USE OF DATA FROM BUSINESS TENDENCY SURVEYS IN OUTPUT GAP ESTIMATION[1]

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Abstract

In this paper, the results of empirical research are presented regarding the most commonly used macroeconomic indicators of business cycles together with the Research Institute for Economic Development (RIED) Business Tendency Surveys data in output gap estimation. As a tool for determining business cycle, principal component analysis (PCA) is used. The empirical evidence allows to confirm the usefulness of qualitative RIED indices in modelling the output gap and, at the same time, support the conclusions made by Roeger, McMorrow, Hristov and Vandermeulen (2019) that inflation and the current account balance do not perform well as indicators of the cycle in Poland. The cyclical component obtained using PCA is highly correlated with the cyclical component of the RIED barometer and real GDP change.

Keywords: business cycle, cycle indicators, output gap, principal components, survey data.

JEL codes: C38, C83, E32.

Introduction

Following Okun (1962), the output gap is the ratio of actual output over potential output. It is an indicator of real economic imbalance, thus it shows a cyclical position of an economy. The imbalance puts pressure on prices, wages, interest rates and the exchange rate, among others. For example, the CPI above its long-term growth rate and a current account deficit testifies that the output gap is positive, i.e. an economy

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produces above-potential output. In this position, according to the European Commission, was the Polish economy in 2019 (European Commission, 2019, p. 132).

The output gap is used for policymaking purposes, provided that its estimation is correct. Assessment of the output gap, however, requires determining the potential output, the measurement of which—both in terms of estimation methods and data selection—is questioned (e.g. by Tooze, 2019). For example, according to European Commission estimates, the economies of Italy and Germany were in 2019 in the same cyclical position despite the very fact that their performance greatly differed (Roeger, McMorrow, Hristov, & Vandermeulen, 2019, p. 5).

The purpose of this paper is to show that there are indeed reasons to undermine the output gap estimation method adopted and used by the European Commission (described by Havik et al., 2014). To do so, the results of estimating the output gap in Poland are compared using 2 groups of economic indices: (1) a standard set of quantitative business cycle indicators, and (2) survey databased indicators, developed by the Research Institute of Economic Development of the Warsaw School of Economics (RIED). It has been shown that some of the traditional indicators are not useful in estimating the output gap, because they contain strong trend components. Furthermore, they can be successfully replaced by qualitative indicators. It has also be shown that estimation method has significant impact on output gap estimates.

This paper consists of 3 parts. In the first one, the method and data used to estimate the output gap in Poland are presented, while in the second part, the results of this estimation are demosntrated. Conclusions resulting from the method comparison are included in the summary of the analysis.

1. Output gap estimation methods

As it was mentioned above, contrary to actual output of an economy, potential output, and thus, also of the output gap, cannot be observed and measured directly, but only estimated. In order for this to be done, a vast plethora of methods are used and compared, but they all assume that the actual volume of output is the resultant of 2 overlapping processes with different characteristics and origin, i.e. a trend that corresponds to potential output, and a business cycle that deviates an economy from its trend. Amongst many methods, the most commonly used are:

- econometric models, including those based on the macroeconomic production function;
- statistical techniques.[2]

[2] See Álvarez and Gómez-Loscos (2017) for a brief review of output gap estimation methods.

Econometric modelling requires certain forms of processes which contribute to output growth, being adopted *a priori*. In ST models, e.g., trends and cyclical components are separately estimated (see e.g. Harvey, Koopman, & Shepard, 2004; Harvey, 2005), and the accuracy of estimation depends on statistical properties of time series and assumptions regarding forms of those processes that are stochastic in nature. Alternatively, potential output is estimated on the basis of the macroeconomic production function—this method is used, e.g. by the European Commission (see Havik et al., 2014)—but in this case, the accuracy of estimation depends on assumptions regarding the form of the production function and its parameters.

The idea of statistical methods is quite different. They separate a trend from short-term fluctuations based on statistical analysis of output variability over time. Two approaches are used: the first is based on trend estimation and residual determination of a cyclical component (e.g. the Hodrick-Prescott filter), in the second, a cyclical component is estimated, and a residual trend is determined (e.g. the Baxter-King filter, the Christiano-Fitzgerald filter). Although computational algorithms used to derive the filtres are different, these methods provide similar results (see e.g. Adamowicz, Dudek, Pachucki, & Walczyk, 2009; Fagiolo, Napoletano, Piazza, & Roventini, 2009; Larsson & Vasi, 2012). Here we use the asymmetric Christiano-Fitzgerald filtre (2003)[3], an advantage of which is that it performs lossless approximation of the cyclical component, and endof-sample estimates are relatively stable (see e.g. Adamowicz et al., 2009).

The following standard cycle indicators are used to estimate the output gap regarding:

- real GDP growth rate;
- consumer price index;
- average gross nominal wage growth rate;
- unemployment rate (BAEL);
- current account balance.

In addition, partly due to the suggestions of Fleischman and Roberts (2011) and Geyer and Marc (2018), several qualitative indicators are included in the study, namely: the RIED barometer[4] and the balances of overall assessment concerning the economic situation in Poland, derived from business tendency surveys conducted by RIED in the manufacturing (MAN) and construction (CON) industries, and trade (TRD). It is argued that, by construction, business tendency indicators are

[3] Lower and upper bounds are 8 and 48 quarters. Mean adjustment applied.

[4] The RIED barometer is a composite indicator calculated as a weigthed average of seven confidence indicators based on business and consumer survey balances. It has been found to be a good indicator of economic activity in Poland ($r \approx 0.8$).

sufficiently precise indicators of a cyclical position of an economy and, as such, those which are complementary to traditional indicators (Fleischman & Roberts, 2011; Gayer & Marc, 2018).

The time series under study are quarterly,[5] and span between Q1 2003 to Q3 2021. If non-stationarity is observed, the stationarity is obtained by differentiation. Then, principal components analysis (PCA) is applied. It allows to extract principal components from individual cycle indicators, which are assumed to be proxies for the cyclical component of output. Moreover, using this method, the correlational degree between indicators and principal components can also be assessed.

2. Results of output gap estimation in Poland

2.1. Principal component analysis

The results of principal component analysis show that the first 2 components together, explain almost 2/3 of the variability for each indicator, of which 40% accounts for the first component (Table 1). Some indicators, namely: the balances of economy assessment made by manufacturers (MAN) and construction firms (CON), and the real GDP growth rate, are highly correlated with the first component (Table 2). In total, these 3 indicators constitute 3/4 of the first component (Table 3). Together with the trade balance (TRD), they contribute to the majority of the first principal component (91.6%).

In Figure 1, a positive correlation is shown between the first component and all indicators. The current account balance, CPI and the wage growth rate are strongly and positively correlated with the second principal component, which raises concern about their ability to identify cyclical positions. The unemployment rate has a valid negative sign of the correlation with PC2. All the other indicators are not (or weakly) correlated with the second component. In Figure 2, it is indicated that the second principal component does not reveal a strong cyclical pattern.

Table 1. Percentage of explained variability by principal components

	PC1	*PC2*	*PC3*	*PC4*	*PC5*	*PC6*	*PC7*	*PC8*
Standard deviation	1.79	1.45	0.97	0.91	0.59	0.53	0.49	0.26
Proportion of variance (%)	40	26	12	10	4	3	3	1
Cumulative proportion (%)	40	66	78	88	93	96	99	100

Source: Own computation based on Eurostat and RIED data.

[5] The business tendency survey in the manufacturing industry is conducted monthly. Quarterly estimates are calculated as weighted averages of monthly data with weights of 1/6, 1/3 and 1/2 for subsequent months.

Table 2. Correlation coefficient between individual indicators and principal components

	PC1	*PC2*	*PC3*	*PC4*	*PC5*	*PC6*	*PC7*	*PC8*
CPI	0.01	0.68	0.68	–0.07	0.02	–0.13	0.23	0.00
Real GDP growth rate	0.85	0.03	–0.04	0.31	0.15	–0.36	–0.14	–0.04
Wage growth rate	0.37	0.83	0.10	–0.08	0.21	0.22	–0.26	0.04
Current account balance	0.36	0.65	–0.26	0.51	–0.33	0.10	0.08	–0.02
Unemployment rate (BAEL)	0.08	–0.61	0.63	0.42	–0.11	0.13	–0.15	0.01
CON	0.91	–0.24	0.04	–0.15	0.09	0.19	0.12	–0.18
TRD	0.75	–0.04	0.10	–0.51	–0.37	–0.08	–0.12	0.04
MAN	0.90	–0.30	–0.08	0.08	0.13	0.07	0.19	0.18

Source: Own computation based on Eurostat and RIED data.

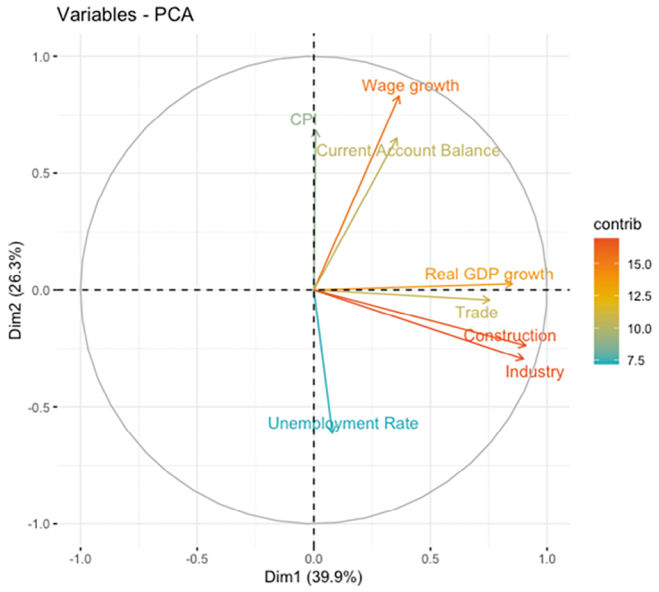

Figure 1. Target loads of individual indicators

Notes: The coordinates for the end of each of the plotted vectors correspond to the factor loading of the individual indicators. The length of the vector represents the information stock of the indicators that the principal components capture. The longer the vector, the greater the contribution of the indicators to the principal components. The vector end coordinate sign, i.e. the sign of the factor load, indicates a positive or negative correlation of the indicators and principal components. If we consider both axes together (PC1 & PC2), then primary variables can be classified into 1 of 4 categories, depending on the combination of +/– signs for their factor loads. The angle between the vectors indicates the correlation:

- $0 < \alpha < 90°$: the smaller the angle between the vectors representing the indicators, the stronger the positive correlation between them;
- $\alpha = 90°$: the vectors are perpendicular, i.e. the individual indicators are not correlated;
- $90 < \alpha < 180°$: the larger the angle between the vectors representing the indicators, the stronger the negative correlation between them.

Source: Based on Eurostat and RIED data.

Table 3. Contribution of individual indicators to principal components

	PC1	*PC2*	*PC3*	*PC4*	*PC5*	*PC6*	*PC7*	*PC8*
CPI (%)	0.0	22.3	48.3	0.5	0.1	6.4	22.3	0.0
Real GDP growth rate (%)	22.7	0.0	0.2	11.5	6.3	48.1	8.6	2.7
Wage growth rate (%)	4.2	32.8	1.0	0.8	12.7	17.7	28.4	2.4
Current account balance (%)	4.0	20.1	7.2	30.9	31.0	3.4	2.7	0.5
Unemployment rate (BAEL) (%)	0.2	17.8	41.4	21.1	3.6	6.4	9.4	0.2
CON (%)	25.9	2.7	0.2	2.7	2.4	13.7	6.5	45.9
TRD (%)	17.8	0.1	1.0	31.6	39.0	2.2	6.1	2.2
MAN (%)	25.3	4.2	0.6	0.9	4.9	2.0	16.0	46.1

Source: Own computation based on Eurostat and RIED data.

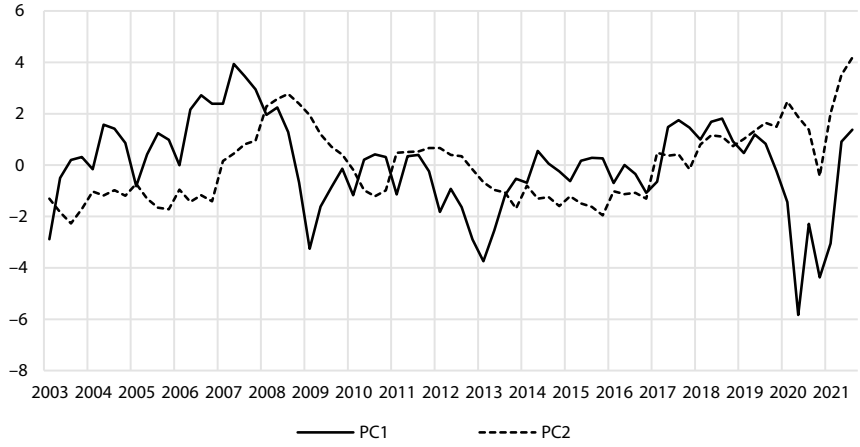

Figure 2. Comparison of PC1 and PC2
Source: Based on Eurostat and RIED data.

2.2. Output gap

Bearing in mind the above, the output gap in Poland is estimated only on the basis of the first principal component. In Figure 3, a comparison is presented between the first principal component and the real GDP growth rate[6] as well as the RIED barometer. It is illustrated that, on the whole, all the 3 indicators are coincident and highly correlated with each other. Indeed, as shown in Tables 4 and 5, the correlation coefficient between the first principal component and the real GDP growth rate is 0.851, while the Harding-Pagan's concordance index for the pair of the indicators totals 0.676.[7] The 2 measures are even higher for the cyclical components of the indicators (see Tables 6 and 7). All turning points of

[6] The real GDP growth rate has been chosen for reference since the Polish economy has not recorded a recession (in the technical or classical sense) for the last three decades, not including the COVID-19 pandemic episode.

[7] Both of them are lower for lags/leads.

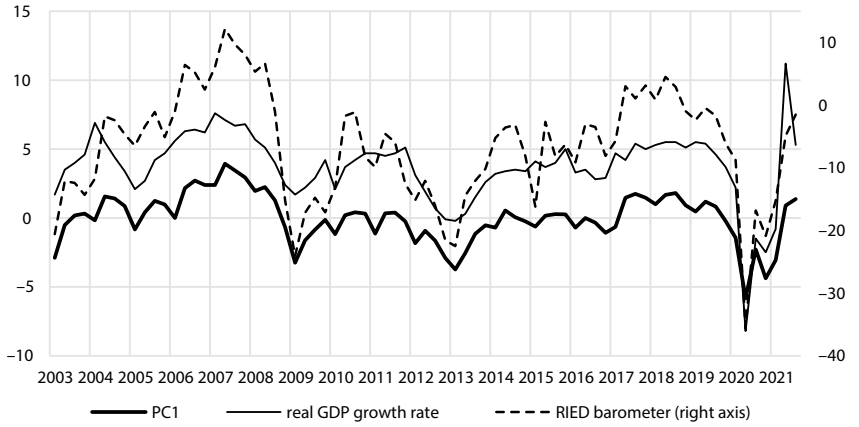

Figure 3. PC1, real GDP growth rate and RIED barometer, Poland, 2003–2021
Source: Based on Eurostat and RIED data.

the cyclical component concerning the real GDP growth rate are signalled by the turning points of the cyclical component of PC1, with 4 out of 10 of them being synchronous, 4 leading, and 2 lagged (see Figure 4).

Table 4. Correlation between PC1, real GDP growth rate and the barometer

	PC1	GDP growth rate	RIED barometer
PC1	1	0.851	0.927
GDP growth rate		1	0.746
RIED barometer			1

Notes: p-value < 0.001.
Source: Own computation based on Eurostat and RIED data.

Table 5. Concordance between PC1, real GDP growth rate and RIED barometer

	PC1	GDP growth rate	RIED barometer
PC1	1	0.676	0.784
GDP growth rate		1	0.649
RIED barometer			1

Source: Own computation based on Eurostat and RIED data.

Table 6. Correlation between the cyclical components of PC1, the real GDP growth rate and the RIED barometer

	PC1	GDP growth rate	RIED barometer
PC1	1	0.936	0.956
GDP growth rate		1	0.837
RIED barometer			1

Notes: p-value < 0.001.
Source: Own computation based on Eurostat and RIED data.

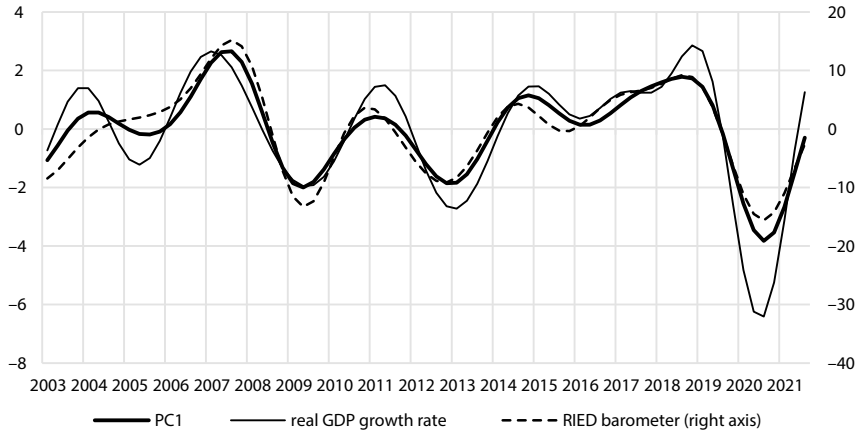

Figure 4. Cyclical components of PC1, real GDP growth rate and RIED barometer, Poland, 2003–2021

Source: Based on Eurostat and RIED data.

Table 7. Concordance between the cyclical components of PC1, the real GDP growth rate and the RIED barometer

	PC1	GDP growth rate	RIED barometer
PC1	1	0.878	0.878
GDP growth rate		1	0.784
RIED barometer			1

Source: Own computation based on Eurostat and RIED data.

Conclusions

In this study, it has been shown that the output gap, estimated by principal components based on selected macroeconomic indicators and data from business tendency surveys, coincides with the output gap measured by the real GDP growth rate. In this respect, specifically, the first principal component outperforms the RIED barometer, which has been found to be a good indicator of output in Poland. Analysis allows to reveal that traditional business cycle indicators, such as: the consumer price index and current account balance, generate ambiguous signals and, hence, are not suitable for output gap estimation. It turns out, however, that they can be successfully substituted for data regarding business tendency surveys (here: the balances of manufacturing and construction firms' opinions about general economic situation in Poland), which contains valuable information about the current and anticipated state of an economy.

References

Adamowicz, E., Dudek, S., Pachucki, D., & Walczyk, K. (2009). Synchronizacja cyklu koniunkturalnego polskiej gospodarki z krajami strefy euro w kontekście struktury tych gospodarek. In *Raport na temat pełnego uczestnictwa Rzeczypospolitej Polskiej w trzecim etapie Unii Gospodarczej i Walutowej. Projekty badawcze*. *Część I* (pp. 8–224). Warszawa: NBP.

Álvarez, L. J., & Gómez-Loscos, A. (2017). *A menu on output gap estimation methods*. (Documentos de Trabajo No. 1720). Banco de España.

Christiano, L., & Fitzgerald, T. J. (2003). The bandpass filter. *International Economic Review*, *44*(2), 435-465.

European Commission. (2019, November). *European economic forecast. Autumn 2019*. (Institutional Paper No. 115).

Fagiolo, G., Napoletano, M., Piazza, M., & Roventini, A. (2009). *Detrending and the distributional properties of U.S. output time series*. (LEM Working Paper Series No. 14).

Fleischman, C., & Roberts, J. (2011). *From many series, one cycle: Improved estimates of the business cycle from a multivariate unobserved components model*. (Finance and Economics Discussion Series Working Paper No. 46).

Gayer, C., & Marc, B. (2018). *A new modesty? Level shifts in survey data and the decreasing trend of "normal" growth*. (European Economy Discussion Paper No. 83).

Harvey, A. C. (2005). *Readings in unobserved components models*. Oxford: Oxford University Press.

Harvey, A. C., Koopman, S. J., & Shephard, N. (2004). *State-space and unobserved component models. Theory and applications*. Cambridge: Cambridge University Press.

Havik, K., McMorrow, K., Orlandi, F., Planas, C., Raciborski, R., Roeger, W., ... Vandermeulen, V. (2014). *The production function methodology for calculating potential growth rates and output gaps*. (European Economy Economic Papers No. 535).

Larsson, G., & Vasi, T. (2012). *Comparison of detrending methods*. Uppsala: Uppsala University.

Okun, A. M. (1962). *Potential GNP: Its measurement and significance*. (Proceedings of the Business and Economic Statistics Section, pp. 98–104). Washington: American Statistical Association.

Roeger, W., McMorrow, K., Hristov, A., & Vandermeulen, V. (2019). *Output gaps and cyclical indicators*. (European Commission Discussion Paper No. 104).

Tooze, A. (2019). *Output gap nonsense*. Social Europe. Retrieved May 29, 2022 from https://socialeurope.eu/output-gap-nonsense