Uncertainty of Czech macroeconomic data: advanced analysis: output gap

Jan Čapek

Faculty of Economics and Administration

Masaryk University

Lipová 41a, Brno

capek@econ.muni.cz

Abstract

The article analyses output gap values that are published by the Czech National Bank. It shows that output gap estimates are uncertain and substantial revisions occur very often. The revisions are often so radical, that it is not sure, whether the economy is above or below its potential. The contribution also constructs confidence bands for "true" values of output gap. Ascertained data uncertainty is very strong and the quality of output gap estimates is low.

Keywords

Data uncertainty, output gap, CNB, estimate, confidence bands.

Introduction

Contribution's aim

The aim of this contribution is to evaluate uncertainty of published output gap values. To achieve the objective, it is necessary to investigate, which institutions publish output gap estimates. The next step is to evaluate the quality of such estimates. In this case, it is not possible to evaluate the quality of the estimates by comparison to data, because output gap is not measurable (or observable) quantity. Assessing of output gap revisions significance or comparison amongst various institutions, which publish output gap estimates may be the alternative ways of evaluating quality of estimates.

Output gap definition

Czech National Bank (hereafter CNB) is the only institution in the Czech Republic that periodically publishes output gap estimates. It is therefore useful to define output gap the same way CNB does or adopt it altogether:[1]

> "Output gap (= production gap) is a difference between real GDP (published by Czech Statistical Office, hereafter CZSO) and potential product. Potential product is a level of GDP that doesn't raise costs (especially wages) and concurrently doesn't raise prices. The level is independent of stage in business cycle the economy is in."

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[1] [1, July 2004, p. 13].

1 Output gap values analysis

This part of the paper analyses published estimates of output gap by two approaches. As was mentioned before, all analysed data are from the CNB. This institution publishes output gap quarterly in Inflation Reports. Six values are given in tables, the rest is only in graphs and CNB doesn't publish numbers for these points in graphs. There is a possibility of error approximately 0.1 percentage point (pp) as a result of the need to read values from graphs.

Approach 1 groups data into time series according to Inflation Report (hereafter ZOI) it was published in. Each time series (and also a line in a graph) depicts output gap values for various time periods from one given Inflation Report. The number of such time series is the same as the number of Inflation Reports, which publish output gap values.

Approach 2 groups data into time series according to time periods it was published for (in whichever ZOI). Each time series therefore depicts output gap values for one given time period from various Inflation Reports. The number of time series is the same as time periods, for which an estimate was published.

Notation comment: Output gap values are quarterly and the notation of time is as follows: 2004.25 denotes the first quarter of 2004, ..., 2005.00 denotes the the last quarter of 2004. Notation of Inflation Reports uses czech abbreviation ZOI, so for example ZOI 01–2004 is an Inflation Report from January 2004 or ZOI 07–2006 stands for Inflation Report from July 2006.
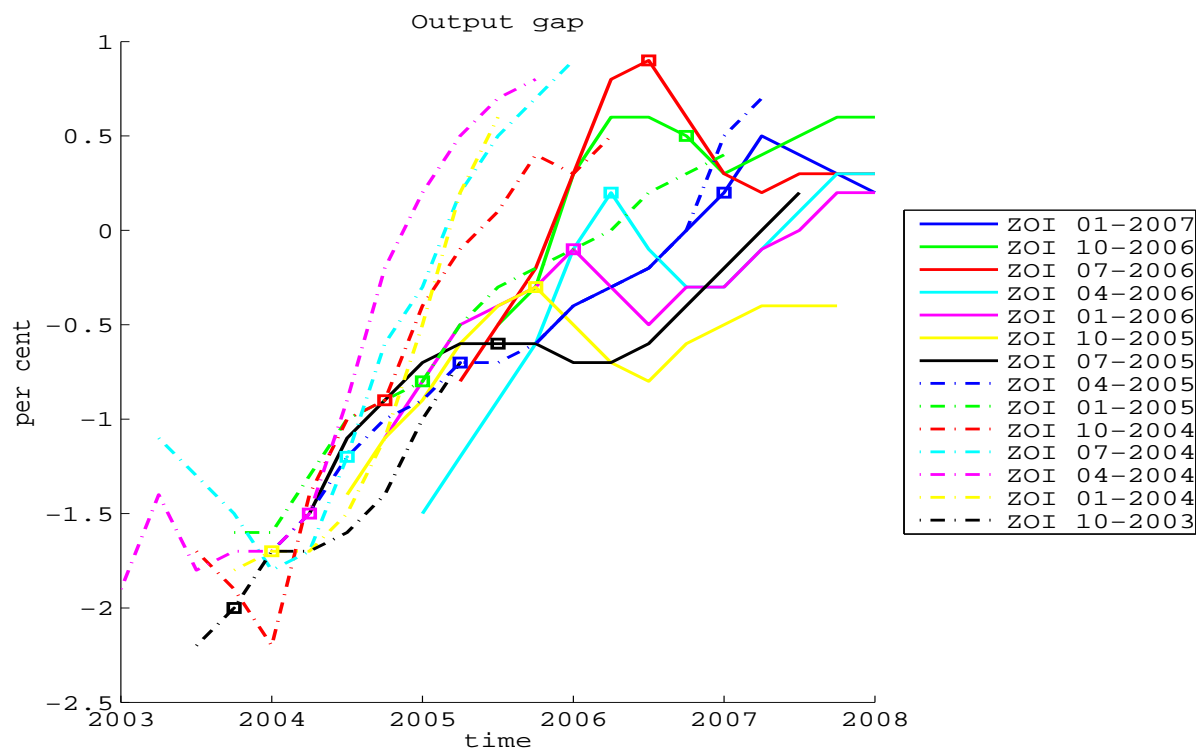
1.1 Approach 1

Figure 1: Output gap values from given Inflation Reports (ZOI)

Figure 1 depicts output gap estimates according to individual Inflation Reports (ZOI).

A line represents all values of output gap that were published by the Inflation Report that is quoted in legend. A little square on each line denotes time period, in which was given Inflation Report published.[2]

Analysis uses the following system: It deals with each two ZOI that have in common at least 6 time periods, in which they publish output gap estimates. For each of these cases, some numerical characteristics are computed.[3] Summary statistics are in Table 1. "Error (err.)" in this context is a difference between published values of output gap in two selected ZOI. "Absolute error (abs. err.)" is absolute value of error (sign of the error doesn't matter). Chosen numerical characteristics are: standard deviation of errors, average absolute error, maximum and minimum absolute error, and a difference between maximum and minimum error.

	count	std	avg. abs. err.	max. abs. err.	min. abs. err.	diff. m–m
MAX	13	0.66	0.97	**1.70**	**0.50**	1.90
MIN	06	0.08	0.07	**0.30**	0.00	0.20
O. MEAN	09	0.38	0.45	0.90	0.08	1.06
W. MEAN	09	0.38	**0.44**	0.89	0.07	**1.08**

Table 1: Summary statistics for analysis of output gap values from different ZOI

Table 1 presents summary statistics, that is, maximum (MAX), minimum (MIN), average (O. MEAN), and weighted average (W. MEAN)[4] for characteristics in the heading of the table. Units are (except "count") percentage points (pp).

Most interesting values from Table 1 are in bold and this paragraph will explain them line by line. The maximum value of a maximal absolute error is 1.7 pp. This number occurred at a time period, where there was the biggest discrepancy of estimates of two different ZOI for one given period of time.[5] The maximum value of a minimal absolute error is 0.5 pp. Hence there exist a case where the estimates from two different ZOI have its closest point 0.5 pp from each other. All other estimates of this case are even further than 0.5 pp. The minimum value of a maximal absolute error is 0.4 pp. So, even the closest estimates differ by 0.4 pp at some time period. Weighted average of an average absolute error is 0.44 pp. Output gap estimates from various ZOI differ in average by this value. Last chosen value is weighted average of differences between maximal and minimal (not absolute) error. This indicator "penalizes" crossing of time series. Indicator stays low, when time series differ by approximately constant value and have a similar trend. High value of weighted average of this indicator (1.08 pp) gives evidence of frequent and strong crossing of time series and therefore of inconsistent estimates of output gap values.

1.2 Approach 2

Figure 2 depicts output gap values a bit differently than Figure 1. The horizontal axis is not marked with time (as in Figure 1), but with individual Inflation Reports (ZOI) according to its publication. A line on the graph therefore denotes estimates of various

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[2]Strictly speaking, the square is shifted one month back in order to lay on the line.
[3]There are 66 of these "overlays".
[4]Weights are lengths of "overlays" (count).
[5]Actually, it doesn't have to be the ultimate biggest number because time series with less than 6 overlaying values were not investigated.
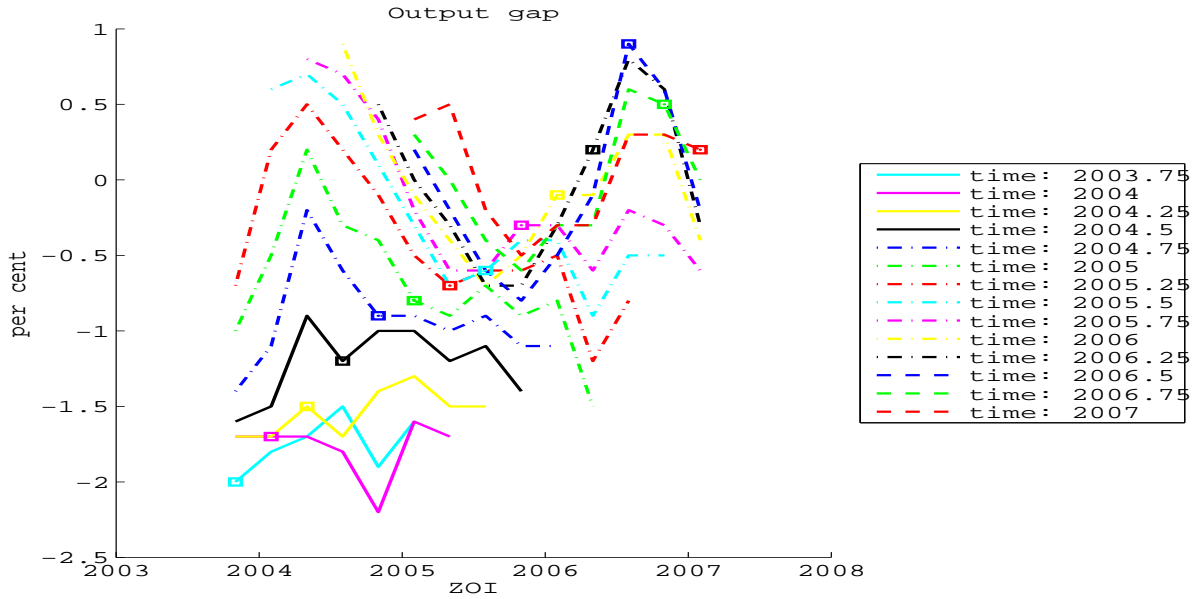
Figure 2: Output gap values for given time periods

ZOI for one given time period stated in legend. Again, to ease legibility, a square on the line denotes a point, when the time in legend and a publication date of ZOI match.

Example of how to read in Figure 2 follows: Green dash–dotted line represents, according to legend, estimates of output gap for fourth quarter of 2004. Inflation reports, which published estimates for this time period are ZOI from 10–2003 up to 04–2006: these are the points, where the line begins and ends.

Figure 2 shows some places, where are the lines in a given point on the horizontal axis (= given ZOI) shifted up or down. An example of the most striking shift upwards is the "optimistic" ZOI 04–2004. The deviation can be possibly explained by a bad calibration of the CNB model or maybe bad data as well. The most striking shift downwards is not so prominent and is published by the "pessimistic" ZOI 04–2006.

Similarly to the previous part, an analysis is introduced here. In this case, only the standard deviation and a difference between maximal and minimal value in the series are reported. A restriction is also similar, the length of the series must be at least 6 values: Estimate of output gap for a given period of time must be published in at least 6 Inflation Reports. There are 17 of such series and Table 2 presents summary statistics.

	count	std	diff. m–m
MIN	6	0.15	**0.40**
MAX	12	0.56	**1.70**
O. MEAN	09	0.38	1.16
W. MEAN	10	0.40	**1.23**

Table 2: Summary statistics for analysis of output gap values for given time periods

The difference between maximal and minimal value must be interpreted a bit differently than in the previous case. It is a difference between the most "optimistic" and

"pessimistic" ZOI in publishing estimates for given time period. The lowest discrepancy is 0.4 pp and the highest is striking 1.7 pp. Average difference between the most "optimistic" and "pessimistic" ZOI is 1.23 pp.

2   Confidence bands for output gap estimates

Figure 3 depicts estimated densities[6] of output gap estimates for a given time period by various ZOI. More concretely, each line in Figure 3 is an estimated density of values represented by the lines in Figure 2. Almost all of the densities are unimodal, which indicates that the estimates are centered and spread around the mean. The estimated densities from 2005.75 to 2006.75 seem quite flat, which means higher uncertainty about the "true" value of output gap.

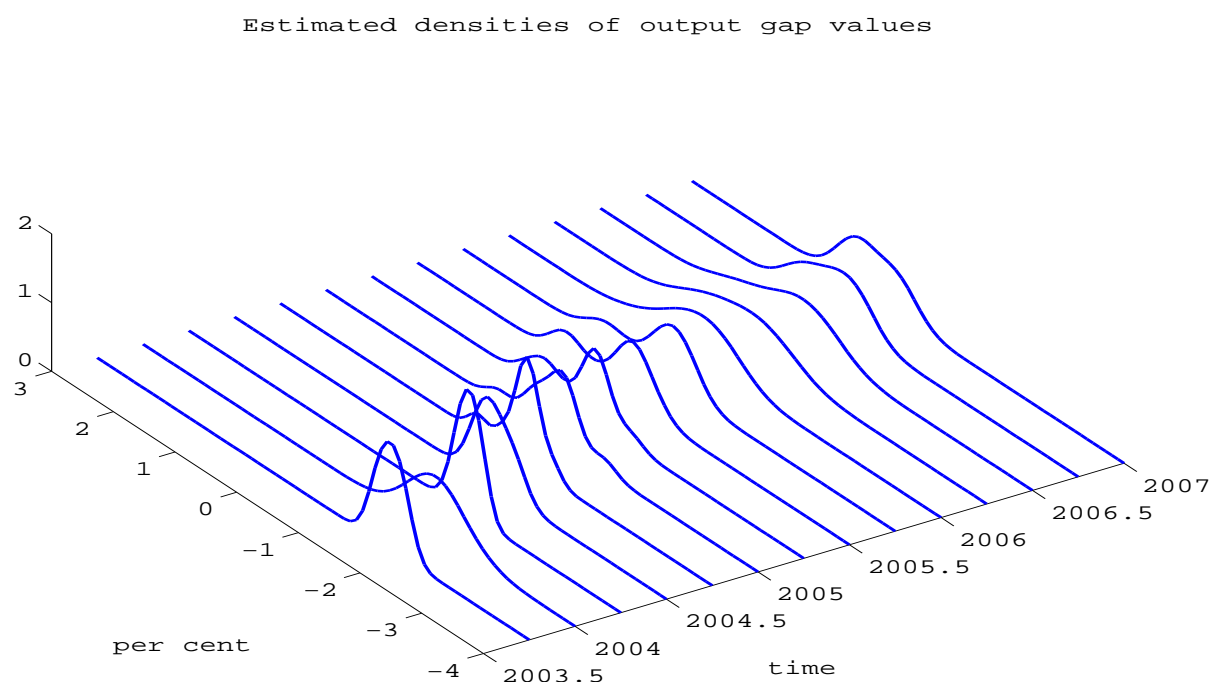Estimated densities of output gap values

Figure 3: Estimated densities of output gap estimates

Figure 4 presents confidence bands for "true" values of output gap computed from estimated densities that are depicted in Figure 3. Values for confidence bands are computed as $\frac{\alpha}{2}$ and $1 - \frac{\alpha}{2}$ quantiles, respectively.

The amount of uncertainty is clearly visible in Figure 4. The greatest uncertainty about the "true" value of output gap is in 2006.5 where the 99% bands are about 3 pp wide. Narrowing of confidence bands in the last two quarters doesn't necessarily mean less uncertainty, or, a better guess. There are still a lot of Inflation Reports yet to come that will publish output gap estimates for these time periods and possibly widen the confidence band.

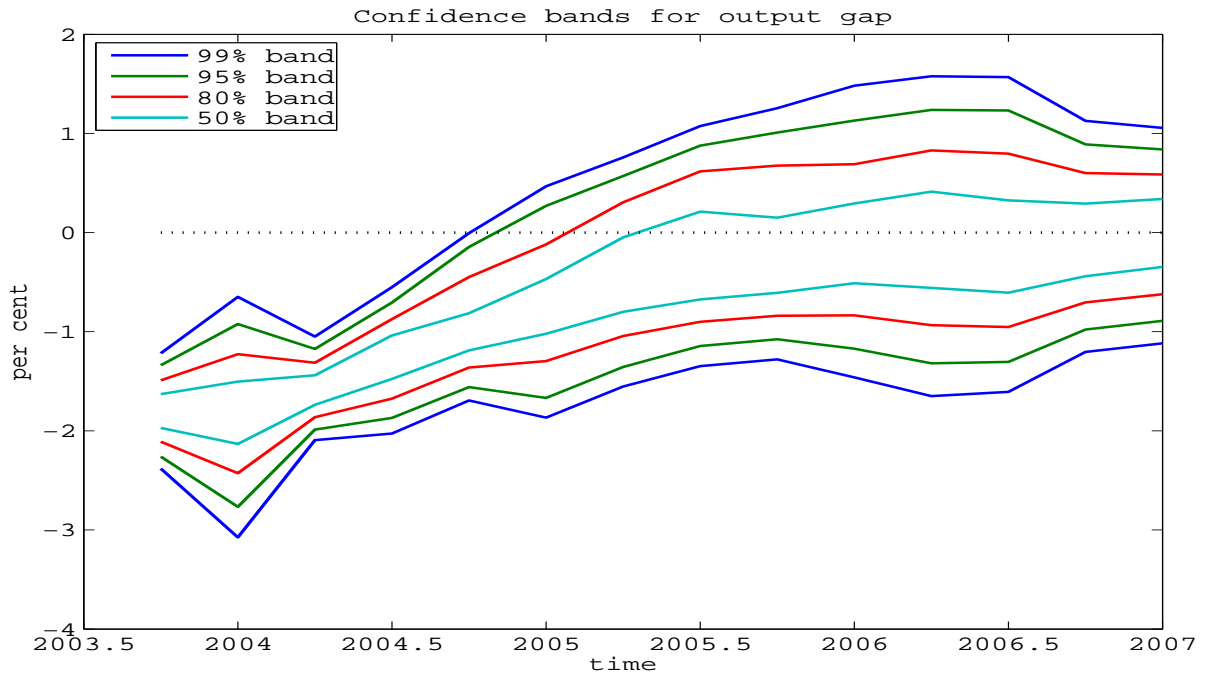[6]Matlab function *ksdensity* was used to compute density estimate using kernel–smoothing method.

Figure 4: Confidence bands for output gap values

3 Comparison of prognosticated and "real" values of output gap

Figure 5 depicts prognoses and corresponding "real" values. Time series are drawn in two panels for clarity. Also because there doesn't seem to be any regularity in the graph, numerical analysis follows. Computed numerical characteristics are the same as in Table 1 with the exception of a number of (overlaying) values, because there are always 6 of them. For this reason, ordinary and weighted means are the same.

	std	avg. abs. err.	max. abs. err.	min. abs. err.	diff. m–m
MAX	0.59	0.97	**1.20**	**0.60**	1.50
MIN	0.16	0.17	**0.40**	0.00	0.40
MEAN	0.32	**0.54**	0.88	0.20	**0.80**

Table 3: Summary statistics for analysis prognosticated and "real" values of output gap

First bold number in Table 3 is a maximum value of maximal absolute error, which is 1.2 pp. The biggest discrepancy between prognosis and "reality" that can be found in the whole data set is therefore 1.2 pp. The highest value of a minimal absolute error shows that there are time series of prognosis and "reality" that differ by 0.6 pp or more. The lowest value of a maximal absolute error on the contrary shows time series with the lowest prognostic error, that is, time series that are nearest to each other. These time series differ in no point by more than 0.4 pp. The average absolute error is 0.54. The average value of a difference between maximal and minimal error is 0.8 pp. Again, it is higher than the average value of an average absolute error, which indicates crossing of prognosis time series with "reality" time series.
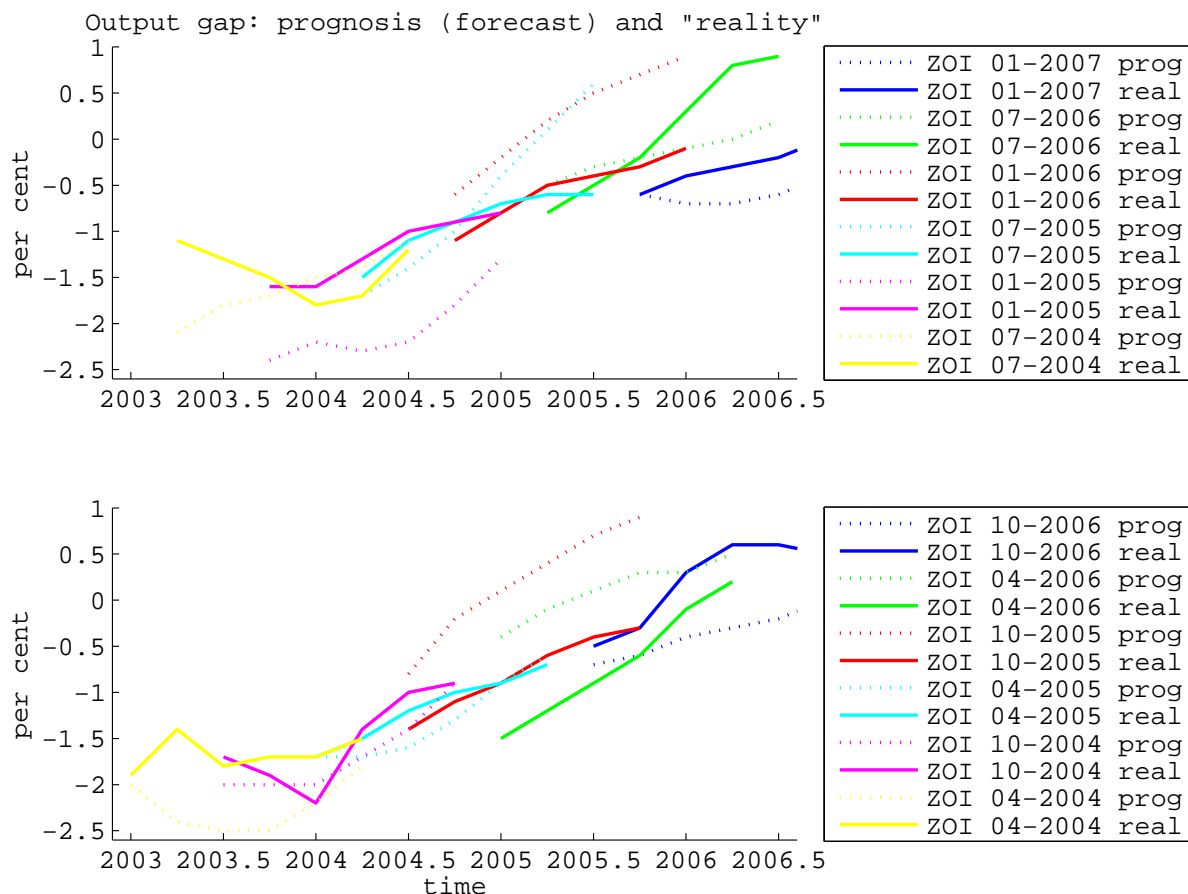
Figure 5: Prognosis (forecast) and "reality"

Conclusion

The paper analyses output gap values published by the Czech National Bank. It shows that output gap estimates are uncertain and substantial revisions occur very often. Revisions are frequently so radical, that it also changes the sign of the output gap value, which means that it is not known, if the economy is above its potential or below it.

The contribution's aim was fulfilled with a result that ascertained data uncertainty is very strong and the quality of output gap estimates is low.

Acknowledgement

References

[1] Czech National Bank: *Inflation reports* July 2003 – January 2007 (15 reports)

[2] Čapek, Jan: Nejistota českých makroekonomických dat: úvodní analýza: mezera výstupu. In *MEKON 2007* Ostrava, ISBN 978-80-248-1324-0.