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# Economic growth in the EMU
# before and after 1999

## Introduction

Economic integration in the world is no longer a new phenomenon. Real life experience of regional initiatives in this regard, along with accumulated statistical data, allow for a rigorous analysis of wealth effects on underlying societies. In the early years of the European Union (EU), and the Economic and Monetary Union (EMU), there were numerous studies that drew heavily from growth theory and were based on a multitude of assumptions. They were all missing a solid empirical grounding for the scenarios and projections that they offered. A review of those studies can be found in De Grauve [2016]. Today, one can cast those projections against hard data. Evidence of macroeconomic performance over the last two decades in Europe reveals interesting insights into economic integration, as practiced by the EU.

Originally, in the early literature on economic integration, it was perceived that economic integration was an effective way of achieving economic success. This perception was based on assumptions that levels of international trade and foreign investment would continuously increase. Such visions were attractive for governments and citizens alike in various countries and regions of the world. Ways to integrate were sought, openness was encouraged, and multilateral cooperation was fostered. One could find such ideas that materialized effectively not only in Europe, but also on other continents (table 1). Non-European economic and monetary integration initiatives have provided tangible benefits to all stakeholders over the last 50 years [Młodkowski, 2007a]. Nonetheless, there are still challenges for advancing with closer, and therefore, more politically demanding international cooperation, as is the case of ASEAN [Młodkowski, 2017]. Still,

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the economic integration may be represented merely by a free trade agreement or a customs union. However, a real life common market phenomenon is still a unique feature of the EU and CARICOM, while full economic and political union remains a purely theoretical concept so far.

The aim of this paper is to answer a question about average GDP rates after introducing the common currency in the EMU. The method used is a simple statistical test (for equality) of the mean in two populations.

The paper is organized as follows. The next section presents a literature review on economic growth and its factors, offering some bias towards economic integration-related factors. Then the methodology employed in the empirical investigation is described along with the sources of data utilized. This is followed by a simple empirical test for economic growth effects in the EMU. The last section concludes on and summarizes findings. A biased interpretation of the results is offered.

### Economic integration and growth

In order to get a proper understanding of how significant economic integration issues are to economists and policymakers, it is proper to explain more about the prevalence of related initiatives in the world today (as of the second half of 2017). It happens that there are only several countries that remain outside any of economic integration initiatives in operation (table 1).

**Table 1. Economic integration initiatives around the world.**

| | |
|---|---|
| Economic and monetary union | CSME-CARICOM, EU |
| Economic union | EAEU, MERCOSUR, GCC, SICA |
| Customs and monetary union | CEMAC, WAEMU |
| Common market | EEA, ASEAN |
| Customs union | CAN, EAC, SACU |
| Multilateral free trade area | CISFTA, COMESA, GAFTA, NAFTA, SAFTA, AANZFTA, PAFTA, SADCFTA |

Source: Author.

These outsiders are: China, Mongolia, Iran, and Uzbekistan in Asia, Cuba in America, Somalia and Ethiopia in Eastern Africa, plus Nigeria, Ghana, Mauritania, Sierra Leone and Liberia in Western Africa. One may conclude that there is a great deal of socio-political reasons, facilitated by generous research funds, that motivate studies focused on economic integration today.

The gist of economic integration literature focuses on just a few main research questions. These questions include the following:

1.  Which countries should cooperate, and in what form? (feasibility studies)
2.  What are factors driving benefits generated by economic integration? (international comparative studies, main stream  of growth literature)
3.  What are the actual benefits of economic integration in terms of real growth? (panel data-based empirical investigations)

There is a separate section with economic policy specialized questions from super-national institutions facing real and financial sector issues at a regional and global scale (i.e. IMF Policy Discussion Papers, and IMF Occasional Papers).

This paper belongs to the third group, listed above. It tests for the effects of monetary integration on real economic growth in per capita terms. When it comes to interpreting aggregated economic data that describes growth (and growth per capita), one should be aware of Simpson's paradox, as explained by Zee Ma [2015]. The current paper aims at accurate interpretations of aggregated data, so it checks for manifestations of the aforementioned paradox.

Literature on economic growth surveys a wide set of variables as potential stimulants, trying to find patterns in different samples. Agenor and Dinh [2014] focused on low-income countries in the 20th century. They showed the role of social capital and imitation for fueling GDP growth. As such, their results allow for benchmarking the current study, because economic integration in Europe facilitated social capital formation at the supra-national level. Then, there is a seminal work by Ang [2013] who studied institutional development at a national level in 99 countries, starting from 1500A.D. The European Union and its institutional manifestations at the regional level seem to match the relationships advocated by Ang [2013]. It is rarely suggested that EU institutions suffer from organizational flaws or are counter--productive, and therefore can be perceived as facilitating economic growth.

Berg, Ostry and Zettelmayer [2011] studied 140 countries in the 20th century, discovering, inter alia, that democratic institutions at the national level contribute to economic growth. The EMU is an initiative based on these democratic institutions at both national and regional levels. So their findings suggest another reason for fueling economic growth. In addition to institutions, Berg, Ostry and Zettelmayer [2011] tested for openness to FDI and macroeconomic stability as growth factors. Introducing the euro facilitated both, the FDI, by macroeconomic stability, and mitigated exchange rate over/undervaluation. These factors fueled growth in the sample of 140 countries, and may also be present in the EMU case studied here.

Woo [2010] drew attention to fiscal spending and taxes as growth factors in 93 countries from 1960 to 2000. Due to fiscal convergence criteria along with the Growth and Stability Pact in place for EMU members, there might be a reason for reduced growth effects after the year 2000. This is due to the fiscal consolidation required by the legal framework in the EMU. Stability might come at the cost of growth rate in the short run, as argued by Młodkowski [2009]. It is a measure for strengthening the whole system by achieving fiscal policy flexibility to be utilized in periods of significant internal, or external, shocks.

**Table 2. Growth and economic integration literature.**

| Author(s) | Coverage | | Growth drivers |
|---|---|---|---|
| | Countries/regions | Period of time | |
| Agénor and Dinh (2014) | Low-income countries | 20th century | social capital, human capital, and imitation on GDP growth |
| Ang (2013) | 99 | From year 1500 | institutional development |
| Bywaters and Młodkowski (2012) | Theoretical study | Theoretical study | innovation, specialization, transactions costs |
| Berg, Ostry, Zettelmayer (2011) | 140 | 20th century | degree of equality of the income distribution; democratic institutions; export orientation, greater openness to FDI, and avoidance of exchange rate overvaluation; and macroeconomic stability |
| Woo (2010) | 93 | Three sample periods covering in total 1960–2000: 41 years | income distribution, fiscal spending and taxes, and sociopolitical instability, macroeconomic volatility |
| Owen, Videras, Davis (2009) | 81 | 1970–2000: 31 years | quality of institutions, degree of law and order, latitude and being landlocked |

Source: Author.

There may be some flexibility in shaping public spending and taxes in a monetary union, but only for those members that managed to accumulate enough room for it in terms of total spending and public debt [Młodkowski, 2007b].

Then there is a contribution by Owen, Videras and Davis [2009] who argued that law and order at the national level contributes to economic growth. With their sample of 81 countries over 31 years (1970–2000) they also claimed that the quality of institutions matters. Both arguments can be used as reference for growth--focused studies on the EMU. The European Union is an elite club of democratic countries with well-developed institutions and rules of law. The importance of this latter element to the European Commission was seen in the reaction to the Constitutional Tribunal turmoil and other local actions that endangered the independence of the judicial system in Poland in 2017.

Concluding, there are several good reasons to observe continuous growth in the EMU after 1999. The first reason is that there are high quality democratic institutions that serve all EU citizens. Secondly, there are rules of law that facilitate economic activities in member states. The Eurosystem also required unification of business law in respect to the monetary and financial system. This brought transaction costs down for intra-union and international business activities. Third, macroeconomic stability and proper valuation of the external exchange rate both

serve as facilitators for transactions, by bringing transaction costs down. Fourth, there may be a negative stimulant for EMU members coming from the Stability and Growth Pact (and fiscal convergence criteria). Together, these factors may be responsible for observed growth rates in EMU before and after year 1999.

## METHODS AND DATA USED

Statistical data on annual real GDP growth rates (*per capita*), for countries covered by this study, comes from the GAPMINDER database. The Group in focus is composed of the original EMU member states that introduced the virtual euro in 1999 and euro banknotes and coins in 2000: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, and Spain. Greece is excluded due to two reasons: (1) it joined the EMU later, so external factors may deter the true nature of the relationship tested, and (2) there were serious EMU-specific issues that resulted from fiscal and social irresponsibility in Greece. As such, this particular country's official GDP statistics reflect other factors that are not studied here. Greece remains an outsider and is therefore excluded.

In the course of this empirical study on real effects of the economic and monetary integration in the EMU, a simple statistical testing will be employed.

The research question is as follows: was the GDP growth rate (as a proxy for changes in national wealth) in EMU countries different before and after 1999?

Gapminder data concerning the growth rates of Gross Domestic Product per capita (at constant prices) is used (Statistical Appendix). For each of the 11 EMU states, the observations are divided into two sections, representing an 8-year long period before and a 9-year period after 1999. For every country, GDP/capita time series normality test (Shapiro-Wilk test: $\alpha=0.05$, n=8 or n=9) for the samples was conducted and checked for possible significant difference of variances. The same was done for the aggregated data for all countries, before and after joining the EMU.

Raw GDP/capita growth rates for 11 countries serve as the basis for calculation of the weighted average GDP growth rate before EMU accession, and after. Weighting is done by the means of each country's share of the total EMU (11 countries) nominal GDP. For the purpose of estimating these shares, the World Bank time series were employed, defined as GDP in USD, inflation-adjusted (Statistical Appendix). There are two reasons for using the weighted average of the GDP per capita in this study. First, the economic integration that preceded the euro exercised positive effects in an asymmetric manner due to small-economy adjustment effect (i.e. Ireland). Inertia of big economies (France & Germany) and their multisector industrial structure may not allow for quick adjustments. The second reason is due to perceiving the European Union as a group of independent countries working together towards a common goal. This cooperation had already been there for many years before the euro was created. As this study focuses on

common currency effects on achieving the common goal, the benefits (if any) should be weighted by the size of economies affected. It might be the case that sudden improvements and gains in smaller members are realized at the cost of big states that contribute to smaller ones' success in a wide variety of ways and intra-union policies. This means that what has been interpreted as economic integration success, or euro-related effect, has been in fact a result of fueling growth in small member states at the cost of the rest of the Union.

To answer the basic research question, the following hypothesis is tested:

**$H_0$: $\mu_1 = \mu_2$** → there is no difference between real GDP growth rates before and after introducing the EMU (i.e. 1999)

**$H_A$: $\mu_1 \neq \mu_2$** → there is a significant difference between real GDP growth rates before and after introducing the EMU

Testing the above presented hypotheses uses a simple **t Test** under assumptions about equal or unequal variances, and dealing with a small sample. The rule for rejecting $H_0$ is: **P value < 5%**.

$$H_1 : \mu_1 \neq \mu_2 \qquad\qquad t = (-\infty;\ -t_{p,n1+n2-2}) \cup (t_{p,n1+n2-2};\ +\infty)$$
$$H_2 : \mu_1 < \mu_2 \qquad\qquad t = (-\infty,\ -t_{2p,n1+n2-2})$$
$$H_3 : \mu_1 > \mu_2 \qquad\qquad t = (t_{2p,n1+n2-2};\ +\infty)$$

Under the assumptions that are satisfied by the underlying data (see Statistical Appendix for normality of distribution tests), the following statistic:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\dfrac{n_1 S_1^2 + n_2 S_2^2}{n_1 + n_2 - 2}\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}} \tag{1}$$

has a T-student distribution with $n_1 + n_2 - 2$ degrees of freedom.

## Results and Conclusions

The tables that report the results of the distribution test can be found in the Statistical Appendix. The assumptions about normal distribution of average growth rates of GDP *per capita* in both periods in focus are met. Then, the Statistical Appendix reports in detail procedure for testing equality of the mean growth rate before and after the introduction of the euro.

For the accepted probability at 0.05%, the critical value for the t-Test is 1.753, while the t-statistic based on GDP growth rates in the Eurozone was estimated at 0.22. This result shows that the average GDP per capita growth rate before and after introduction of the euro were statistically not different. Such a strong result, due to low nominal value of the estimated t-statistic, calls for further investigation and analysis of factors that could be held responsible.

Economic integration concluded by the common currency in Europe was perceived as a strong stimulus for the real GDP. Such expectations were formulated assuming the effects resulting from reductions in transaction costs. Lowering transactions costs due to the common currency was supposed to be the reason for the whole chain reaction. However, the relationships here are not of a simple one-direction cause-consequence nature. Lower transaction costs motivate economic agents to adjust their activities by specializing more and therefore depending relatively more on exchange with other agents. Changes to efficiency of economic processes responsible for economic growth in this framework depend critically on the scope and scale of resulting specialization [Młodkowski, 2013]. This, in turn, is driven by innovation at the microeconomic level. As argued by Bywaters and Młodkowski [2012], economic growth can be explained by changes to transaction costs and resulting adjustments in agents' decisions about what to produce and exchange with other agents. In spite of this, there were real changes in the level of transaction costs for the EMU members from 1999/2000. They did not really result in suggested 'adjustments' in agents' make versus buying decisions. Specialization at the microeconomic level does not seem to be more advanced since the euro started to serve in intra-EMU transactions.

Monetary union should reduce transactions costs more than would otherwise occur, but because there are many other factors affecting transactions costs, for example developments in transport, EMU might not be the primary driver, and its effects could be overwhelmed by the others, as the results suggests might be the case. Either the reductions in transaction costs that followed were too modest to fuel further specialization or there was no room for such specialization anymore.

Another issue could be timing difficulties. EMU was negotiated in the Maastricht treaty, around 1992, so arguably, the whole sample is to some extent post EMU, or at least, post the commitment to it. Whether it was the common market or any other stage of economic integration in Europe that unlocked growth opportunities through innovation, reduction in transaction costs and specialization may be a subject for further empirical investigations in this area.

Finally, to what extent did the actual implementation of EMU meet the conditions of optimal currency area theory, and potentially be capable of reducing transactions costs? The answer is rather mixed, which is one of the reasons that the UK was so nervous of joining. There are conditions about integration of markets, in particular labor markets, which in the case of EMU were limited by language difficulties, to the extent that in most EU countries, less than

10% of workers have ever come from other EU states. Comparable figures for states in the USA are higher, where the language difficulties are less. Secondly, there is the EU theory and policy of free movement, for example of labor, but massive impediments in practice, not just of language, but of the absence of an EU welfare state, and the increase in risk to migrants arising from 27 very different separate welfare states. An EU old age pension, for example, would help labor integration, quite apart from acting as an automatic fiscal stabilizer in the event of macroeconomic shocks. EU regional policy actually directs funds to countries which are typically losing migrants, funded by additional costs imposed on states which are typically receiving the migrants, and receiving the bills for new hospitals, schools etc. in order to accommodate the migrants. That is politically disastrous, but also shows a complete failure to align implemented detailed policies to EU goals and objectives. This discussion is also relevant to why Greece was removed, as an "outlier". Arguably, it has been a victim of EU policy failure.

As with many other aspects of the EU, the integration is very desirable in theory, but the practice has sometimes left a great deal of scope for improvement, often because of the glaring democratic deficit. Institutionally, doing away with the "Council of Ministers" and the intergovernmental ways of doing things, would be highly desirable, and vesting political control of the EU in a government created from the EU parliament.

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## Summary

This paper deals with economic growth in the Eurozone before and after 1999. The economic integration process led to the finalizing of initiatives that started at the end of the 1950s with the Rome Treaty and Coal&Steel Community. The introduction of the euro in the 1999 affected countries that substituted their national monies for the common currency. A question emerges; whether this last step in economic integration contributed in any manner to changes in the pace of accumulation of national wealth? The literature on growth offers a wide pattern of factors that could be responsible for GDP developments. Some of the most prominent factors were present in the focus group due to the EU's membership and euro introduction. Trying to answer the question about growth effects in the Eurozone, a simple statistical test for mean equality in two populations (with normal distribution) was employed. The weighted average GDP per capita growth rate was tested to examine if it was statistically different in the Eurozone before and after 1999. It turned out that it was not justified at a p=0.05% confidence level to reject the hypothesis that average growth rates were not statistically different. Concluding on this result calls for the following interpretation. Introducing the euro in 1999 did not contribute in a significant manner to changing the average growth rate in the EMU. However, having a common currency in operation may have seemed neutral for economic growth at that time. Referring to the literature allows us to claim that postulated gains to economic growth materialized at earlier stages of integration. The real effects of the euro seem to have a much more subtle nature.

*Keywords:* EMU, economic integration, euro, economic growth, transactions costs.

## Wzrost gospodarczy w strefie euro po 1999 roku

### Streszczenie

Artykuł podejmuje zagadnienie wzrostu gospodarczego w Europie przed i po roku 1999. Procesy integracji gospodarczej doprowadziły bowiem do ukoronowania wysiłków zapoczątkowanych w końcu lat 50. ubiegłego stulecia Traktatem Rzymskim oraz Wspólnotą Węgla i Stali wprowadzeniem wspólnego pieniądza. Zakres badania to grupa krajów, które zastąpiły swoje waluty narodowe przyjmując euro w 1999 roku. Powstaje pytanie, czy ten ostatni krok w integracji gospodarczej

przyczynił się do osiągnięcia istotnych zmian w zakresie tempa akumulacji bogactwa narodowego. Literatura przedmiotu oferuje szeroki zestaw czynników, które mogą być odpowiedzialne za wzrost PKB. Niektóre z czynników podawanych za najistotniejsze były obecne w badanej grupie krajów w związku z faktem członkostwa w Unii Europejskiej. Szukając odpowiedzi na postawione pytanie o efekty w zakresie wzrostu gospodarczego wykorzystano prosty test statystyczny dla wartości średniej w populacjach o rozkładzie normalnym. Sprawdzono, czy średnia ważona stopa wzrostu PKB na mieszkańca w strefie euro była istotnie różna przed i po wprowadzeniu wspólnej waluty. Okazało się, że nie można było odrzucić hipotezy zerowej, głoszącej, że średnie stopy wzrostu PKB (w ujęciu *per capita*) przed i po roku 1999, w grupie objętej badaniem, nie różniły się istotnie od siebie. Oznacza to, że wprowadzenie unii monetarnej nie przyczyniło się do istotnych zmian w zakresie tempa wzrostu gospodarczego strefy euro. Interpretując powyższe wyniki można wskazać na neutralność wspólnego pieniądza. Oprócz tego, odwołania do literatury przedmiotu pozwalają sądzić, że postulowane korzyści w zakresie wzrostu gospodarczego zmaterializowały się już na wcześniejszych etapach integracji. Realne efekty wprowadzenia euro wydają się mieć o wiele bardziej subtelny i długofalowy charater.

*Słowa kluczowe:* EMU, integracja gospodarcza, euro, wzrost gospodarczy, koszty transakcyjne.

JEL: D23, F45, O47.

# Statistical appendix

### GDP *per capita* growth rates

|  | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| Austria | 2.31 | 0.77 | -0.45 | 1.82 | 2.64 | 2.33 | 2.19 | 3.67 |
| Belgium | 1.46 | 1.12 | -1.35 | 2.91 | 2.17 | 1.23 | 3.48 | 1.71 |
| Finland | -6.51 | -4.03 | -1.29 | 3.21 | 3.57 | 3.23 | 5.89 | 4.75 |
| France | 0.57 | 1.04 | -1.08 | 1.83 | 1.64 | 0.67 | 1.78 | 2.95 |
| Germany | 4.35 | 1.14 | -1.65 | 2.12 | 1.38 | 0.50 | 1.59 | 1.85 |
| Ireland | 1.35 | 2.64 | 2.18 | 5.34 | 9.07 | 7.29 | 10.38 | 7.31 |
| Italy | 1.46 | 0.70 | -0.91 | 2.13 | 2.89 | 1.11 | 1.81 | 1.42 |
| Luxembourg | 7.20 | 0.48 | 2.81 | 2.42 | 0.02 | 0.15 | 4.62 | 5.17 |
| Netherlands | 1.63 | 0.94 | 0.55 | 2.34 | 2.61 | 2.93 | 3.74 | 3.28 |
| Portugal | 4.53 | 1.07 | -2.17 | 0.75 | 4.01 | 3.40 | 4.06 | 4.74 |
| Spain | 2.31 | 0.60 | -1.34 | 2.11 | 2.52 | 2.18 | 3.60 | 4.10 |

Source: World Bank database.

|  | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| Austria | 3.3 | 3.42 | 0.47 | 1.19 | 0.38 | 1.96 | 1.71 | 3.16 |
| Belgium | 3.3 | 3.42 | 0.46 | 0.91 | 0.39 | 2.82 | 1.17 | 2.03 |
| Finland | 3.7 | 5.11 | 2.05 | 1.59 | 1.77 | 3.82 | 2.56 | 4.01 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| France | 3 | 2.98 | 1.1 | 0.2 | 0.19 | 1.8 | 1.07 | 1.76 |
| Germany | 1.8 | 2.92 | 1.34 | -0.2 | -0.4 | 1.18 | 0.74 | 3.82 |
| Ireland | 9.5 | 7.79 | 3.14 | 4.1 | 2.48 | 2.61 | 3.07 | 2.83 |
| Italy | 1.4 | 3.61 | 1.8 | 0.13 | -0.8 | 0.73 | 0.19 | 1.62 |
| Luxembourg | 7 | 7 | 1.3 | 3.02 | 0.32 | 2.92 | 3.83 | 3.31 |
| Netherlands | 4 | 3.2 | 1.16 | -0.6 | -0.1 | 1.88 | 1.81 | 3.23 |
| Portugal | 3.6 | 3.37 | 1.31 | 0.03 | -1.6 | 0.97 | 0.32 | 1.11 |
| Spain | 4.2 | 4.17 | 2.48 | 1.23 | 1.4 | 1.6 | 1.93 | 2.33 |

Source: World Bank database.

**Share of each EMU country in total nominal GDP.**

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| Austria | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Belgium | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Finland | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| France | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| Germany | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.32 | 0.32 |
| Italy | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 |
| Luxembourg | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Netherlands | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Portugal | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Spain | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |

Source: Author.

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| Austria | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Belgium | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Finland | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| France | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.23 | 0.22 |
| Germany | 0.32 | 0.32 | 0.32 | 0.31 | 0.31 | 0.31 | 0.30 | 0.31 |
| Italy | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Luxembourg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Netherlands | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Portugal | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Spain | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 |

Source: Author.

**Normality test of distribution of weighted average GDP *per capita* growth rate
in the pre-euro period ["num" – is the value of the numerator in the formula
for Shapiro-Wilk normality test].**

| i | a(1) | X(n-i+1) | Xi | X(n-i+1) - Xi | num |
|---|------|----------|-----|---------------|-----|
| 1 | 0.47 | 0.39 | -0.05 | 0.44 | 0.21 |
| 2 | 0.32 | 0.37 | 0.12 | 0.25 | 0.08 |
| 3 | 0.26 | 0.32 | 0.22 | 0.10 | 0.02 |
| 4 | 0.21 | 0.26 | 0.23 | 0.03 | 0.01 |
| | | | | Sum | 0.321 |
| | | | | Sum squared | 0.103 |
| | | | | Variance | 0.018 |
| | | | | Shapiro-Wilk | 5.697 |

Source: Author.

**Normality test of distributio of weighted average GDP per capita growth rate
in the post-euro period ["num" – is the value of the numerator
in the formula for Shapiro-Wilk normality test].**

| i | a(1) | X(n-i+1) | Xi | X(n-i+1) - Xi | num |
|---|------|----------|-----|---------------|-----|
| 1 | 0.47 | 0.42 | 0.03 | 0.40 | 0.187 |
| 2 | 0.32 | 0.42 | 0.15 | 0.27 | 0.086 |
| 3 | 0.26 | 0.29 | 0.16 | 0.13 | 0.033 |
| 4 | 0.21 | 0.27 | 0.18 | 0.09 | 0.019 |
| | | | | Sum | 0.325 |
| | | | | Sum squared | 0.106 |
| | | | | Variance | 0.013 |
| | | | | Shapiro-Wilk | 8.151 |

Source: Author.