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The Output Gap in Cyprus and EU-28

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Alexandros Polycarpou*

Abstract

Output gap estimates are used in the calculation of structural fiscal balance indicators that are subsequently employed for the surveillance of economic growth and stability. The European Commission has adopted the production function approach for the estimation of output gap in the EU member states. This paper reviews the estimates and forecast for the output gap over the period 1998 to 2017 for Cyprus, which is obtained using the EU methodology, and compare them with the ones for EU-28. It also examines the sensitivity of the output gap estimates to the assumptions made by the EU for the wage share and for the construction of the capacity utilisation business survey (CUBS) indicator.

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Περίληψη

Το παραγωγικό χάσμα, που ορίζεται σαν η διαφορά μεταξύ πραγματικής και δυνητικής παραγωγής σε μια οικονομία, χρησιμοποιείται στον υπολογισμό δεικτών δημοσιονομικού ισοζυγίου βάση των οποίων αξιολογείται η οικονομική ανάπτυξη και σταθερότητα μιας χώρας. Επίσης, οι εκτιμήσεις του παραγωγικού χάσματος μπορούν να χρησιμοποιηθούν σαν δείκτης για τη θέση της οικονομίας στον οικονομικό κύκλο και συνεπώς, οι πληθωριστικές πιέσεις μπορεί να προληφθούν με τη χρήση αντικυκλικών μακροοικονομικών πολιτικών. Επιπρόσθετα οι εκτιμήσεις του δυνητικού προϊόντος βοηθούν στον καθορισμό των συνολικών παραγωγικών δυνατοτήτων της οικονομίας και των ευκαιριών για οικονομική ανάπτυξη χωρίς πληθωριστικές πιέσεις.

Η Ευρωπαϊκή Επιτροπή έχει υιοθετήσει την μέθοδο συνάρτησης παραγωγής και συγκεκριμένα την χρήση της Cobb-Douglas συνάντησης με σταθερές αποδόσεις κλίμακας, για την εκτίμηση του παραγωγικού χάσματος στις χώρες μέλη της. Σε αυτό το πλαίσιο, το τελικό προϊόν εξαρτάται από τον συντελεστή ολικής παραγωγικότητας της οικονομίας που μετράει τον βαθμό χρησιμοποίησης και αποδοτικής χρήσης των συντελεστών παραγωγής. Το δυνητικό προϊόν της οικονομίας επιτυγχάνεται όταν όλοι οι συντελεστές παραγωγής είναι στο δυνητικό τους επίπεδο και χρησιμοποιούνται αποτελεσματικά.

Σε αυτή την μελέτη αναλύονται οι εκτιμήσεις της Ευρωπαϊκής Επιτροπής για το παραγωγικό χάσμα στην Κύπρο και τις υπόλοιπες χώρες μέλη της ΕΕ-28. Επίσης μελετάται η ευαισθησία των εκτιμήσεων για το παραγωγικό χάσμα στην Κύπρο ως προς: (i) την υπόθεση ότι το μερίδιο αμοιβής της εργασίας στο συνολικό προϊόν στη Κύπρο είναι ίσο με το μέσο μερίδιο αμοιβής της εργασίας στις χώρες της ΕΕ-28, και (ii) ο δείκτης χρήσης παραγωγικής ικανότητας (capacity utilisation business survey indicator (CUBS)) της οικονομίας βασίζεται κυρίως στην χρήση της παραγωγικής ικανότητας στην βιομηχανία.

- Στην Κύπρο, το παραγωγικό χάσμα ήταν θετικό (δηλ. η πραγματική είναι μεγαλύτερη από την δυνητική παραγωγή της οικονομίας) κατά την περίοδο 2000 με 2011, και έφτασε μέχρι το 5.5 τοις εκατό το 2007 και 2008. Μετά το 2008 το παραγωγικό χάσμα άρχισε να μειώνεται και το 2011 έγινε αρνητικό. Το 2013 και 2014, μετά δηλαδή το κλείσιμο της Λαϊκής Τράπεζας και το κούρεμα των καταθέσεων της Τράπεζας Κύπρου, το παραγωγικό χάσμα έφτασε την αρνητική τιμή του -6.5 τοις εκατό. Το αρνητικό παραγωγικό χάσμα αναμένεται να αρχίσει να μειώνεται μετά το 2015 και μέχρι το 2017 να γίνει θετικό.
- Στην ΕΕ-28 το παραγωγικό χάσμα μεταξύ του 2001 και 2008 ήταν θετικό με ψηλότερη τιμή το 2.7 τοις εκατό το 2007. Το 2008 το παραγωγικό χάσμα μειώθηκε στο 1.6 τοις εκατό και μετά μειώθηκε δραματικά στο -3.5 τοις εκατό το 2008. Τα επόμενα χρόνια, το παραγωγικό χάσμα παρέμεινε αρνητικό αλλά σχετικά σταθερό μεταξύ -3 και -2 της εκατό. Το παραγωγικό χάσμα αναμένεται να μειωθεί στο -1.3 τοις εκατό το 2015 και στο -0.8 και -0.2 τοις εκατό το 2016 και 2017 αντίστοιχα.
- Στην Κύπρο ο ρυθμός ανάπτυξης του δυνητικού προϊόντος κατά την περίοδο 2009 με 2014 ακολούθησε αρνητική πορεία, από 2.2 τοις εκατό το 2009 σε -2.6 τοις εκατό το 2014. Ο αρνητικός ρυθμός ανάπτυξης του δυνητικού προϊόντος αναμένεται να συνεχιστεί και την περίοδο 2015 με 2017 αλλά με φθίνοντα ρυθμό. Συγκεκριμένα, το δυνητικό προϊόν αναμένεται να μεταβληθεί κατά -1.3 τοις εκατό το 2015, κατά -0.6 τοις εκατό το 2016 και κατά -0.3 τοις εκατό το 2017.

Για να αξιολογήσουμε την ευαισθησία των εκτιμήσεων του παραγωγικού χάσματος για την Κύπρο στις υποθέσεις της ΕΕ, πρώτα εξετάσαμε πως αλλάζουν οι εκτιμήσεις όταν χρησιμοποιηθεί το μερίδιο αμοιβής της εργασίας στο συνολικό προϊόν στην Κύπρο (0.60)

αντί του μέσου όρου της ΕΕ (0.65). Τα αποτελέσματα που προέκυψαν δείχνουν ότι η διαφορά στο παραγωγικό χάσμα που εκτιμάται με τα δυο μερίδια αμοιβής της εργασίας είναι ανεπαίσθητη. Επίσης, πολύ μικρή για να έχει πρακτικές συνέπειες είναι η διαφορά

μεταξύ των εκτιμήσεων που λαμβάνονται όταν ο δείκτης χρήσης παραγωγικής ικανότητας που βασίζεται κυρίως στον δείκτη της βιομηχανίας, και χρησιμοποιείτε από την ΕΕ, αντικατασταθεί με τον δείκτη που υπολογίστηκε ειδικά για την Κύπρο και βασίζεται κυρίως στην χρήση της παραγωγικής ικανότητας στις υπηρεσίες.

Μελλοντική έρευνα περιλαμβάνει την περαιτέρω μελέτη της ευαισθησίας των εκτιμήσεων του παραγωγικού χάσματος στις υποθέσεις που γίνονται για την εφαρμογή εναλλακτικών μεθόδων υπολογισμού του. Επίσης θα χρησιμοποιηθούν τεχνικές προβλέψεων ώστε να εκτιμηθεί η βραχυχρόνια (τρία με πέντε χρόνια) εξέλιξη του πραγματικού προϊόντος, του δυνητικού προϊόντος και του παραγωγικού χάσματος στην Κύπρο.

1. Introduction

The output gap is the deviation of the actual from the potential output. In the short run, the potential output is defined as the level of output that can be produced without inducing supply constraints and inflationary pressures. The long run potential output is linked to the future evolution of technical progress and to the likely growth rate of potential labour and physical capital.

In general, potential output gives an indication of the aggregate supply capacity of the economy and the possibilities of non-inflationary growth. Thus, the level of potential output - and of the associated output gap - plays an important role in the design of macroeconomic policy. When the economy is producing below its potential level, then fewer jobs are available and less tax revenue is received. In addition, the output gap can be used for explaining price and wage inflation.

Potential output is unobserved and the variety of methods proposed for its estimation often give different results. Estimates that rely on statistical filters were very popular in the past mainly due to their simplicity. Statistical filters, however, are not based on economic theory; thus, it is generally not possible to give structural interpretation to their results and guidance for economic policy. Nowadays, multivariate statistical filters that combine economic variables with non-structural measures of business cycle and/or structural theory based methods are used.¹¹

Policy making institutions like the OECD and the EU have an officially adopted method for the estimation of output gap that combines a flexible production function methodology with other economic relations for estimating variables like employment and potential capital; and univariate filters for calculating trend variables like labour market participation, hours worked and total factor productivity (TFP). On the other hand, some institutions (e.g. ECB and IMF) do not have an official method for computing potential output and, depending on the country under study, they may use the production function or some other structural approach; or a non-structural statistical method like the Hodrick-Prescott (HP) filter.

Output gap estimates, together with other output elasticity indicators, are used in the calculation of structural fiscal balance indicators that, in turn, are used for the surveillance of the economic growth and stability of the country. Also the output gap estimates can be used as an indicator for the position of the economy in the business cycle so that inflationary pressures can be prevented using counter-cyclical macroeconomic policies. For example, estimates of the output gap are employed by the EU for the surveillance of its member states.

In this paper we first briefly describe the production function methodology used by the European Commission (EC) and present the estimates and forecasts for the output gap and the growth rates of actual and potential output for the period 1998 to 2017 for Cyprus and compare them with the ones for the EU-28 member states.²² We then assess the sensitivity of the output gap estimates for Cyprus to the assumptions made by the EC about the wage share and the construction of the capacity utilisation business survey (CUBS) indicator, which is used in the estimation of the potential level of TFP.

¹ Reviews on methods to estimate potential output and output gaps include Dupasquier et al. (1999), Giorno et al. (1995), Cotis et al. (2004), Mc Morrow and Roeger (2001) and Polycarpou (2015).

² The 28 member states of EU (EU-28) are: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

The paper is structured as follows. Section 2 gives a brief description of the methodology used by the EC for estimating the output gap in its member states. Section 3 presents the evolution of the output gap from 1998 to 2014 and its forecast for 2015, 2016 and 2017 for Cyprus, and compare it with the one for EU-28. Also the actual output and potential output growth rates for Cyprus and EU-28 are presented and discussed. Section 4 investigates the sensitivity of the output gap estimates to the assumptions made by EC for the wage share and the construction of the CUBS indicator. Section 5 summarises and concludes the paper.

2. The EU methodology for estimating the output gap

In 2002 the European Policy Committee of the EU decided to adopt an economic and, in particular, the production function approach for estimating the potential output and output gap for the surveillance of the EU member states.

This decision was based on the requirement for the operational surveillance tools to adhere to the following principles:

- relatively simple and fully transparent methods should be used, where the key inputs and outputs are clearly defined;
- equal treatment for all of the EU's member states should be assured; and
- false optimism or unjustified pessimism should be avoided so as to promote unbiased estimates of the past and future evolution of potential growth.

The production function approach is deemed to satisfy the above requirements. In addition, as an economic based methodology, it allows creating a meaningful link between policy reform measures and actual output. It also highlights the close relation between potential output and the Non-Accelerating Wage Rate of Unemployment (NAWRU) concept, through its requirement to estimate the “normal” or equilibrium rate of unemployment. In addition, the production function methodology gives the opportunity of making forecasts or building scenarios of possible future prospects by making explicit assumptions about the future evolution of demographic, institutional and technological trends (Havik et al., 2014).

2.1. Cobb-Douglas production function

In most empirical applications, including the EU ones, the Cobb-Douglas specification is used because it greatly simplifies estimation and exposition.³³The main assumptions of the Cobb-Douglas specification are constant returns to scale and factor price elasticity equal to one. These assumptions are made for simplicity, and are supported by empirical findings (Douglas, 1976).

³ The production function methodology requires production technology, returns of scale, technological process and representative utilisation of the production factors to be specified. According to the Cobb-Douglas specification, output (Y) is produced using labour (L) and capital (K) based on the production technology described by the functional form

$$Y = (U_L L E_L)^a (U_K K E_K)^{1-a} = (TFP) L^a K^{1-a},$$

where U_L and U_K are the degree of excess utilisation of labour and capital, respectively; E_L and E_K the level of efficiency of labour and capital, respectively; and TFP the total factor productivity which is given by

$$TFP = (E_L^a E_K^{1-a}) (U_L^a U_K^{1-a}),$$

and depends on the degree of utilisation and the level of efficiency of the factors of production; a and $(1 - a)$ are the output elasticity of labour and capital, respectively.

The potential level of output is given by $Y^* = (TFP^*) L^{*a} K^{*1-a}$, where K^* is the potential level of capital, L^* the potential level of labour and TFP^* the potential level of total factor productivity.

The potential output is obtained when all factors of production are at their potential level and are fully and efficiently utilised. The potential level of capital is defined as the maximum output contribution of capital obtained by the full utilisation of the existing capital stock in the economy. Thus, the potential level of capital can be defined as the existing capital stock of the economy.

The potential level of TFP is given when factor inputs are fully utilised at the normal (trend) level of efficiency. The latter is measured using a bivariate Kalman Filter model, which exploits the link between the TFP cycle and the degree of capacity utilisation in the economy. In particular, it is measured as a Kalman filtered Solow residual, i.e. by subtracting the contribution of labour and capital inputs from total output.

The potential level of labour is defined as the maximum potential output contribution of labour and is determined in terms of hours.⁴⁴The NAWRU indicator is based on the Neo-Keynesian Philips (NKP) curve, and the idea is that actual unemployment below equilibrium unemployment is associated with wage inflation above its expected value. In the NKP curve rational expectations are assumed, as opposed to adaptive expectations assumed by the Traditional Keynesian Philips curve (TKP). In empirical applications a hybrid NKP, which allows for a combination of backward and forward looking behaviour, is allowed.^{5,6}⁵⁶

The variables for the working age population, smoothed participation rate, NAWRU, trend average hours worked, investment to potential output ratio and Kalman filtered Solow Residual are exogenous; whereas the potential labour input, investment, capital stock and potential output are endogenous.

3. The output gap in Cyprus and EU-28

The EU reports estimates on the output gap for the member states three times a year: winter, spring and autumn. Table A1 and A2 in the Appendix show the output gap estimates (for Cyprus and EU-28, respectively) - along with other information used in the output gap calculation, based on the latest (Spring 2016) EC report.

Figure 1 shows the evolution of the output gap from 1998 (2001 for EU-28) to 2014, and the forecast for the years 2015, 2016 and 2017 for Cyprus (solid line) and EU-28 (dashed line).

- Cyprus had a negative output gap, i.e. the actual output of the economy was lower than its potential level, during 1998, 1999 and in the period after 2011.
- In the period 2000 to 2011 the output gap was positive and hit its top level in 2007 and 2008, when the actual output of the economy was 5.3 and 5.5 percent higher than its potential level.

⁴ The potential labour is approximated by $L_t^* = popw * parts * (1 - u_t^*) * hourst_t$, where: *popw* is the working age population, *parts* the smoothed participation rate and u_t^* the NAWRU; and *hourst* the trend average hours worked.

⁵ Assuming that the unemployment gap follows an AR(2) process then the hybrid NKP curve used by the EU is given by $\Delta ruc_t = \delta \Delta ruc_{t-1} - \beta_1(u_t - u_t^*) + \beta_2(u_{t-1} - u_{t-1}^*)$, where Δruc_t is the growth rate of real unit labour cost (wage) at period *t*, u_t the unemployment rate at period *t*, u_t^* the NAWRU level of unemployment; $\beta_1 < 0$, $\beta_2 > 0$, and δ are parameters.

⁶ In summary the model can be described as follows:

- the potential labour input is given by $L_t^* = popw_t * parts_t * (1 - u_t^*) * hourst_t$,
- the potential capital input by: $K_t = I_t + (1 - \delta)K_{t-1}$ where $I_t = IYPOT * Y_t^*$,
- the potential output by: $Y_t^* = L_t^{*0.65} K_t^{0.35} SRK$, and
- the output gap is given by: $Y_t^{gap} = (Y_t / Y_t^* - 1)$.

- The output gap declined sharply to 1.1 percent in 2009, and to 0.7 percent in 2010. In the period 2011 to 2014 the output gap followed an increasingly negative path; the actual output was 6.5 percent in 2013 and 6.4 percent in 2014 below its potential level.
- The negative output gap is expected to decrease to -3.6 percent in 2015 and to -1.4 percent in 2016; whereas in 2017 is expected to become positive at 0.9 percent.

FIGURE 1: The output gap in Cyprus and EU-28



The evolution of output gap through time in EU-28 follows a smoother path compared to Cyprus. For the period 2001-2008 the output gap was positive⁷⁷ and reach a top level of 2.7 percent in 2007. In 2008 it declined to 1.6 percent and then dropped sharply to -3.5 percent in 2009. In the following years, the output gap remained negative but relatively stable between -3 and -2 percent. For the period 2015 to 2017 the negative output gap is expected to decline to -1.3 percent in 2015 and, subsequently, to -0.8 and -0.2 percent in 2016 and 2017, respectively.

A change in the output gap can be the result of a change in actual output, in potential output or in both. Figures 2 and 3 show, respectively, the actual output growth and potential output growth in Cyprus and EU-28.

The actual output growth rate in Cyprus and EU-28 followed the same pattern in the period 1998 to 2008, though in Cyprus the curve is shifted upwards by, on average, 2.5 percentage points compared to the one in EU-28. In particular,

- in Cyprus, the actual output growth rate was between 5.1 percent in 1998 and 3.7 percent in 2008, whereas in EU-28 it was between 3 percent in 1998 and 0.5 percent in 2008;
- in 2009 the growth rate of actual output declined sharply to -2 percent in Cyprus and -4.4 percent in EU-28;
- after 2009 the evolution of actual output growth follows a different path in Cyprus and EU-28, and from 2010 onwards it was higher in EU-28 than in Cyprus;
- in EU-28, the growth rate was close to 2 percent in 2010 and 2011, became negative (around -0.5 percent) in 2012, and then, in 2013 and 2014, followed a positively sloped change;

⁷ In 2003 it was marginally negative at -0.2 percent.

- in Cyprus, the actual output growth rate was 1.4 percent in 2010, 0.4 percent in 2011 and negative in the period 2012 to 2014 (it reached its lowest point in 2013, when actual output declined by 6 percent);
- in the period 2015 to 2017, the actual output in EU-28 is expected to grow at a rate around 2 percent, whereas the corresponding rate for Cyprus is expected to be around 1.6 percent in 2015 and 2017 and close to 2 percent in 2017.

FIGURE 2: Actual output growth rate in Cyprus and EU-28

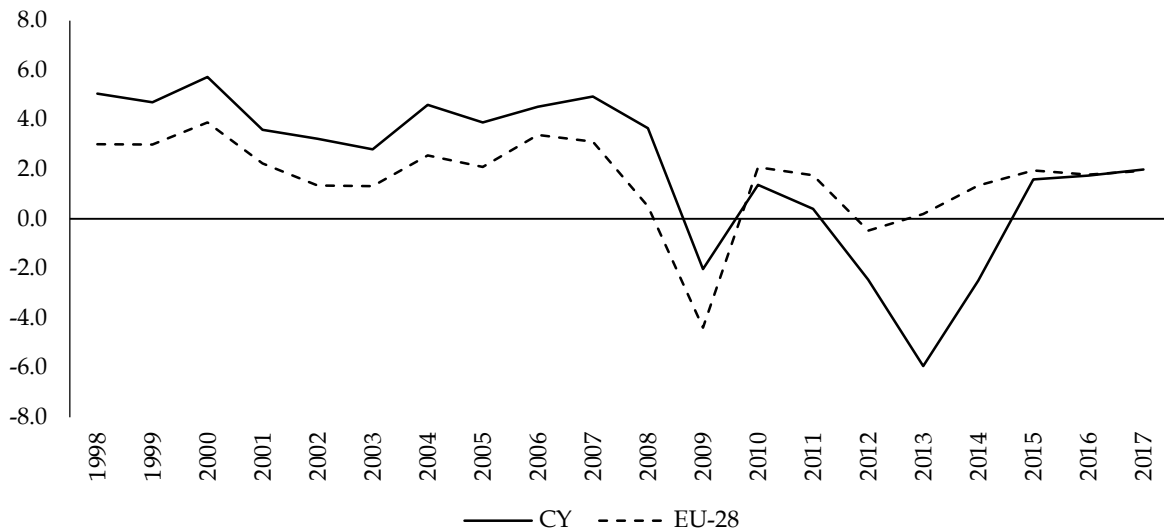
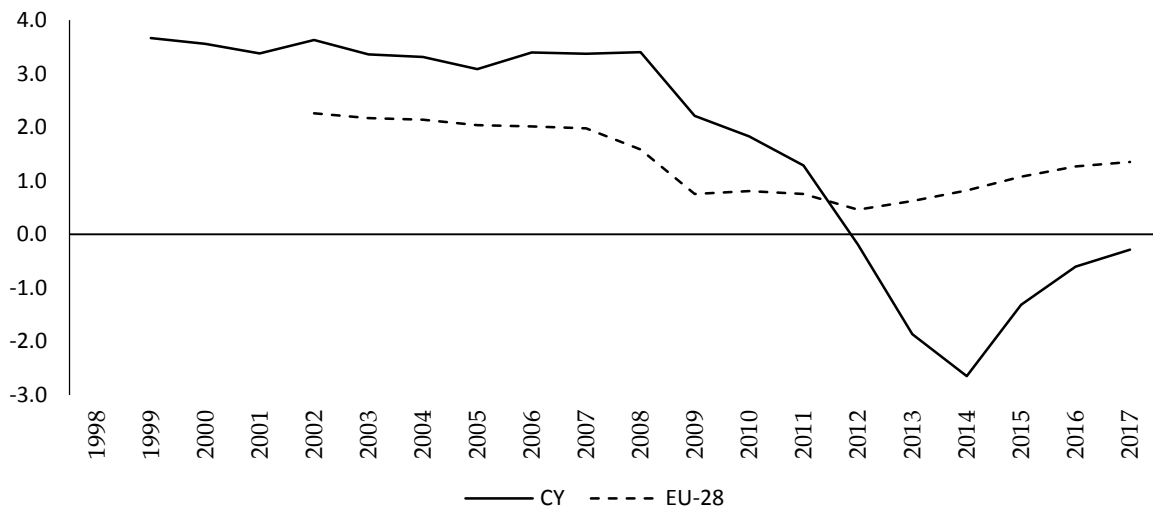


Figure 3 shows the growth rate of potential output in Cyprus (solid line) and EU-28 (dashed line) for the period 1999 to 2017. In general, the growth rate of potential output follows a much smoother pattern compared to the growth rate of the actual output. In particular,

- between the years 1999 and 2008, potential output was rather stable in both Cyprus and EU-28, with its growth rate ranging between 3.1 and 3.7 percent in Cyprus, and between 1.6 and 2.3 percent in EU-28;
- in 2009 a reduction in the growth rate of potential output to 2.2 percent is observed in Cyprus and 0.8 percent in the EU-28;
- in EU-28, the potential output growth rate remained stable, around 0.8 percent, over the period 2009 and 2014;
- in Cyprus, the growth rate of potential output followed a decreasing path between 2009 and 2014: from 2.2 percent in 2009 to 1.8, 1.3, -0.2, -1.9 and -2.6 percent in the years 2010, 2011, 2012, 2013 and 2014, respectively;
- in EU-28 the potential output is expected to increase by 1.1 percent in 2015 and by about 1.3 percent in 2016 and 2017; and
- in Cyprus the negative growth rate of potential output is expected to continue over the period 2015 to 2017, albeit at a decreasing rate: -1.3 percent in 2015, -0.6 percent in 2016 and -0.3 percent in 2017.

FIGURE 3: Potential output growth rate in Cyprus and EU-28



Figures 1A and 2A in the appendix show the actual and potential output growth rates for the period 1998 to 2017, in Cyprus and EU-28, respectively. In general, actual and potential output growth follow the same trend but, as said earlier, the growth of potential output follows a much smoother pattern compared to the growth of actual output. For Cyprus the actual output is relatively stable in the period 1999 to 2008, and decreasing in the period 2009 and 2014.

4. Analysing the output gap estimates for Cyprus

In this section we investigate the sensitivity of the output gap estimates obtained by the EC to: (i) the assumption that the wage share in Cyprus is the average of the EU-28 member states; and (ii) the construction of the CUBS indicator based on the capacity utilization in industry.

4.1. The wage share

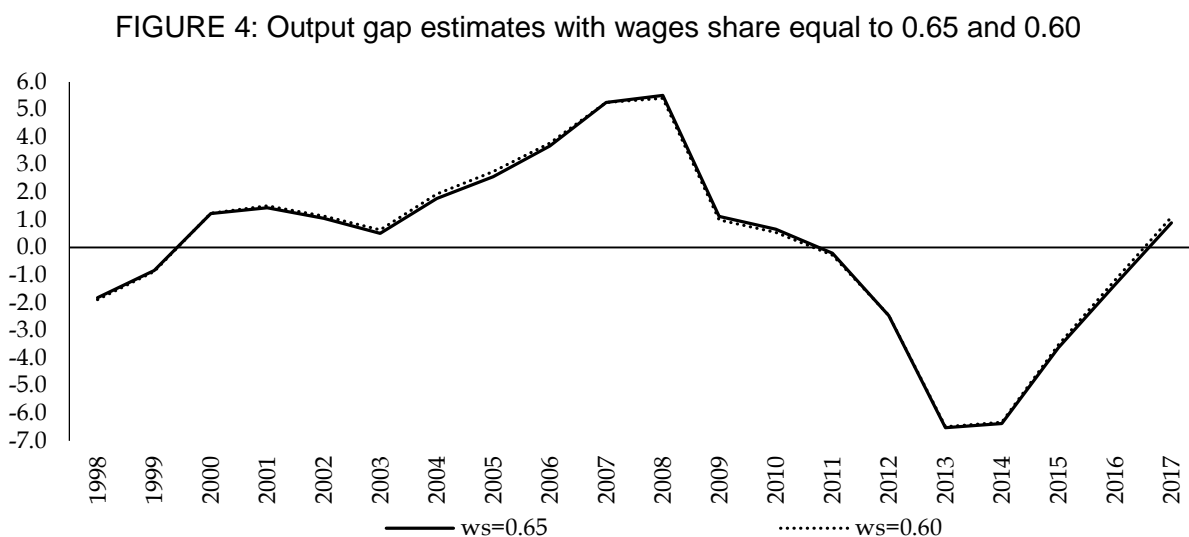
In the Cobb-Douglas specification used by the EC for estimating the potential output and output gap of the EU member states, constant returns to scale and factor price elasticity equal to one are assumed. Under perfectly competitive markets, the parameters of the Cobb Douglas production function can be estimated using the wage share. The EC use the average wage share of the member states. In Cyprus, the average wage share is lower. In particular, for the period 1998 to 2015 was closer to 0.60 rather than the EU average of 0.65.

In order to examine whether the higher than the actual average wage share in Cyprus assumed by the EC has significant consequences, we estimated the yearly output gap in Cyprus setting the wage share to 0.60 and compare the result with that obtained when a wage share of 0.65 is used. As is clearly shown in Figure 4, the yearly output gap estimates are essentially not affected when the Cyprus wage share is used (solid line) in place of the EU average (dotted line).

4.2. The CUBS indicator

The CUBS indicator is used as a proxy for the unobserved true level of capacity utilisation in the economy. It is used in the Kalman filter-based approach for estimating the TFP trend, which exploits the theoretical link between TFP and capacity utilisation (Havik et al., 2014).

The EC constructs the CUBS indicator as a composite index of three components: (i) the capacity utilisation in industry (CU.INDU); (ii) the economic sentiment indicator for the services sector (ESI.SERV); and (iii) the economic sentiment indicator for the construction sector (ESI.BUIL).⁸⁸ The weights used for combining the three indicators into one are taken to be the shares of the corresponding sectors in the economy.



The CUBS indicator, however, is defined as the weighted average of the three variables above only when all of them are available. For the years when either ESI.SERV or ESI.BUIL is not available, the CUBS variable is set equal to CU.INDU; and to missing when the latter variable is also unavailable. One could argue that this approach may not be appropriate for Cyprus because the share of industry in the economy is only about 8 percent, whereas services account for about 86 percent of total output. Thus, it makes more sense to base the capacity utilisation measure of the economy on that observed in the services rather than the industry sector.⁹

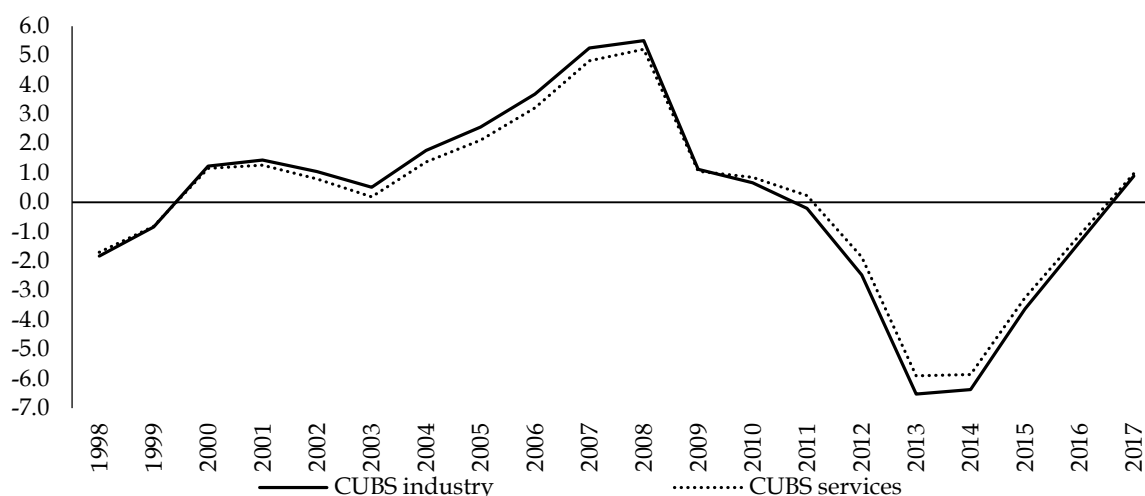
To construct a capacity utilisation index that describes better the economy in Cyprus we have re-evaluated the CUBS indicator by: (i) substituting the economic sentiment indicator for services with the capacity utilisation of services; and (ii) use the latter (instead of using the capacity utilisation of industry) as the main indicator in the construction of the CUBS indicator. The output gap estimates based on the CUBS indicator used by the EC (labelled CUBS industry) and on the one constructed for Cyprus (labelled CUBS services) are put in the same diagram (Figure 5) for comparison¹⁰.

⁸ For a detailed description of the methodology for constructing the CUBS indicator see the European Commission (2014) note.

⁹ Information on the capacity utilisation of services in Cyprus are available for the years after 2010 and for the capacity utilisation of industry for the years after 2008.

¹⁰ Table 3A in the Appendix show numerical values of the output gap estimates using the CUBS industry and CUBS services for wages share equal to 0.65 and 0.60.

FIGURE 5: Output gap estimates with CUBS indicator based on the capacity utilisation of industry and services



The results suggest that basing the CUBS indicator on the capacity utilisation of services, instead of the utilisation of services of industry, does not change significantly the estimated evolution of the output gap in Cyprus. More precisely,

- from 1998 to 2000 and, also, in 2009 the two alternative CUBS indicators (services-based and industry-based) yield practically the same output gap estimates;
- from 2000 to 2008 the output gap estimates obtained from the services-based CUBS indicator are, on average, lower by 0.3 percentage points compared to those obtained from the industry-based CUBS indicator; and
- from 2010 to 2017 the output gap estimates obtained from the services-based CUBS indicator are higher by, on average, 0.4 percentage points compared to those obtained from the industry-based CUBS indicator.

5. Summary and Conclusions

The output gap, defined as the difference between the actual and potential output, is used in the calculation of the fiscal balance indicator, which can help in the surveillance of economic growth and stability of a country. Furthermore, by indicating the position of the economy in the business cycle, it can help prevent inflationary pressures with counter-cyclical macroeconomic policies. At the same time, estimates of the potential output (required for the calculation of the output gap) allow the aggregate supply capacity of the economy and the possibilities of non-inflationary growth to be determined.

The European Commission has adopted the production function approach - and, in particular, a constant return to scales Cobb-Douglas function - for estimating the output gap for its member states. In the context of this specification, the final output depends on the total factor productivity of the economy, which measures the degree of utilisation and the level of efficiency of the factors of production. The potential output is obtained when all factors of production are at their potential level and are fully and efficiently utilised.

This paper examines the output gap estimates produced by the European Commission for Cyprus and the rest of the EU-28 states; and the sensitivity of the Cyprus output gap to: (i) the assumption that the wage share in Cyprus is the average of the EU-28; and (ii) the capacity utilisation business survey (CUBS) indicator is based mainly on the capacity utilisation in industry.

- In the case of Cyprus, the output gap appears to be positive (i.e. the actual was higher than the potential output of the economy) during the period 2000 to 2011, and hit its top level of about 5.5 percent in 2007 and 2008. After 2008 it started declining and in 2011 became negative. It hit its lowest level (about -6.5 percent) in 2013 and 2014, after the closure of Laiki Bank and the drastic haircut of savings deposited with the Bank of Cyprus. The negative output gap is expected to start declining after 2015 and become positive in 2017.
- In EU-28 the output gap between 2001 and 2008 was positive and peaked at 2.7 percent in 2007. In 2008 it declined to 1.6 percent and dropped sharply to -3.5 percent in 2009. In the following years, the output gap remained negative but relatively stable between -3 and -2 percent; and is expected to decline to around -1.3 percent in 2015 to -0.8 and -0.2 percent in 2016 and 2017, respectively.
- In Cyprus, the growth rate of potential output in the period 2009 to 2014 followed a decreasing path, from 2.2 percent in 2009 to -2.6 percent in 2014. The negative growth rate of potential output is expected to continue during the period 2015 to 2017, albeit with a decreasing rate. In particular, the potential output is expected to grow by -1.3 in 2015 percent, by -0.6 percent in 2016 and by -0.3 percent in 2017.

To assess the sensitivity of the output gap estimates for Cyprus to the assumptions made by the EC, we first consider how these estimates change when the wage share of the economy of Cyprus (0.60) is used in place of the EU-28 average (0.65) assumed by the EC. The results obtained suggest that the difference in the output gap obtained with the two wage shares is imperceptible. Also too small to have practical consequences is the difference between the estimates obtained when the industry-based CUBS indicator used by the EC is replaced by the services based one we compute specifically for Cyprus.

Plans for future work include further analysis of the sensitivity of the output gap estimates to assumptions made by alternative methodologies. In addition, forecasting techniques will be utilised in order to estimate the short run (three to five years) evolution of the actual and potential output, as well as the output gap, of the Cyprus economy.

Appendix

TABLE 1A: Potential Output and Output Gap in Cyprus

	Output Gaps (% of Potential Output)	Actual Output Growth (annual % change)	Potential Growth (annual % change)	Contributions to Potential Growth					Determinants of Labour Potential and Capital Accumulation			
				Total Labour (Hours) Contr.	Labour (persons) Contr.	Changes in Hours (per Empl) Contr.	Capital Accumulation Contr.	TFP Contr.	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1995	#N/A	9.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	2.3	65.9	#N/A	#N/A
1996	#N/A	1.6	#N/A	#N/A	#N/A	#N/A	1.7	#N/A	2.1	65.8	#N/A	#N/A
1997	#N/A	2.4	#N/A	#N/A	#N/A	#N/A	1.7	#N/A	2.0	65.8	#N/A	#N/A
1998	-1.8	5.1	#N/A	#N/A	#N/A	#N/A	1.0	#N/A	1.9	65.7	4.0	18.4
1999	-0.8	4.7	3.7	1.2	1.0	0.2	1.4	1.0	1.8	65.6	4.2	20.6
2000	1.2	5.7	3.6	1.2	1.1	0.1	1.3	1.0	1.8	65.7	4.3	20.0
2001	1.4	3.6	3.4	1.2	1.3	-0.1	1.2	0.9	1.8	65.9	4.5	19.4
2002	1.1	3.2	3.6	1.2	1.5	-0.3	1.6	0.8	1.9	66.3	4.7	21.2
2003	0.5	2.8	3.4	1.2	1.7	-0.4	1.5	0.7	1.9	66.9	5.0	20.8
2004	1.8	4.6	3.3	1.2	1.8	-0.6	1.5	0.6	2.0	67.6	5.3	21.0
2005	2.6	3.9	3.1	1.0	1.6	-0.6	1.7	0.4	2.1	68.2	5.7	21.7
2006	3.7	4.5	3.4	0.9	1.5	-0.5	2.3	0.2	2.3	68.4	6.1	25.4
2007	5.3	4.9	3.4	1.0	1.5	-0.5	2.4	0.0	2.8	68.4	6.5	26.5
2008	5.5	3.7	3.4	1.0	1.5	-0.5	2.6	-0.2	3.3	68.0	7.0	28.0
2009	1.1	-2.0	2.2	0.7	1.2	-0.4	1.8	-0.3	3.4	67.5	7.7	23.6
2010	0.7	1.4	1.8	0.7	1.0	-0.3	1.5	-0.3	3.2	66.8	8.2	22.0
2011	-0.2	0.4	1.3	0.6	0.9	-0.3	1.0	-0.4	3.0	66.2	8.8	19.7
2012	-2.5	-2.4	-0.2	-0.2	0.0	-0.2	0.4	-0.4	1.7	65.6	9.5	15.7
2013	-6.5	-5.9	-1.9	-1.5	-1.3	-0.1	0.1	-0.5	-0.4	65.0	10.3	13.6
2014	-6.4	-2.5	-2.6	-1.9	-1.8	-0.1	-0.3	-0.4	-1.5	64.6	10.9	11.4
2015	-3.6	1.6	-1.3	-1.0	-0.9	-0.1	-0.1	-0.2	-0.2	64.2	11.5	13.2
2016	-1.4	1.7	-0.6	-0.6	-0.5	-0.1	0.1	-0.1	0.2	64.1	12.1	14.5
2017	0.9	2.0	-0.3	-0.5	-0.4	-0.1	0.2	0.0	0.1	64.1	12.8	15.3
2018			0.2	-0.1	0.0	-0.1	0.3	0.1	0.1	64.2	13.1	16.1
2019			0.7	0.2	0.4	-0.1	0.4	0.1	0.1	64.6	13.1	16.9
2020			0.9	0.3	0.4	-0.1	0.5	0.1	0.0	65.0	13.1	17.5

Source: 2016 Spring European Commission's output gap results.

TABLE 2A: Potential Output and Output Gap in EU-28

	Output Gaps (% of Potential Output)	Actual Output Growth (annual % change)	Potential Growth (annual % change)	Contributions to Potential Growth					Determinants of Labour Potential and Capital Accumulation				
				Total Labour (Hours) Contr.	Labour (persons) Contr.	Changes in Hours (per Empl) Contr.	Capital Accumulation Contr.	TFP Contr.	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)	
1998	#N/A	3.0	#N/A	#N/A	#N/A	#N/A	0.8	#N/A	#N/A	#N/A	#N/A	9.3	#N/A
1999	#N/A	3.0	#N/A	#N/A	#N/A	#N/A	0.8	#N/A	#N/A	#N/A	#N/A	9.2	#N/A
2000	#N/A	3.9	#N/A	#N/A	#N/A	#N/A	0.9	#N/A	#N/A	#N/A	#N/A	9.1	#N/A
2001	1.5	2.2	#N/A	#N/A	#N/A	#N/A	0.8	#N/A	#N/A	#N/A	63.5	9.0	21.7
2002	0.6	1.4	2.3	0.2	0.4	-0.3	0.7	1.4	0.3	63.7	8.9	21.1	
2003	-0.2	1.3	2.2	0.3	0.5	-0.2	0.7	1.2	0.4	63.9	8.9	21.0	
2004	0.2	2.6	2.1	0.4	0.6	-0.2	0.7	1.1	0.5	64.1	8.8	21.2	
2005	0.3	2.1	2.0	0.4	0.5	-0.1	0.7	0.9	0.4	64.3	8.7	21.5	
2006	1.6	3.4	2.0	0.4	0.5	-0.1	0.8	0.8	0.4	64.5	8.6	22.3	
2007	2.7	3.1	2.0	0.4	0.5	-0.2	0.9	0.7	0.4	64.7	8.5	23.1	
2008	1.6	0.5	1.6	0.2	0.4	-0.2	0.8	0.6	0.3	64.9	8.6	22.6	
2009	-3.5	-4.4	0.8	-0.2	0.1	-0.3	0.4	0.5	0.2	65.1	8.8	19.8	
2010	-2.3	2.1	0.8	-0.1	0.2	-0.3	0.4	0.5	0.1	65.3	8.9	19.7	
2011	-1.3	1.8	0.8	-0.1	0.1	-0.2	0.4	0.4	-0.1	65.4	8.8	19.9	
2012	-2.3	-0.5	0.5	-0.2	0.0	-0.2	0.3	0.4	-0.1	65.6	8.9	19.3	
2013	-2.7	0.2	0.6	0.0	0.1	-0.2	0.3	0.4	0.0	65.7	8.9	18.9	
2014	-2.2	1.3	0.8	0.1	0.2	-0.1	0.3	0.4	0.0	65.9	8.8	19.2	
2015	-1.3	2.0	1.1	0.3	0.3	0.0	0.3	0.4	0.1	66.0	8.6	19.7	
2016	-0.8	1.8	1.3	0.4	0.4	0.0	0.4	0.5	0.3	66.1	8.5	20.0	
2017	-0.2	1.9	1.4	0.4	0.3	0.0	0.5	0.5	0.2	66.2	8.4	20.5	
2018			1.2	0.2	0.2	0.0	0.5	0.6	0.0	66.3	8.3	20.7	
2019			1.2	0.1	0.1	0.0	0.5	0.6	0.0	66.5	8.3	20.8	
2020			1.3	0.1	0.1	-0.1	0.5	0.7	0.1	66.6	8.3	20.9	

Source: 2016 Spring European Commission's output gap results.

FIGURE 1A: Actual and potential output growth rates in Cyprus

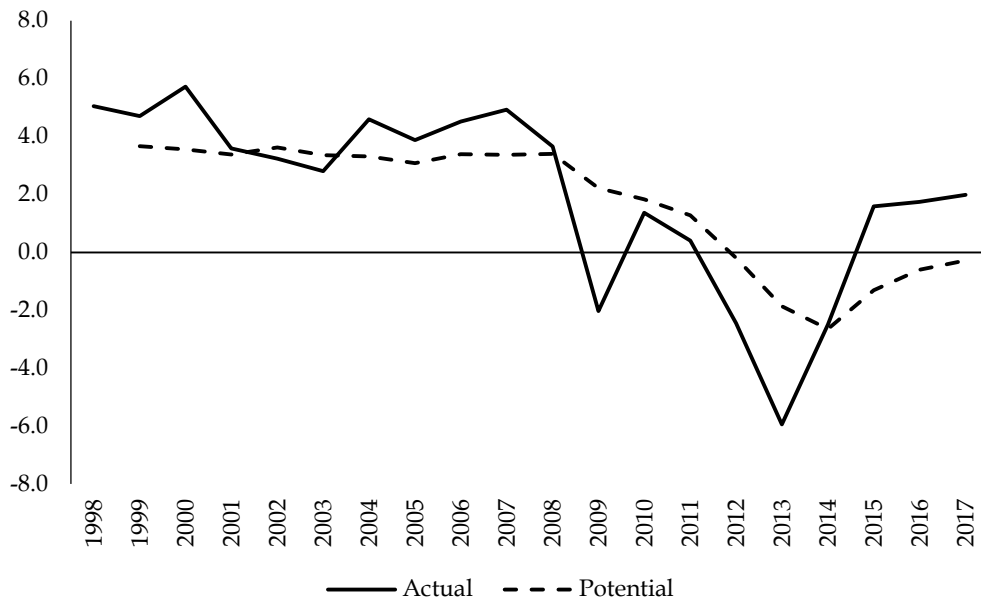


FIGURE 2A: Actual and potential output growth rates in EU-28

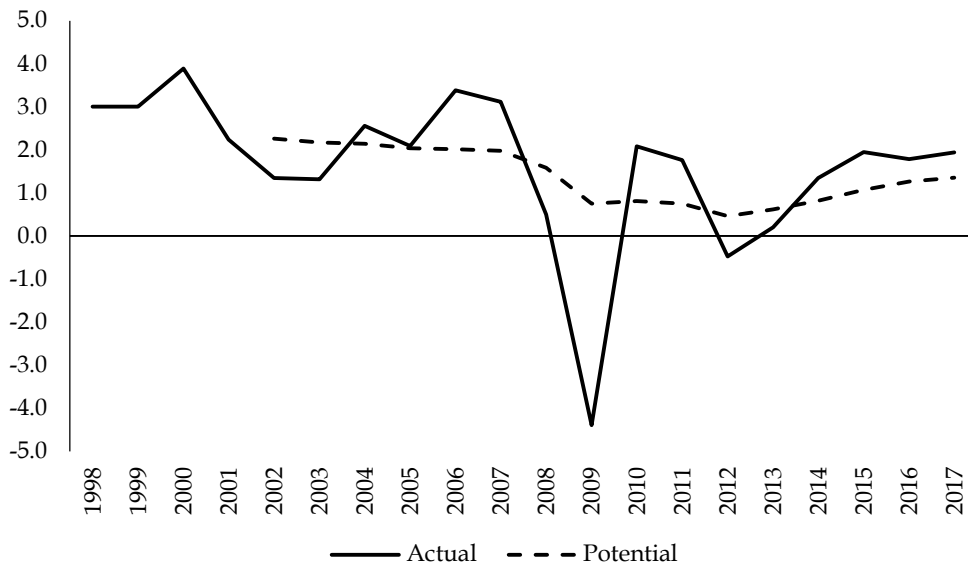


FIGURE 3A: Output gap estimates with alternative CUBS and wage share values



TABLE 3A: Output gap estimates with alternative CUBS and wage share values

	CUBS based on CU of industry		CUBS based on CU of services	
	ws=0.65	ws=0.60	ws=0.65	ws=0.60
1998	-1.8	-1.9	-1.7	-1.7
1999	-0.8	-0.9	-0.8	-0.8
2000	1.2	1.2	1.2	1.1
2001	1.4	1.5	1.3	1.3
2002	1.1	1.1	0.8	0.8
2003	0.5	0.6	0.2	0.2
2004	1.8	1.9	1.4	1.5
2005	2.6	2.7	2.1	2.2
2006	3.7	3.8	3.2	3.2
2007	5.3	5.3	4.8	4.7
2008	5.5	5.4	5.2	5.0
2009	1.1	1.0	1.1	0.9
2010	0.7	0.5	0.9	0.7
2011	-0.2	-0.3	0.2	0.2
2012	-2.5	-2.5	-1.9	-1.8
2013	-6.5	-6.5	-5.9	-5.8
2014	-6.4	-6.3	-5.9	-5.7
2015	-3.6	-3.5	-3.2	-3.1
2016	-1.4	-1.2	-1.1	-0.9
2017	0.9	1.1	1.0	1.2
2018	0.6	0.7	0.7	0.8
2019	0.3	0.4	0.3	0.4
2020	0.0	0.0	0.0	0.0

References

Cotis J., J. Elmeskov, and A. Mourougane, (2004), 'Estimates of potential output: Benefits and pitfalls from a policy perspective, The euro area business cycle: stylized facts and measurement issues', Centre for Economic Policy Research, 35-60.

Douglas P. H., (1976), 'The Cobb-Douglas production function once again: Its history, its testing, and some new empirical values', *Journal of Political Economy* 84, 903-915.

Dupasquier C., A. Guay, and P. St-Amant, (1999), 'A survey of alternative methodologies for estimating potential output and the output gap', *Journal of Macroeconomics*, 21: 577-595.

European Commission, (2014), 'Constructing the combined Capacity Utilization Business Survey (CUBS) indicators', ECFIN/A3/RR.

Giorno C., P. Richardson, D. Roseveare, and P. Van den Noord, (1995), 'Estimating potential output, output gaps and structural budget balances', Economics Department Working Paper 152, OECD, Paris.

Havik K., K. Mc Morrow, F. Orlandi, C. Planas, R. Raciborski, W. Röger, A. Rossi, A. Thum-Thysen, and V. Vandermeulen, (2014), 'The production function methodology for calculating potential growth rates and output gaps', (No. 535), Directorate General Economic and Financial Affairs (DG ECFIN), European Commission, 1-105.

Mc Morrow K., and W. Roeger, (2001), 'Potential output: Measurement methods, "new" economy influences and scenarios for 2001-2010', (No. 150), Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission, 1-142.

Polycarpou A., (2015), 'Methodologies for estimating the output gap with an application to Cyprus', Economic Analysis Papers 10-15, Economics Research Centre, University of Cyprus.

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