



GDAŃSK UNIVERSITY OF TECHNOLOGY  
FACULTY OF MANAGEMENT AND ECONOMICS

# CREDIBILITY OF CENTRAL BANKS INFLATION FORECASTS

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GUT Faculty of Management and Economics  
Working Paper Series A (Economics, Management, Statistics)  
No 7/2016 (37)

February 2016

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This version 19/02/2016

## Abstract

Modern monetary policy focuses on credibility and shaping consumers' inflation expectations. According to the concept of inflation forecast targeting (IFT), inflation forecasts play a crucial role in the instrument rate decision-making process and may be a specific intermediate target. The aim of the study is to analyse the credibility of inflation forecasts published by the central banks of England, Sweden and Norway. The article presents the proposition of an inflation forecast credibility index. The inflation forecasts' credibility index may be calculated for all types of inflation forecasts made by central banks, which implement an inflation targeting (IT) regime. It consists of three main elements: the accuracy of the forecasts, the similarity of the forecasts and the inflation forecast deviations from the inflation target. The credibility index has been calculated for the inflation forecasts made by central banks of England, Sweden and Norway. The research conducted shows that most of the inflation forecasts published in selected central banks were credible.

Keywords: inflation forecasts targeting, inflation forecast, inflation forecast credibility index, inflation expectations

JEL codes: E58, E52, E47

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\*The article presents the results of the research financed by the National Science Center in Poland: "Forecasting inflation on the basis of DSGE models in the implementation of inflation targeting in selected central banks" contract No 2013/09/N/HS4/03766.

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# 1. Introduction

Almost every central bank implementing an inflation targeting regime (IT) publishes inflation forecasts. According to L.E.O. Svensson (1997), “inflation forecasts play a crucial role in modern forward-looking monetary policy.” Firstly, inflation forecasts shape consumers’ inflation expectations and, in the long term, anchor them to the inflation target. Inflation forecasts are the main part of central banks’ transparency strategy and should develop their credibility (Szyszko, 2013). Inflation targeting may take the form of inflation forecasts targeting (IFT). L.E.O. Svensson has created the concept of IFT, in which the inflation forecast plays the role of an intermediate target of monetary policy and becomes a basis for the instrument rate decision-making process in central banks.

Inflation forecasts may be made on the basis of three different instrument-rate assumptions: the constant instrument rate during the forecast horizon (CIR), market expectations of the future interest rates (ME) and the endogenous rate (Svensson & Tetlow, 2005). These assumptions are directly connected with the Monetary Policy Committee’s decision-making procedure. Made on the assumption of CIR, the inflation forecast may be an intermediate target in the procedure called the rule of thumb. This procedure may be presented as follows: if the inflation forecast is in the medium horizon above the inflation target, the central bank should raise the instrument rate; if the inflation forecast is in the medium horizon below the inflation target, the central bank should lower the instrument rate; if the inflation forecast is equal or very close to the inflation target, the central bank should leave the instrument rate at the same level (Svensson, 1997). Made on the assumption of the endogenous instrument rate, the inflation forecast requires implementing an optimal monetary policy path, one in which the Monetary Policy Committees make the decisions about the instrument rate according to and similar to the published instrument rate forecast (Svensson & Woodford, 2003). In the long term, every type of inflation forecast should be equal or very close to the inflation target (Svensson & Tetlow, 2005).

The studies of inflation forecasts published by central banks may be divided into two types. The first type of studies involves analysis of the accuracy of the inflation forecasts. The Bank of England (BoE) publishes density forecasts made for each quarter (mean, standard deviation and skewness). For external researchers such transparency facilitates the conducting of studies. Inflation forecasts errors have been analysed by K. Wallis (2003) and K. Dowd (2007). These studies are only limited to inflation forecasts made on the CIR assumption. The inflation forecasts made on the ME assumption were analysed by M. Knüppel and G. Schulte Frankenfeld (2008). The accuracy of the inflation forecasts made by the CIR assumption and ME assumption in the Bank of England have yet to be compared.

The inflation forecasts made on the assumption of CIR and published by the Central Bank of Sweden and the Bank of England were also analysed by K. Dowd (2004). The conducted research proved that the inflation forecasts made by Swedish National Bank are more accurate than the inflation forecasts made by the Bank of England. The subject of the before-mentioned research was the inflation forecasts made on the assumption of the constant rate during the forecast horizon. Likewise, the inflation forecasts made by the Central Bank of Norway were examined by N. Skrova-Falsch and R. Nymoen (2011). The study conducted here compares central banks' forecasts made on the assumption of the endogenous rate with naïve forecasts with forecasts obtained from external econometric models (Skrova-Falsch & Nymoen, 2011).

The second type of research study involves analysis of inflation forecasts from the point of view of inflation forecast targeting. The research conducted by M. Szyszko examined interdependency between inflation expectations and inflation forecasts (2013).

In the article we propose an index which may connect these two types of studies and so be used to measure the credibility of all kinds of inflation forecasts. The aim of the study is to analyse whether the inflation forecasts made by the central banks of England, Sweden and Norway are credible. The Central Bank of Norway is, according to Svensson, a pioneer in implementing an optimal monetary policy path (Svensson & Tetlow 2005). The Swedish National Bank is the only central bank implementing the IT regime, which has published all three types of inflation forecasts made on the CIR, ME and the endogenous rate assumption, respectively. In addition, the Bank of England is the only central bank implementing the IT regime, which publishes in parallel two kinds of inflation forecasts made on the CIR and ME assumptions. The central banks selected here officially declare the use of IFT procedures.

**Our hypothesis assumes that the inflation forecasts published by central banks of England, Sweden and Norway are credible.** In order to conduct the study, we have created a concept of an inflation forecasts credibility index.

The research presented in the article is the first complex analysis of the credibility of inflation forecasts.

## **2. Methodology and research assumptions**

The concept of the inflation forecast credibility index is based on four assumptions.

First assumption. *Not only the present but also the previous inflation forecasts shape the inflation expectations.* Economic agents make their decisions on the basis of present and previous inflation forecasts and they will remember if the previous ones were inaccurate.

Second assumption. *Inflation forecasts are considered credible if they do not differ significantly from the previous forecasts.* When consecutive inflation forecasts differ significantly from each other, the economic agents do not believe in them. In this situation, inflation forecasts do not shape inflation expectations properly.

Third assumption. According to the L.E.O. Svenssons' concept of IFT, *inflation forecasts at the end of the forecast horizon should be equal or very close to the inflation target.* Only then may inflation forecasts guide the consumers' inflation expectations to the inflation target.

Fourth assumption. *The credibility of inflation forecasts declines exponentially.* This assumption entails that when inflation forecasts are considered very credible, this credibility can decline very quickly. It does not make any difference to the economic agents in making economic decisions whether the inflation forecasts are not very credible or are not credible at all.

The inflation forecasts credibility index consists of three main elements: the accuracy of inflation forecasts, the similarity of the consecutive inflation forecasts and the inflation forecast deviations from the inflation target.

**The accuracy of the inflation forecast** is measured as follows. Central banks make the inflation forecasts three or four times per year. If the central bank publishes three inflation forecasts per year, the accuracy of the inflation forecasts is the sum of weighted absolute errors of both the previous and present forecasts. If the central bank publishes four inflation forecasts per year, then the accuracy of the inflation forecasts will be the sum of weighted absolute errors of the two previous and one present forecasts. We shall denote:

$j$  – inflation forecast horizon (quarters),

$i$  – number of inflation forecast,

$y_i$  – inflation forecast,

$\dot{y}_i$  – inflation rate,

$MAE_{y_i}$  – present inflation forecast absolute error,

$w_i$  – weight of the inflation forecast absolute error,

$A_{y_i}$  – accuracy of the inflation forecast.

The inflation forecast absolute error is measured using the formula:

$$MAE_{y_i} = \frac{1}{j} \sum_{i=1}^j |\dot{y}_i - y_i|. \quad (1)$$

For the central bank that publishes inflation forecasts three times per year, the formula for accuracy of the inflation forecast is as follows:

$$A_{y_i} = w_{i-2} MAE_{y_{i-2}} + w_{i-1} MAE_{y_{i-1}} + w_i MAE_{y_i}. \quad (2)$$

For the central bank that publishes inflation forecasts four times per year, the formula for accuracy of the inflation forecast is as follows:

$$A_{y_i} = w_{i-3}MAE_{y_{i-3}} + w_{i-2}MAE_{y_{i-2}} + w_{i-1}MAE_{y_{i-1}} + w_iMAE_{y_i}. \quad (3)$$

The structure of the **index of similarity of inflation forecasts** also depends on the frequency of the forecasts publication. If the central bank makes the inflation forecasts three times a year, the inflation forecast will be compared to the two previous forecasts. The similarity of the forecast is measured for the middle part of the forecast horizon. This means that this study only involves the forecast horizon without the first two and the last two quarters. If the inflation projections are made four times per year, then the inflation forecast is compared to the three previous forecasts and the study involves only the forecast horizon without the first three and the last three quarters. We shall denote:

$S_{y_i}$  – similarity of inflation forecast.

For the central bank publishing inflation forecast made three times per year, the formula for the similarity of the inflation forecast is as follows:

$$S_{y_i} = \left( \frac{|y_i - y_{i-1}| + |y_i - y_{i-2}|}{2j} \right). \quad (4)$$

For the central bank publishing inflation forecast four times per year, the formula for the similarity of the inflation forecast is as follows:

$$S_{y_i} = \left( \frac{|y_i - y_{i-1}| + |y_i - y_{i-2}| + |y_i - y_{i-3}|}{3j} \right). \quad (5)$$

As the next step, the **absolute deviations of the inflation forecast** from the inflation target are measured. We shall denote:

$\pi$  – inflation target,

$D_{y_i}$  – deviations of inflation forecast from the inflation target.

The formula for the deviation of the inflation forecast from the inflation target is as follows:

$$D_{y_i} = \left| \frac{y_i - \pi}{j} \right|. \quad (6)$$

The accuracy, similarity and deviations from the inflation target are then used to determine the **inflation forecast credibility index**. The credibility index is shown in the form of a natural exponential function. The formula for the credibility index is as follows:

$$C_{y_i} = \frac{100}{\exp(A_{y_i} + v_i S_{y_i} + z_i D_{y_i})} \quad (7)$$

The sum of weights is equal to 1. For forecasts published three times a year, it is  $w_i + w_{i-1} + w_{i-2} + v_i + z_i = 1$  while for forecasts published four times a year, it is

$w_i + w_{i-1} + w_{i-2} + w_{i-3} + v_i + z_i = 1$ , where  $v_i$  is the weight of the similarity index and  $z_i$  is the weight for deviations. The weights given to accuracy, similarity and deviations depend on the central banks' preferences.

To conduct this research we have chosen theoretical weights. The theoretical formula for inflation forecasts published three times per year is as follows:

$$C_{y_i} = \frac{100}{\exp(0,1MAE_{y-2} + 0,2MAE_{y_{i-1}} + 0,3MAE_{y_i} + 0,2S_{y_i} + 0,2D_{y_i})}. \quad (8)$$

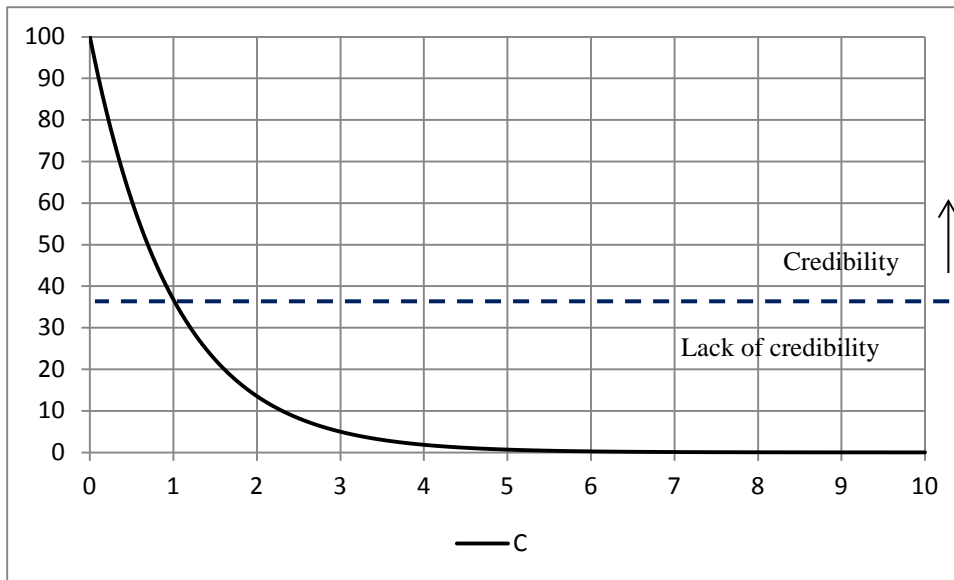
The theoretical formula for inflation forecasts published four times a year is as follows:

$$C_{y_i} = \frac{100}{\exp(0,05MAE_{y_{i-3}} + 0,1MAE_{y_{i-2}} + 0,15MAE_{y_{i-1}} + 0,3MAE_{y_i} + 0,2S_{y_i} + 0,2D_{y_i})} \quad (9)$$

The index of credibility was constructed in the form of a natural exponential function. It is assumed that even if the forecasts are considered credible, small errors can lower their credibility very quickly. If the forecasts are considered not very credible, the small errors will not create such a significant difference for consumers and the reduction of credibility will be smaller.

The values of the credibility index are in the range (0, 100). The values of 0 and 100 may be defined as extreme results. If the value of the index is close to 0, the inflation forecast is not credible at all. If the value of the index is close to 100, then the inflation forecast is absolutely credible, but such a situation will never take place.

The inflation target for central banks implementing the IT strategy is usually presented in the form of a quantitative point with a symmetrical tolerance range for deviations of +/- 1 p.p. (26 out of 27 central banks implementing the IT regime declare 1 p.p. range of deviations). The index of credibility has been created on the basis of absolute differences between the values of inflation forecasts and the inflation rate, consecutive inflation forecasts, inflation forecasts and the inflation target. If the sum of the weighted accuracy, similarity and deviations for the chosen forecast is smaller than one, then the value of the credibility index is larger than 36.5 and the inflation forecast should be considered credible. If the sum of weighted accuracy, similarity and deviations for the chosen forecast is greater than one, then the value of the credibility index is smaller than 36.5, while the inflation forecast should be considered to completely lack of credibility. The theoretical values of the credibility index formula are presented in Figure 1. The interpretation of credibility index is given in Table 1.



**Figure 1: Inflation forecast credibility index**

Source: author's calculations.

**Table 1: The interpretation of inflation forecasts credibility index**

Credibility index	Interpretation
$(0; 36.5>$	Inflation forecast is not credible
$<36.5; 100)$	Inflation forecast is credible

Source: own.

### 3. Data

Inflation forecasts made by central banks implementing the IT regime are presented in the form of fan charts. The fan chart consists of the central path and uncertainty intervals. The inflation forecast credibility index is calculated only for the inflation forecasts central paths and does not take into account surrounding intervals.

The research involves the calculation of the credibility index of the central paths of inflation published by central banks of England, Sweden and Norway. For each central bank, the separate analysis has been conducted. The time horizon for the study in all central banks has been chosen due to the available data. Inflation forecasts made by selected central banks differ in horizon, assumptions of instrument rate and measure of inflation. The description of the data is given in Table 2.



**Table 2: Description of the data**

Central bank	Instrument rate assumption		Measure of inflation in forecast		Forecast horizon		Frequency of publishing inflation forecasts (per year)	
	Assumption	Time horizon	Measure	Time horizon	Forecast horizon	Time horizon	Frequency	Time horizon
Bank of England	CIR	02.1993-05.2012	RPIX	02.1993-02.2004	7	02.1993-11.1993	4	02.1993-05.2011
			CPI	05.2004-05.2012	8	02.1994-05.1993		
					9	08.1993-05.2012		
	ME	02.1998-05.2011	RPIX	02.1998-05.2004	9	02.1998-05.2011		
			CPI	11.2004-05.2011				
Central Bank of Norway	Endogenous	02.2006-03.2010	CPI	02.2006-03.2010	Consecutive 13,14,15,16	02.2006-03.2010	3	02.2006-03.2010
Swedish National Bank	CIR	03.1999-01.2005	CPI	03.1999-03.2010	9	03.1999-02.2005	4	03.1999-04.2005
	ME	02.2005-03.2006			13	03.2005-03.2006	3	01.2006-03.2010
	Endogenous	01.2007-03.2010			14	01.2007-03.2010		

Source: own.

This first analysis focuses on the case of the Bank of England (BoE). The BoE has produced its own macroeconomic forecasts in February 1993. It imposes the starting point of the research. Inflation forecasts can be divided into four data sets. The first data set consists of forecasts measured by RPIX and made on the CIR assumption. The second consists of forecasts measured by RPIX and made on the ME assumption. The third involves forecasts measured by CPI and made on the CIR assumption, while the last one is made up of forecasts measured by RPIX and made on the ME assumption. The inflation forecasts measure corresponds with the measure of inflation target. Since 1998 the Bank of England has been publishing two types of forecasts in parallel based on the CIR and the ME assumption. The credibility of these two types of forecasts has been compared. The study of the inflation forecasts central paths published by the BoE has been conducted for forecasts made from 1993 to May 2011. The credibility index has then been calculated for 117 inflation forecasts.

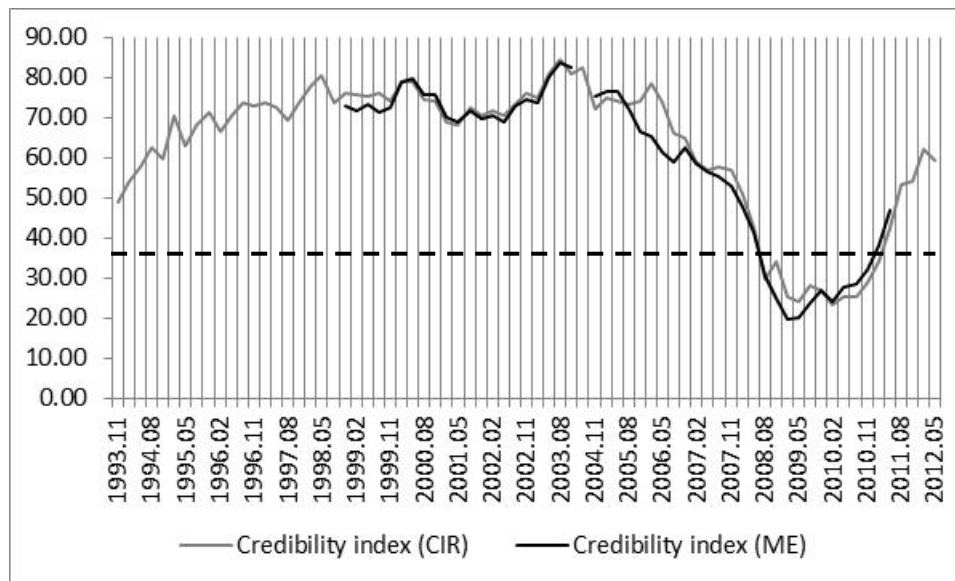
The study of the inflation forecasts central paths published by the Central Bank of Norway has been conducted for the years 2006-2010. The inflation forecasts were made on the endogenous rate assumption and were published three times per year. The credibility index was thus calculated for 12 inflation forecasts.

The inflation forecasts published in the Central Bank of Norway may be divided into three data sets. The first data set consists of inflation forecasts made on the CIR assumption, the second

on the ME assumption and the third on the endogenous rate assumption. The study of the inflation forecast central paths published by the BoE was conducted for forecasts made from March 1999 to March 2010. The credibility index was calculated for 40 inflation forecasts.

## 4. Results

The values of the credibility index calculated for the inflation forecasts published in the Bank of England are presented in Figure 2.



**Figure 2: Credibility of inflation forecasts made by Bank of England**

Source: author's calculations.

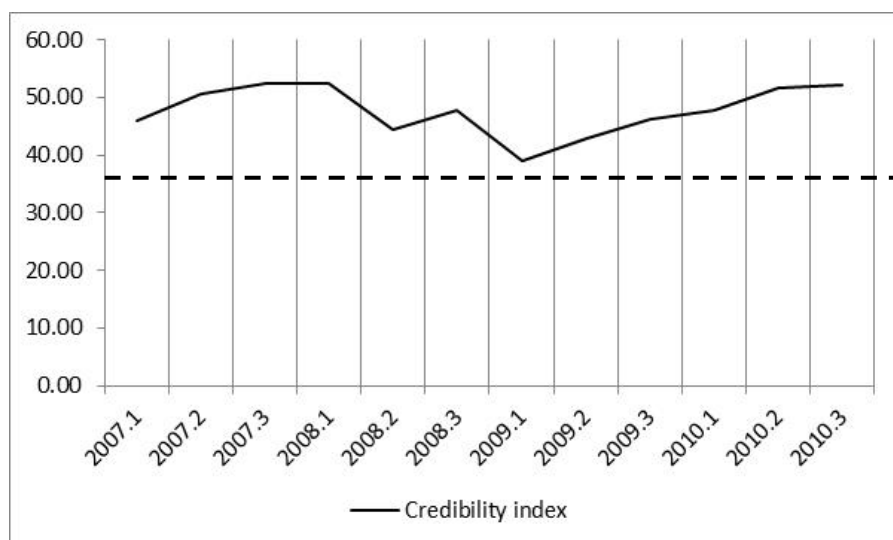
The conducted research shows that only inflation forecasts made between the years 2008-2010 were not credible (12 inflation forecasts). The differences in credibility between the inflation forecasts made on the CIR and ME assumptions are not significant. The mean values of the inflation forecast credibility index calculated for the inflation forecasts published from February 1998 to May 2005 are given in Table 3.

**Table 3: The interpretation of inflation forecasts credibility index**

Mean value of credibility index	Assumption of instrument rate	Interpretation
60.96	CIR	Inflation forecast is credible
59.05	ME	Inflation forecast is credible

Source: own.

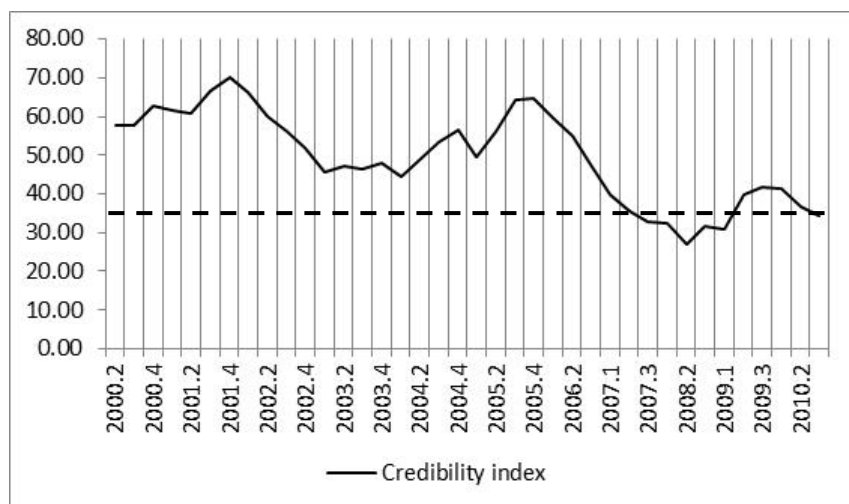
The inflation forecasts published in the Central Bank of Norway were credible. The values of the credibility index calculated for the inflation forecasts published in Central Bank of Norway are presented in Figure 3.



**Figure 3: Credibility of inflation forecasts made by Central Bank of Norway**

Source: author's calculations.

In the Central Bank of Norway, only the inflation forecasts made from February 2007 to February 2009 were not credible (7 inflation forecasts). The values of the credibility index calculated for the inflation forecasts published in Central Bank of Norway are then presented in Figure 4.



**Figure 4: Credibility of inflation forecasts made by Swedish National Bank**

Source: author's calculations.

The mean values of inflation forecast credibility index calculated in the selected central banks are shown in Table 4. These results cannot be compared because of a different time horizon.

**Table 4: Mean values of credibility index in selected central banks**

Central bank		Mean value of credibility index	Horizon of the study
Bank of England	CIR	62.73	11.1993-05.2012
	ME	59.05	11.1998-05.2011
Central Bank of Norway		47.97	02.2006-03.2010
Swedish National Bank		49.53	03.1999-03.2010

Source: own.

## 5. Conclusion

The study that we have conducted shows that the majority of inflation forecasts published in the selected central banks was credible. However, the credibility of the forecasts declined significantly during the financial crisis. The credibility of the inflation forecasts published in the Bank of England did not depend on the chosen instrument rate assumption.

The obvious limitation of the study is the time horizon. Moreover, the issue of the assigned weights to the components of the credibility index is a debatable one, remaining theoretical and subjective. We will address and seek to solve this problem in the next study.

## Acknowledgement and Disclaimer

The article presents the results of research financed by the National Science Center in Poland: Forecasting inflation on the basis of DSGE models in the implementation of inflation targeting in selected central banks contract No. 2013/09/N/HS4/03766.

We thank the audience at the conference the 15th International Conference on Finance and Banking “25 Years of Economic and Financial Transition in Central and Eastern Europe” organized by The Department of Finance and Accounting at Silesian University, School of Business Administration in Karviná in 13-14 October 2015 in Prague in Czech Republic for developing the ideas presented here and a critical support.

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**Original citation:** Tura-Gawron K. (2016). Credibility of central banks inflation forecasts. GUT FME Working Papers Series A, No 7/2016(37). Gdansk (Poland): Gdansk University of Technology, Faculty of Management and Economics.

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