by actual GDP growth data.

This possibility was examined by analyzing the relationship between "revealed" asymmetric shocks and the level of public debt. It is assumed that countries with high debt levels have limited or no fiscal space, while countries with low debt levels have sufficient fiscal space to absorb negative asymmetric shocks. The relationship between the debt level and the fiscal space is not linear, however. Public debt becomes an effectively binding constraint on fiscal policy only at relatively high debt levels. To properly control for the level of public debt, all 380 annual observations have therefore been divided into two subsets – observations with high debt levels and observations with low debt levels – with the threshold separating the two subsets set at 90% of GDP. In selecting this specific threshold value the author draws on Reinhard and Rogoff [2010] and Cechetti et al. [2011], who found that the 90% threshold is the critical level above which public debt starts to negatively influence growth in developed economies[9]. One assumes therefore that for high-debt observations (with debt levels of 90% of GDP or more) there would generally be no fiscal response to shocks, while for low-debt observations (with debt levels below 90% of GDP) fiscal policy would effectively neutralize asymmetric shocks. If the hypothesis on the existence of "non-revealed" asymmetric shocks is correct, the revealed negative asymmetric shocks should generally more often be observed in years characterized by higher debt levels. Table 3 shows the regression results for GDP growth rates deviations and public debt levels.

As can be seen, controlling for the debt level demonstrates that the relationship between public debt levels and GDP growth rate deviations is different for high-debt level observations and for low-debt level observations. For high-debt level observations, there is a statistically significant negative correlation between debt levels and GDP growth rates deviations (stronger for "Measure 1" shocks and weaker for "Measure 2" shocks, as shown by equations (10) and (14), respectively). This means that, for the given panel data, high levels of public debt tend to be associated with larger negative deviations of individual GDP growth rates from EA-wide deviations (because the structural coefficients are significant and negative). This implies that in high-debt member countries with little or no fiscal space, the revealed negative asymmetric shocks tend to be more frequent. On the other hand, for low-debt level observations (below 90% of GDP), no statistically significant relationship is generally observed between the debt level and deviations of GDP growth rates (as shown by equations (9) and (13)). This lack of correlation means that in member countries with abundant fiscal space negative asymmetric shocks may have been neutralized with autonomous fiscal policy reaction. This implies the existence of "non-revealed" asymmetric shocks.

The relationship between debt-levels and asymmetric shocks (individual GDP growth rates deviations of *opposite sign* to EA-wide deviations from trend) is less clear. For "Measure 1" shocks, a strong statistically significant negative correlation is observed between debt levels and GDP growth rate deviations for high-debt countries, as shown by equation (12), which is consistent with previous results. However, no significant correlation has been found for “Measure 2” shocks (equation (16)[10].

TABLE 3. Regression of public debt levels and GDP growth rate deviations (all observations and asymmetric shocks) for EA member countries, 1996–2015[a]

Eq. No	Coverage	No. of obs.	Constant	Debt, b)	R^2
“Measure 1” (deviations of GDP growth rates from trend)					
(9)	All observations for debt < 90% SEE	301	1.3618 (0.4523)	0.0229 (0.0891)	0.0215
(10)	All observations for debt > 90% SEE	79	7.3386 (1.7393)	–0.0685*** (0.0152)	0.2079
(11)	Asymmetric shocks for debt < 90% SEE	72	0.4433 (0.5277)	–0.0191* (0.0109)	0.0419
(12)	Asymmetric shocks for debt > 90% SEE	15	9.7937 (3.4922)	–0.0905** (0.0287)	0.4334
“Measure 2” (deviations of GDP growth rates from moving averages)					
(13)	All observations for debt < 90% SEE	301	0.5997 (0.5849)	0.0143 (0.0115)	0.0051
(14)	All observations for debt > 90% SEE	79	4.1136 (1.8576)	–0.0368** (0.0163)	0.0624
(15)	Asymmetric shocks for debt < 90% SEE	73	0.2418 (0.4058)	0.0008 (0,0084)	0.0001
(16)	Asymmetric shocks for debt > 90% SEE	17	1.6282 (2.0656)	–0.0098 (0.0183)	0.0187

[a] Asymmetric shocks defined as individual countries’ GDP growth rate deviations with signs opposite to those of the EA-wide deviations; standard errors of estimate (SEE) in brackets; public debt levels as % of GDP.

Source: own calculations.

On balance, it can be argued that the results obtained suggest the existence of “non-revealed” shocks, both symmetric and asymmetric. There are two possible implications. First, the EA member countries may actually be less structurally different than suggested by the “revealed” shocks. This is especially true for the differences between the high-debt and the low-debt countries. The differences in the number of observed asymmetric shocks in the EA member countries may to some extent reflect different fiscal policy reactions in individual countries and are not necessarily an indication of widening structural divergence across the EA. Second, it is possible that some “revealed” asymmetric shocks in high-debt countries may actually be symmetric shocks that have been successfully neutralized by low-debt countries. This again would suggest less structural divergence across the EA than suggested by observed GDP growth rate deviations.

Conclusions

The main purpose of the paper has been to check for the occurrence of asymmetric shocks in EA member countries in the period 1996–2015, in order to assess the extent of structural divergence between EA member countries and across time. Another purpose was to check whether a higher number of *revealed* asymmetric shocks in some individual member countries may have been related to the lack of sufficient shock-absorbing capacity in their public finances – or a lack of sufficient fiscal space. Before identifying asymmetric shocks, one first critically assesses the standard definition of an asymmetric shock as a country-specific component of the deviation of an individual country GDP growth rate from its trend over the analyzed period. We argue that this measure simply gauges the extent of dispersion in individual growth rates, rather than any true *asymmetry* in GDP performance.

To properly identify asymmetric shocks, two alternative measures are proposed. "Measure 1" defines asymmetric shocks as individual countries' growth rate deviations from trend with *signs opposite* to those of the EA growth rates deviations from its EA trend. "Measure 2" differs from "Measure 1" in that the individual deviations are this time calculated as differences between the actual GDP level index in a given member state for a given year, and the hypothetical trend level estimated as a *moving average* of actual GDP index values. We have also divided the asymmetric shocks into "weak" shocks (growth differentials of less than 2 percentage points) and "strong" shocks (growth differentials exceeding 2 percentage points).

Both measures were applied to the panel of data covering 19 EA member countries over the twenty year period of 1996–2015. With respect to geographical distribution of asymmetric shocks, there are three distinct groups of countries in the EA – the "core", the "semi-core" and the "periphery". In the "core" group, which includes Belgium, Germany, France, Italy, the Netherlands, Austria and Finland, no "strong" shocks and very few "weak" shocks were generally observed. The "semi-core" group, which includes Cyprus, Ireland, Luxemburg, Portugal, Spain and Slovenia, registered more shocks but very few "strong" shocks. These two groups of countries display a high, or moderately high, degree of structural convergence, and can be assumed to broadly constitute parts of an optimum currency area. In the "periphery" group, which includes Estonia, Greece, Ireland, Latvia, Lithuania, Malta and Slovakia, the frequency of asymmetric shocks is much higher, which suggests that these countries may not belong to the same optimum currency area as the first group of countries. However, given that most of the "periphery" countries joined the EA only recently, they may still converge in the future. With respect to the distribution of asymmetric shocks over time, we found a moderate increase in the frequency of shocks in years 1999–2000, and a stronger increase in years 2008–2012. This increase, however, reflects a higher number of shocks observed in the "program" countries most affected by the financial-cum-debt crisis, and therefore should not be interpreted as a symptom of increased structural divergence. It can be noted, that EA member countries with a low initial degree of structural convergence, as well as new EA members, have also been most vulnerable to economic and financial crises.

Finally, we addressed the question to what extent negative asymmetric shocks have materialized because they were not – or could not be – neutralized by an active national fiscal policy response due of to the lack of necessary fiscal space. We tested the hypothesis on the possible existence of "non-revealed" shocks in low-debt countries, i.e. shocks that could not have been observed because they were effectively neutralized by countercyclical fiscal policy. We also examined the relationship between revealed asymmetric shocks and public debt levels in individual countries. All observations were divided into two subsets – low-debt observations (with public debt levels below 90% of GDP) and high-debt observations (with public debt at or above 90% of GDP). We found that there is a statistically significant negative correlation between high-debt observations and GDP growth rate deviations, and much lower or no correlation between low-debt observations and GDP growth rate deviations. This implies the existence of "non-revealed" asymmetric shocks in low-debt countries.

To sum up, while EA countries still differ structurally, the actual divergence may be smaller than suggested by the number of revealed shocks. Rather, the observed differences in the number of asymmetric shocks in EA member countries (and their increase in the crisis years) may actually reflect different fiscal policy reactions in individual countries as well as the impact of financial and debt crises, and are not necessarily an indication of widening structural divergence across the EA.

Notes

1 Author's email address: drosat@sgh.waw.pl

2 The issue is of practical importance. The idea to establish a "fiscal capacity" for the Eurozone, put forward, *inter alia*, in the so-called "Five Presidents Report", is based on the assumption that the scope for asymmetric shocks in the EA is still so large that a common budget is needed to provide a public risk-sharing mechanism that would help smooth the negative impact of shocks across member countries [European Commission, 2015].

3 The two-percentage points limit represents 0.63 of standard deviation of all GDP growth rate differentials.

4 The two-percentage point limit represents 0.55 of standard deviation of all GDP growth rate differentials.

5 The rationale for including the „pre-euro" years (1996–1998) is that in the run-up to the euro all prospective member countries had largely fixed exchange rates and had to comply with nominal

convergence criteria, exactly as if they were already members of the currency union. This is also the reason for including member countries that joined the Eurozone at later dates, as they similarly had fixed exchange rate regimes in their pre-euro years.

[6] It should be remembered that the smaller number of asymmetric shocks for the biggest EA member countries (Germany, France, Italy) may to some extent reflect their larger share in the EA's GDP, and therefore relatively smaller deviations of individual GDP growth rates from EA-wide values.

[7] Luxemburg presents a special case, with quite a high number of shocks (especially according to "Measure 1"), even though this country is obviously very much integrated with the rest of the EA through trade and investment. One possible explanation for this anomaly is a very high share of financial services in GDP (the average share for 1996–2015 is 25.8%, compared with the average for the whole EA of 5.0%). The specific structure of Luxemburg's economy makes it five time more vulnerable to shocks originating in the financial services sector than the rest of the EA, but much less so to shocks originating in manufacturing. While it can be argued that Luxemburg is a unique case, for the purpose of the paper it has been classified as "semi-core" rather than "periphery".

[8] The concept of a "fiscal space" can be defined as the distance between the actual public debt level in proportion to GDP, and a certain maximum sustainable public debt level for a given country, estimated on the past history of fiscal behavior of that country [Ostry et al., 2010; Gosh et al., 2013].

[9] It should be noted that the results obtained by Reinhard and Rogoff [2010] have been challenged by Herndon, Ash and Pollin [2013], who demonstrate that while there is indeed a negative correlation between the debt level and the growth rate, the correlation is weaker than estimated by Reinhard and Rogoff, and the critical level is subsequently higher than 90%. In this paper, we do not enter this discussion and choose the 90% threshold as a matter of convention. One possible implication of this assumption is that the low number of asymmetric shocks in some highly indebted EA member countries, such as Belgium and Italy, may be partly due to the fact that the 90% threshold was not critical, because these countries were still able to use shock-absorbing fiscal policies. This indirectly confirms the existence of "non-revealed" shocks in these countries.

[10] Correlations estimated with „Measure 2" shocks are generally weaker than with "Measure 1" shocks. This may be partly due to the fact that large deviations from moving averages are by definition proportionately smaller than large deviations from an exponential trend.

References

Arreaza, A., Bent, S.E., Yosha, O. (1998), *Consumption smoothing through fiscal policy in OECD and EU countries*, NBER Working Paper, No. 6372.

Bayoumi, T., Eichengreen, B. (1992), Shocking aspects of European monetary integration, in: F. Torres, F. Giavazzi (Eds.), *Adjustment and growth in the European Monetary Union*, Cambridge University Press and CEPR, Cambridge.

Bąk, H., Maciejewski, S. (2015), Asymmetric shocks and international risk sharing in the European Monetary Union and the European Union, *Bank i Kredyt*, No. 46(6), pp. 523–564.

Bohn, H., 1998, "The Behavior of U.S. Public Debt and Deficits," *Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 949–63.

Buti, M., Sapir, A. (1998), *Economic policy in EMU*, Clarendon Press, Oxford.

Buti, M., Turrini, A. (2015), *Three waves of convergence. Can Eurozone* countries start growing together again?, VOX, CEPR's Policy Portal, 17 April.

Cecchetti, S.G., Mohanty, M.S., Zampolli, F. (2011), The real effects of debt, *BIS Working Papers*, No. 352, Bank of International Settlements.

De Grauwe, P. (2000), *Economics of Monetary Union*, Oxford University Press.

De Haan, J., Inklaar, R., Jong-A-Pin, R. (2007), Will business cycles in the euro area converge? A critical survey of empirical research, *Journal of Economic Surveys*, Vol. 22, Issue 2, April 2008, pp. 234–273.

Estrada, Á., Galí, J., López-Salido, D. (2012), *Patterns of convergence and divergence in the euro area*, paper presented at the 13th Jacques Polak Annual Research Conference, International Monetary Fund, No. 8–9, Washington.

European Commission (1990), One market, one money: an evaluation of the potential benefits and costs of forming an economic and monetary union, *European Economy*, No. 44, October.

European Commission (2015), *Completing Europe's economic and monetary union*, report by: Jean-Claude Juncker in close cooperation with Donald Tusk, Jeroen Dijsselbloem, Mario Draghi, and Martin Schulz, Brussels, 22 June.

Frankel, J., Rose, A. (1998), The endogeneity of the optimum currency area criterion, *Economic Journal*, No. 108, July, pp. 1009–1025.

Furceri, D., Zdzienicka, A. (2013), *The euro area crisis: need for a supranational risk sharing mechanism?*, IMF Working Paper No. WP/13/98, International Monetary Fund, September.

Ghosh, A.R., Kim, J.I., Mendoza, E.G., Ostry, J.D., Qureshi, M.S. (2013), Fiscal fatigue, fiscal space and debt sustainability in advanced economies, *The Economic Journal*, Vol. 123, February, pp. 4–30.

Herndon, T., Ash, M., Pollin, R. (2013), Does high public debt consistently stifle economic growth? A critique of Reinhard and Rogoff, *Cambridge Journal of Economics*, December, pp. 1–13.

IMF (2013), Towards a fiscal union for the euro area, IMF Staff Discussion Note SDN/13/09, *International Monetary Fund*, September.

Jonung, L., Drea, E. (2009), It can't happen, it's a bad idea, it won't last: U.S. economists on the EMU and the euro, 1989–2002, *Econ Journal Watch*, Vol. 7, No. 1, January 2009, pp. 4–52.

Krugman, P. (1991), *Geography and trade*, MIT Press, Cambridge, Massachusetts.

Krugman, P. (1993), Lessons of Massachusetts for EMU, in: F. Torres, F. Giavazzi (Eds.), *Adjustment for growth in the European Monetary Union*, Cambridge University Press, New York, pp. 241–261.

Krugman, P., Venables, A. (1993), *Integration, specialization and adjustment*, NBER Working Paper Series, No. 4559.

McKinnon, R.I. (1963), Optimum currency areas, *American Economic Review*, Vol. 53, September, pp. 717–724.

Mongelli, F.P., Wyplosz, Ch. (2008), *The euro at ten: unfulfilled threats and unexpected challenges*, Fifth ECB Central Banking Conference, The euro at ten: lessons and challenges, 13–14 November.

Mundell, R.A. (1961), A Theory of optimum currency areas, *American Economic Review*, Vol. 51, November, pp. 509–517.

Mundell, R.A. (1969), *A plan for a European currency*, Paper Prepared for Discussion at the American management Association Conference on Future of the International Monetary System, New York, December 10–12.

Mundell, R.A. (1973), Uncommon arguments for common currencies, in: H.G. Johnson, A.K. Swoboda (Eds.), *The economics of common currencies*, Allen and Unwin, pp. 114–32.

Ostry, J.D., Ghosh, A.R., Kim, J.I., Qureshi, M.S. (2010), *Fiscal space*, IMF Staff Discussion Note, 10/11, International Monetary Fund, Washington, September.

Pisani-Ferry, J. (2012), The known unknown and unknown unknowns of EMU, Bruegel Policy Contribution, Issue 2012/18, October.

Reinhart, C.M., Rogoff, K.S. (2010), Growth in a time of debt, *American Economic Review,* No. 100(2), pp. 573–578.

Rose, A. (2000), One money, one market: the effect of common currencies on trade, *Economic Policy*, Vol. 15, April, pp. 7–45.

Sørensen, B.E., Yosha, O. (1998), International risk sharing and European monetary unification, *Journal of International Economics*, Vol. 45, pp. 211–238.