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STATISTICAL MEASURES OF THE OUTPUT GAP DISTRIBUTION AMONG EUROPEAN COUNTRIES IN THE YEARS 2000–2019

Paweł Umiński[1]

Abstract

Background and Objective: The concept of full capacity utilisation is central in macroeconomic theory and economic policy. One of the most employed variables is the output gap, which shows the gap between real and potential production. The aim of the paper is a statistical analysis of the output gap for 27 European countries in the years 2000–2019, and to investigate the distribution of the output gap.

Study Design/Materials and Methods: Annual output gap data (AMECO database) are analysed for 27 European countries during the period 2000–2019 (540 observations). Statistical measures such as mean, median, standard deviation, kurtosis and skewness are used.

Results: A statistical analysis of the whole sample reveals an almost symmetrical distribution of the output gap for the analysed countries and period. Investigation of particular country cases indicates a more complex picture.

Practical implications: Results suggest that the output gap, which is partially the outcome of economic policies conducted by fiscal and monetary authorities, occurs with almost equal frequency below and above full capacity utilisation.

Conclusion and summary: Output gaps in European countries occur with almost equal frequency, but the situation among countries and periods is more complex. Some waves of business cycles when output gaps in most of the analysed countries change simultaneously are also indicated.

Keywords: capacity utilisation, full employment, output gap

JEL classification: E30, E32

Paper type: research paper

[1] Gdańsk University of Technology, Faculty of Management and Economics, pawumins@pg.edu.pl, ORCID: 0000-0001-6612-4362

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1. Introduction

The issue of capacity utilisation is of great importance from the perspectives of both theoretical and economic policy. From the theoretical point of view, the indication that capacity is below full utilisation under given circumstances paves the way for macroeconomics and explains a state's heavy presence in aggregate demand. This was the beginnings of Keynesian economics. Theoretical research is followed by the practice of proper policy. First of all, indicators of capacity utilisation are needed. First and foremost is the unemployment rate, but under some circumstances, something more comprehensive is required. If counter-cyclical fiscal policy is the aim, a deeper investigation is necessary into the causes and it needs to be known earlier if the hysteresis effect is to be avoided (Blanchard & Summers, 1986). From the practical point of view, the issue of the frequency of periods in which the economy operates under full capacity utilisation is of huge importance. The answer points out the importance of counter-cyclical fiscal policy. From the other point of view, is counter-cyclical fiscal policy needed more frequently, or only occasionally in extreme cases?

The output gap can be analysed as a guideline in fiscal policy decision-making. In this case, real-time data on the output gap are needed because the counter-cyclical policy must be undertaken at the early stage of changes in the business cycle. On the other hand, the data are biased by huge uncertainty, and the scale of their revisions is unfortunately large (Orphanides & Norden, 2002; Kangur et al., 2019). The economy and the output gap can also be analysed using revised data, when the final outcome of the array of variables, including discretionary fiscal policy, is finally estimated. An analysis of the data allows for a measure of the capacity utilisation after economic policy implementation. In this case, it can be useful to measure the final outcome of the policy – does it lead to the most desirable point of full capacity utilisation, or does the economy operate below or above the point? In other words, how often do economies operate below full capacity utilisation, considering the revised output gap?

From the perspectives of economic policy and especially fiscal policy, the distribution of the output gap is a fundamental issue, and there is a lack of such statistical analyses in the literature. The article fills this gap and provides some statistical measures on the output gap in European countries.

To answer the questions above, the article is organised as follows: in the next section, measures of capacity utilisation in the economy are discussed; then, the means of measuring the capacity utilisation will be presented. After that, the distribution of the measures of capacity utilisation among a group of countries will be shown and compared by use of some statistical measures. The paper ends with conclusions and an indication of the next step in research.

2. Literature Review

Considering full capacity utilisation requires digging deeper into the notion and the method of its calculation. As a pivotal notion of contemporary macroeconomics and economic policy, full capacity utilisation is an unobservable phenomenon, thus it requires theory behind it and a measure that will attempt to reflect the idea in numbers.

The roots of full capacity utilisation might be identified in the Keynesian tradition of full employment (Keynes, 1936). A few aspects of full employment can be identified, each one embedded in a different research area (Lichtenberger et al., 2024). Three of these areas are of less interest from the perspective of this paper, i.e. labour economics perspective, socioeconomics perspective and political economy perspective. The remaining perspective, macroeconomics, is a central focus of the subject undertaken in the paper. For Keynes, the issue of full employment was unemployment as the effect of the economy's cyclicality, so the other types of unemployment – structural and frictional, were not taken into consideration because they are possible in the case of full employment in the economy. Identifying full employment as a situation where there is the absence of involuntary unemployment is a theoretical approach and additional work remains on a precise definition of it and numerical measures.

There are at least a few approaches in macroeconomics involving defining and estimating the level of unemployment, representing full employment (Lichtenberger et al., 2024). The first one is the price approach, because the equilibrium between the unemployment rate and stable inflation is central for the approach. Linkage between the unemployment rate and inflation rate in the short-run is of huge importance in the economy, and since the Keynesian revolution, economists have tried to estimate the nonaccelerating inflation rate of unemployment (NAIRU) (Ball & Mankiw, 2002). Economists assume that there must be some level of unemployment consistent with stable inflation, so the NAIRU is often regarded as equal to the natural rate of unemployment. In this sense, full capacity utilisation is the level of production which engages such a number of employees that the rate of inflation does not accelerate. The main problem with NAIRU lies in its volatility. There are at least a few reasons which induce this, i.e. demographic issues, government policy, changes in productivity growth, and many others (Estrella & Mishkin, 1999; Gordon, 2013).

Another approach to determining the level of unemployment that can be considered as full employment is by use of the minimum unemployment and maximum employment approaches. Seemingly, the rate is easier to determine since the unemployment rate is observable – the minimum of unemployment and maximum of employment are recognisable and a researcher avoids advanced modelling. Difficulties begin when the exact amount of the measure must be determined – how long should the period taken into consideration be, which measure of unemployment should be analysed (total unemployment rate, long duration unemployment or some other var-

iants of it), and what about changes due to changes in socio-economic characteristics (Mason et al., 2021).

Another measure of the utilisation of the labour force has been proposed by Beveridge and is known as the Beveridge curve (Bouvet, 2012; Beveridge, 2014). It shows the relationship between unemployment and job vacancies, because Beveridge defined full employment as a situation where there are more vacant jobs than unemployed men, and pointed out a numerical benchmark as the full employment rate. He stated that the number of unemployed individuals should not surpass 3% of the total number of employees. Unfortunately for the approach, there are some concerns raised, especially regarding the data quality in job vacancy statistics (Elsby et al., 2015).

One more measure used to assess the position in the business cycle is the output gap. The output gap is regarded as a deviation of output from its potential, informing fiscal and monetary authorities about the fiscal stance that should be undertaken (Kangur et al., 2019). The output gap is a measure which requires the estimation of potential production. It takes into account not only the issue of employment, but it also encompasses the other factor of production – capital. Thus, aside from the labour market circumstances, it should reflect the utilisation of the available capital. From the beginning, the measure raised controversy. This started in the middle of the 20th century in Cambridge when Joan Robinson questioned the concept of aggregated capital and the possibility of measuring it (Stiglitz, 1974; Pressman, 2005; Hagemann, 2020). Neoclassical economists respond that the notion and the way of its calculation are not perfect, but still give valuable insight (Samuelson, 1966). Even beyond the Cambridge capital controversy, the usage of the aggregated production function and potential production is still controversial. It can be summarised that the potential output and thus the output gap are unobservable variables and require a complex method of estimation (Navarini & Zoppé, 2020), and are subject to significant revisions (Deutsche Bundesbank, 2014). The potential output and output gap are widely deployed variables which are seen as highly instructive in performing economic policy (Barkema et al., 2008). They also play an important role in assessing the fiscal stance of EU countries, so the potential output and the output gap have to be estimated (EU Independent Fiscal Institutions, 2020).

There are some definitions and methods of estimation (Kiley, 2021). The measure used in the research is estimated according to the European Union's commonly agreed methodology (Havik et al., 2014; Blondeau, 2021).

3. Methodology and results

Annual output gap data are analysed from the AMECO database for 27 European countries (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg,

Latvia, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom) during the period 2000–2019, resulting in 540 observations (20 for each country). The output gap is presented as a % of GDP. The choice of the span of the period is governed by two aspects. First, the years before 2000 are dismissed due to data availability, and after 2019 to avoid a huge external shock, such as COVID-19, and its ambiguous impact on the output gap measurement (Barkema et al., 2020).

An analysis of the statistical measures of the data reveals almost the same number of observations with a negative (49.1%) and positive (50.9%) output gap. This means that, on average, in European countries in the years 2000–2019, years with a negative output gap were as frequent as years with a positive one. Comparison of the mean and median values confirms the conclusion. The distribution is highly concentrated around the mean value, although the standard deviation is 3.54 and there are some extreme values, especially on the left side of the distribution (kurtosis is relatively high). On the one hand, it is not surprising that the values of output gaps are concentrated around zero, but on the other hand, some values are relatively distant from zero, indicating extremely overheated or below full capacity utilisation years.

Table 1. Statistical characteristics of the data

Measure	Result	Measure	Result
number of observations	540	standard deviation	3.54
number of observations with a negative output gap (≤0)	265 (49.1%)	median	0.04
number of observations with a positive output gap >0	275 (50.9%)	median of negative values	–1.79
mean	–0.28	median of positive values	1.68
mean of negative values	–2.77	kurtosis	4.73
mean of positive values	2.12	skewness	–1.19

Source: own study.

Figure 1 presents the distribution of the data. It indicates that the most frequent group of observations are those from the range $0<x\leq1$ (88 obs.). As the value of skewness (–1.19) indicates, the distribution is slightly skewed left, a fatter left tail means more extreme negative values than positive. The next figure and table show that Greece and the sovereign debt crisis are responsible for the highest negative values of the output gap.

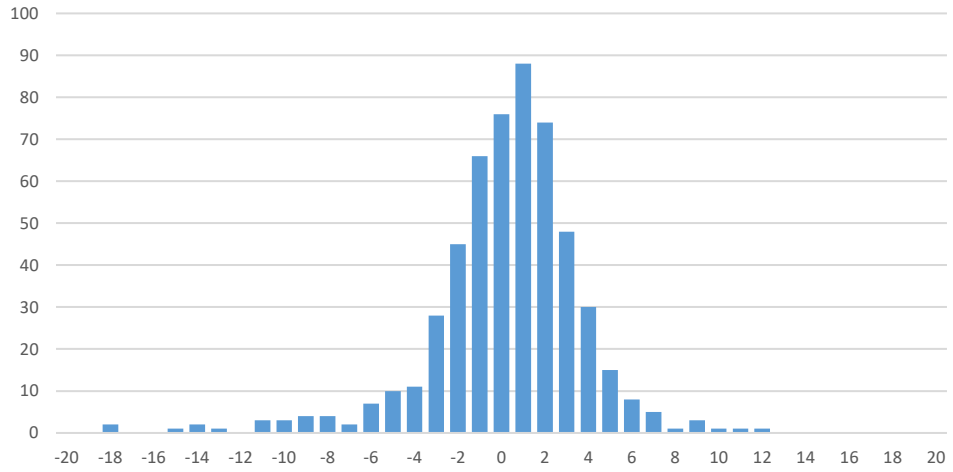

Figure 1. Histogram of the output gap in European countries 2000–2019
Source: own study.

Figure 2 helps analyse the situation in a particular country. Countries on the plot are ordered from the highest median value of the output gap. It is evident that the situation among European countries is highly diverse. There are cases such as Belgium, Sweden or Austria, where the output gap is quite stable, the range of the variable values is narrow, and the mean and median are close to zero. On the other hand, there is a group of countries (Spain, Lithuania and Greece) with relatively wide boxes, indicating deep slowdowns and high booms instead of the stable performance of the economy. The example of Greece is peculiar because almost all values of the output gap for that country are negative. The situation embedded in the data can be traced using Table 2.

Table 2 allows for investigating the situation amongst countries, in a particular year and in a graphical scope. The literature is rich concerning the synchronisation of the economic outcome among European countries, especially those establishing a monetary union (Ahlborn and Wortmann, 2018; Saulius Jokubaitis and Dmitrij Celov, 2023; Arcabic et al., 2022). Research indicates different degrees of business cycle synchronisation in different groups of countries, thus core and periphery patterns can be distinguished. There is a consensus about the core group of countries, and it contains Germany, France, Austria and Italy, with some doubts about the last country (Caporale et al., 2014). Inside the groups, we can indicate similarities in amplitude and signs of the business cycle, but the elements of the group are not obvious.

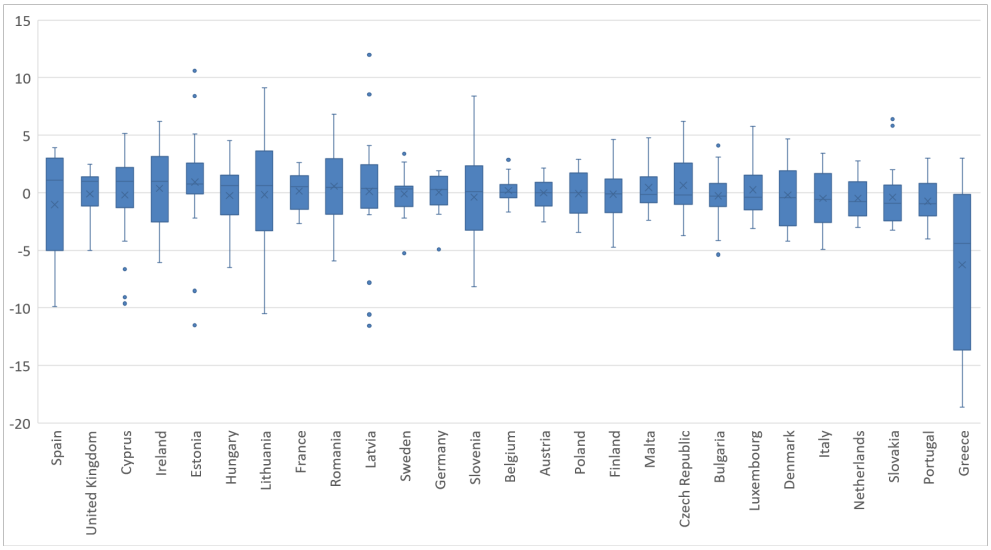

Figure 2. Box plots of the output gap for European countries 2000–2019
Source: own study.

Table 2. Negative (red) and positive (blue) output gaps

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Spain	3.3	3.9	3.6	3.0	2.7	2.7	3.3	3.0	0.8	-4.1	-5.3	-6.5	-9.0	-9.9	-8.4	-4.9	-2.5	-0.3	1.3	2.3
UK	2.5	2.0	0.9	1.3	1.2	1.4	1.5	2.1	0.3	-5.0	-3.8	-3.7	-3.2	-2.5	-0.7	-0.1	0.1	1.1	1.2	1.6
Cyprus	1.5	1.7	1.5	0.5	1.9	3.2	4.0	5.1	4.8	0.1	0.1	-0.9	-4.2	-9.1	-9.6	-6.6	-2.5	-0.3	1.8	3.2
Ireland	6.2	4.1	3.2	0.4	1.6	2.0	2.3	4.1	-1.6	-6.1	-3.5	-1.5	-2.8	-2.5	3.1	5.4	1.7	0.0	-3.0	-5.8
Estonia	-0.1	0.1	1.0	2.0	2.3	5.1	8.4	10.6	2.5	-11.2	-8.5	-2.2	-0.1	-0.2	0.5	-0.1	0.5	2.8	2.7	2.5
Hungary	0.3	0.5	1.0	0.8	1.4	1.9	2.8	0.9	0.5	-6.9	-5.5	-3.8	-5.1	-3.9	-1.3	0.3	0.8	1.9	3.7	4.5
Lithuania	-4.7	-3.8	-3.1	1.1	2.0	4.0	5.2	9.1	6.1	-10.3	-10.2	-5.5	-2.9	-1.2	0.1	0.4	0.8	2.4	3.6	3.7
France	2.0	1.9	1.1	0.2	1.1	1.1	1.9	2.6	1.3	-2.7	-1.9	-0.7	-1.5	-1.8	-1.7	-1.4	-1.2	0.0	0.8	1.9
Romania	-2.2	0.4	2.8	0.9	5.0	3.6	4.9	4.7	6.8	-1.5	-5.9	-2.6	-1.8	-2.6	-0.8	-1.0	-2.0	0.5	1.4	0.9
Latvia	-1.7	-1.9	-1.1	0.0	0.8	3.9	8.5	12.0	4.1	-10.6	-11.6	-7.8	-1.3	-0.4	-0.1	1.1	1.4	2.1	3.5	1.5
Sweden	1.9	0.3	-0.3	-1.1	0.3	0.6	2.7	3.4	0.4	-5.3	-1.5	0.0	-1.8	-2.2	-1.7	0.5	0.7	0.3	0.0	0.4
Germany	1.8	1.8	0.2	-1.5	-1.5	-1.9	0.5	1.9	1.5	-4.9	-1.5	1.3	0.2	-0.9	-0.4	-0.4	0.3	1.6	1.4	1.3
Slovenia	0.5	0.0	0.2	0.2	1.5	2.3	4.8	8.4	7.9	-2.6	-2.9	-3.1	-6.6	-8.2	-6.7	-5.5	-3.6	0.0	2.3	3.3
Belgium	2.1	0.7	0.1	-1.0	0.4	0.6	1.2	2.9	1.5	-1.7	-0.4	0.0	-0.8	-1.3	-0.5	-0.2	-0.4	-0.2	0.2	0.9
Austria	1.8	0.7	-0.1	-1.1	-0.9	-0.9	0.3	2.2	2.1	-2.5	-1.5	0.4	0.1	-1.1	-1.4	-1.3	-0.6	0.3	1.5	2.0
Poland	1.7	-1.4	-3.2	-3.5	-2.0	-1.7	0.5	2.9	2.7	1.5	1.0	1.8	-0.2	-2.5	-2.1	-1.2	-1.4	0.2	2.3	2.8
Finland	3.2	1.6	-0.1	-1.3	-0.2	-0.1	1.6	4.6	3.9	-4.7	-2.0	0.0	-1.6	-2.6	-3.2	-3.0	-1.4	0.8	0.8	1.0
Malta	3.1	-1.1	-0.3	0.8	-1.0	-0.8	-0.8	1.1	2.2	-2.4	0.0	-2.1	-2.2	-0.8	1.0	2.6	-0.5	4.8	4.3	0.9
Czech Rep.	-0.4	0.3	-0.5	-0.3	0.7	2.7	5.0	6.2	5.1	-2.1	-1.3	-0.9	-2.7	-3.7	-3.0	-0.5	-0.2	2.3	2.5	3.4
Bulgaria	-5.4	-4.1	-1.4	-0.3	0.2	1.0	2.0	3.1	4.1	-1.6	-0.6	0.6	0.8	-0.6	-1.7	-1.1	-0.6	-0.3	-0.2	1.1
Luxembourg	5.0	3.1	2.0	0.5	0.5	-0.9	1.3	5.7	2.2	-3.1	-1.1	-2.1	-2.7	-1.7	-1.5	-1.5	0.9	-0.2	-0.7	-0.6
Denmark	3.3	2.3	1.1	0.3	1.7	2.7	4.7	3.9	1.8	-4.2	-3.4	-2.9	-3.6	-3.1	-2.9	-2.4	-1.3	-0.3	-0.6	-0.9
Italy	1.8	2.5	1.6	0.8	1.2	1.5	2.7	3.4	2.1	-3.1	-1.6	-1.3	-3.7	-4.9	-4.5	-3.7	-2.4	-1.1	-0.6	-0.6
Netherlands	2.8	2.0	-0.2	-2.2	-2.0	-1.6	0.1	1.9	2.3	-2.6	-2.0	-1.0	-2.5	-3.0	-2.1	-1.5	-0.5	0.5	0.9	1.1
Slovakia	-2.3	-3.2	-2.9	-2.4	-1.2	-0.5	2.0	6.4	5.8	-2.9	0.3	-1.1	-2.0	-3.2	-2.6	-0.5	-0.7	0.2	1.7	1.6
Portugal	2.0	1.1	-0.1	-2.3	-1.8	-1.8	-1.0	0.8	0.6	-2.3	-0.4	-1.5	-4.0	-4.0	-3.1	-2.0	-0.9	0.8	2.1	3.0
Greece	-0.3	-0.3	-0.2	0.2	1.0	-0.9	2.1	3.0	1.6	-2.7	-7.1	-14.2	-18.6	-18.3	-16.0	-14.9	-13.3	-11.4	-8.5	-6.1

Source: own study.

Guerini et al. (2019) indicate that synchronisation of the business cycle among Euro Area countries was increasing before the global financial crisis and reached a peak during the crisis. The following period saw also a common sovereign debt crisis, but synchronisation of the business cycle among eurozone countries declined. Table 2 allows changes to be confirmed in the degree of synchronisation in sub-periods of the research. Two major common periods can be distinguished for

all European countries in the business cycle. First is the boost period in the years 2006–2008 preceding the global financial crisis. Second, it is evident that between 2009 and 2016, most of the European countries were touched by the global financial crisis and by the sovereign debt crisis in the aftermath. However, during the period, some discrepancies can be seen among countries. Greece and Spain are examples of a severe and prolonged negative output gap, even in relation to other eurozone countries. The table shows that business cycles in European countries might be highly synchronised, but to some extent, they are heterogeneous.

4. Conclusions

The output gap is an instructive measure important for the assessment of the business cycle position. Contrary to measures relying on labour market variables, the output gap takes into consideration the other production factor – capital. In regard to controversy about the estimation of the capital amount, the potential output and output gap are the basis of policy decisions on the stance of fiscal and monetary policy. The aim of the paper was to assess the distribution of output gaps among European countries, whether it is symmetrical or whether one position dominates.

For the whole sample of countries and the analysed period, it can be concluded that there is almost exact equality in the frequency of the number of years of negative and positive output gaps. It means that in the whole sample, almost the same number of periods occur when the economy was understimulated, with room for additional aggregate demand, and overstimulated, where a slowdown in aggregate demand is desired. The whole sample suggests that the scale of the output gap is also almost equal on the two sides of the potential output point. Analysing cases of particular countries and years indicates a more complex picture. Some economies perform mostly on one side of the potential output point (negative or positive output gap), and this is highly correlated with the crisis waves in other countries.

An analysis of the data among countries and the whole period confirms some findings from other research. First, two periods can be determined of relatively high synchronised business cycles among European countries – years before the global financial crisis, when business cycle synchronisation was increasing, and years during the crisis, when synchronisation reached its peak. After the period, the situation among countries was becoming more heterogeneous. Second, there are two or three groups of countries in which business cycles seem to be simultaneous – the core group (Germany, France, Austria and to some extent Italy), the peripheral group (other countries from the eurozone), and other countries from the European Union.

Some other interesting conclusions stem from an analysis of the statistics of particular countries. The scope of changes and the median of the output gap among core countries (excluding Italy) are similar. It means that those countries deal with business cycles with similar effects – they perform quite close to full capacity utili-

sation, even in periods of performing below or above the point where the output gap does not equal zero. On the other hand, inside the group of eurozone countries, there is a group that exhibits remote performance, where the output gap is extremely high or low. It indicates that the situation even among eurozone countries can be highly diverse.

The research can be developed by comparing data with a higher frequency (quarterly), and over a longer period, which includes the COVID-19 crisis and the following years. The most interesting questions are: whether the frequency of the data changes the conclusion of the research, and whether the post-COVID-19-year period characterises the same heterogeneity of output gap outcome among European countries as after the global financial crisis that took place.

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