9. ARE WE SYSTEMATICALLY WRONG WHEN ESTIMATING POTENTIAL OUTPUT AND THE NATURAL RATE OF INTEREST?

"On croit quelquefois les choses véritables,
seulement parce qu'on les dit éloquemment"[1]
(Blaise Pascal, *Petits écrits philosophiques et religieux*)

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Abstract

In this paper we show that, in the process of estimating the natural rate of interest and the potential level of output, together, the algorithmic techniques alongside the natural and unavoidable expert judgment tend – with a high likelihood – to generate systematic biases of estimates. We formulate the following hypothesis: (i) during downturns, the final values of the natural interest rate and of the potential output level are highly likely to be overestimated by integrating algorithmic extraction and the results yielded by the anchoring heuristic; (ii) during boom periods and especially in times of financial bubbles, the final values are highly likely to be overestimated by integrating algorithmic extractions with the results yielded by employing the representativeness heuristic. Shifting from optimism to pessimism and vice versa plays a key role in the selection of heuristics. The overestimation thus generated can be a serious obstacle to the proper conduct of monetary policy. For Romania, the hypothesis is confirmed. In the period from 2005 to 2010, the potential level of output and the natural rate were systematically overestimated during both the upturn of the business cycle and the recession, as well as during the recovery phase.

Keywords: potential output, natural rate of interest, Romania

JEL Classification: E32, E43, E52

[1] "We sometimes believe things true only because they are narrated eloquently". (http://bibliotheq.net/blaise-pascal/petits-ecrits-philosophiques-et-religieux/index.html)

[2] I have benefited from useful discussions on earlier drafts of this paper with Nicolaie Alexandru-Chideşciuc, Cristian Bulete, Mihai Copaciu, Veaceslav Grigoraş, Tudor Grosu, Mădălina Militaru, Valeriu Nălban, Răzvan Radu and Andrei Tănase, whose comments are gratefully acknowledged.

The views expressed herein are those of the author and do not necessarily reflect the views of the National Bank of Romania.

I. Introduction

As of 2013, in Romania, GDP has increased at generally higher rates than the potential ones; the volume of new loans has risen, while net inflation (excluding the VAT rate cuts) and inflation expectations have trended downwards. How can credit and output expand at a very fast pace without an accompanying rise in net inflation and inflation expectations? An immediate explanation lies in the positive supply-side shocks, *i.e*. the decline in oil prices, in agricultural product prices (amid the bumper crops of 2013 and 2014), as well as in some indirect taxes, other than the VAT. Particularly under the influence of these factors, inflation remained subdued, which led to improved inflation expectations. But, supply-side shocks and inflation expectations put aside, what is left to explain inflation is the demand deficit/surplus. How does the recent years' relative demand explain inflation? Was there a demand shortfall exerting disinflationary pressures or else an inflationary demand surplus?

The conventional explanation is that there have been *a negative (contractionary) output gap and a negative (expansionary-inflationary) interest rate gap* starting in 2010 (both being unobservable variables), which still persist. Under the circumstances, output growth can outpace potential rates without accelerating inflation[3].

Romania has entered the seventh year when both the output gap and the interest rate gap are still negative, irrespective of the author of estimates. Many forecast authors anticipate that, given the fiscal easing, the economic growth rate projected for 2016 and the potential GDP level, the output gap will close in the latter part of the year. This means that, in the absence of the fiscal easing scheduled for 2016, the output gap would have closed even later, probably during the eighth year since the entry into recession. Was fiscal easing necessary to accelerate the closing of the output gap and this was not properly understood by the critics of the program that will widen the budget deficit from 1.2 percent of GDP in 2015 to 3 percent of GDP in 2016? Or is there another explanation?

[3] The conventional explanation that economists provided for these developments was that a negative (recessionary-disinflationary) output gap emerged at the beginning of 2010. This gap resulted from a combination of sharp declines in both actual and potential output. The creation of this gap was accompanied by the emergence of a negative (stimulative-inflationary) interest rate gap, resulting from a drop in the *ex ante* real interest rate, required in order to reflect the decline in the natural rate of interest and to stimulate the economy. The output gap has narrowed in time, but is still negative, exerting disinflationary pressures. After the outbreak of the crisis, except for 2009, the interest rate gap has been quasi-permanently negative, *i.e*. stimulative. Against this background, the faster GDP rise above its potential rate starting 2013 was also due to the stimulative (negative- inflationary) interest rate gap and was welcome as well, because the actual GDP was on the rise towards the potential level without however reaching it. The volume of new loans embarked on an upward path, contributing to the pick-up in economic growth, whereas the inflation rate (net of the VAT effect) did not gain momentum. Inflation remained subdued, influenced – as already pointed out – by the reduction in crude oil prices, the successive bumper crops and the cuts in indirect taxes, as well as by the ongoing domestic demand shortfall. The persistence of low inflation led to a reduction in inflation expectations.

One of the explanations proffered when showing why the output gap and the natural rate gap have remained in negative territory for so many years was the *severity of the 2008 crisis*. During a severe downturn and in the recovery phase from such a recession[4], the spare capacities might be much reduced, because "unemployed workers who leave the labor market […] become economically inactive, firms […] close, leaving depressed areas and regions", while "banks […] become very strict with their lending" (Jahan and Mahmud, 2013). In addition, the dramatic fall in investment, as it happened in Romania, diminishes the available capital stock. All these are major changes in themselves in the structure of the economy or produce such changes with celerity.

Under the circumstances, the *de facto values* of potential output and of the natural rate of interest, *i.e*. those that operate in reality, but which we will never know for sure[5], drop to relatively low levels. Given these levels and a certain interest rate policy, the sharper the drop in the *actual values* of GDP, the wider the output gap and the longer the period during which it closes. The vast majority of studies assume equality between the *de facto* values and the *estimated values* of the potential output. For this reason, given the actual output values, a distinction cannot be made between a *de facto* period for output gap closing, dictated by the *de facto* values of potential GDP, and an apparent one, shaped by the estimated values of potential GDP.

However, the period of negative output gap might artificially seem protracted if there is an *overestimation of values* (upward bias of estimates) for the potential output and hence for the natural interest rate[6]. Given the actual GDP values and the interest rate policy, the larger the overestimation of potential values, the longer the period in which the two gaps – of the interest rate and of GDP – appear as negative.

Looking at econometric techniques, estimation errors (over- or underestimates) are usually explained by the relatively low quality of real-time data (end-of-sample problem) or by the short data series. If the period under review is long enough, the sum of errors generated by these causes is zero, while a systematic bias of estimates cannot be identified. In this paper, however, the focus is on *explaining systematic errors*.

In the following section, we will show that systematically overestimating the potential GDP level and/or the natural rate of interest is objectively possible. It is generated by

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[4] This distinction between "downturn" and "the recovery from a deep recession" is important for understanding the dynamics of the output gap. For instance, if the output gap was markedly positive (stimulative-inflationary) during the good times, it is possible that the first year of recession might see a very sharp drop in output, yet still positive GDP gap. Then, it is usual that – as the rates of decline in output slow down – the GDP gap turns increasingly negative for a while. Finally, when output starts to rise at positive and relatively high rates, the output gap might still be negative, but tends to close. Thus, during the recovery from a deep recession, the output gap is rather significantly negative.

[5] This is valid for any reference hereinafter to unobservable values that exist/operate in reality.

[6] It should be pointed out here that, ceteris paribus, a negative gap of the natural rate of interest accelerates inflation, a positive gap decelerates it, while a zero gap leaves it unchanged. Hence, during a downturn or when the economy emerges from a deep recession, a central bank seeks to place the interest rate below the natural rate of interest in order to stimulate the economy. If the natural rate is overestimated, the negative gap of the interest rate that the central bank sets by setting the monetary policy rate vis-à-vis the overestimated natural rate is implicitly less stimulative than the bank intended it to be.

the presence of real-time subjective judgment, along with econometric techniques, in the processes of obtaining final estimates and extends (shortens) the apparent periods of negative (positive) gap closing. Section 3 checks the systematic overestimation hypothesis by means of the successive estimates conducted by the NBR from 2007 Q2 to 2015 Q3 for the period 2005-2010 using its forecasting model. Section 4 argues in favor of the hypothesis that, during a recession, the anchoring heuristic is primarily at work when explaining systematic overestimation, while in times of boom and financial bubbles the latter is mainly triggered by the representativeness heuristic. Shifting from optimism to pessimism and vice versa plays a key role in the selection of heuristics. Section 5 describes several consequences of overestimation from the perspective of macroeconomic policies. Section 6 concludes.

II. The equilibrium level overestimation hypothesis

The economic meaning of overestimation can be understood starting from the aforementioned changes, which occur in the structure of the economy in the aftermath of a crisis and generate a decline to low levels in the *de facto* values of potential output and of the natural rate of interest. However, unlike the explanation based on the severity of the crisis, we now make a more realistic assumption, that the *de facto* and estimated values are usually different for both potential output and natural interest rate.

My hypothesis, which I will explain below, is that, generally, *econometric models* and *expert judgment*, together, convert these *declines in the de facto values* into *insufficient adjustments of the estimated values* of potential GDP and natural interest rate. What follows is an overestimation of these unobservable variables. If the overestimation hypothesis is accurate, chances that the conventional explanation mentioned at the beginning (see footnote 1) is the valid one become slimmer.

In order to be able to justify this hypothesis, it is first and foremost necessary to understand why judgment, which may entail systematically insufficient adjustments, cannot be separated from econometric techniques and eliminated from the estimation of unobservable variables. Then, we need to identify a mechanism that should guarantee – with a high likelihood – that downward adjustments of unobservable variables are insufficient.

As regards the former aspect, i.e. the need to employ judgment in the estimation processes, it is of the essence that unobservable economic variables are, by definition, associated with *uncertainty*. Estimating these variables, the same as forecasting, has increasingly become a science, by using sophisticated *mathematical models and techniques*. Still, scientific and sophisticated as they might be, such techniques cannot eliminate uncertainty. For this reason – and given the absence of the *ceteris paribus* clause in the economy – *judgment* necessarily plays an important role in determining the final estimated values. Thus, employing econometric techniques for an informed judgment is merely a step that experts take in the process of addressing the uncertainty associated with unobservable variables. The other step consists in *formulating judgments amid uncertainty*. At the end of the day, the estimated values are, naturally and necessarily, the result of combining purely algorithmic estimates with calibrations based on experience and judgment. Under these circumstances, there is a high likelihood for estimates to be systematically biased.

Turning to the latter aspect, namely the existence of the insufficient adjustment mechanism, we have resorted to findings from cognitive psychology. Tversky and Kahneman (1974) have shown that, under uncertainty, *people employ several heuristics in making judgments* (representativeness, availability and anchoring). They have pointed out that heuristics and biases (of estimates) are not restricted to laymen, but are also manifest with experienced researchers, when making intuitive judgments "in more intricate and less transparent problems" (p. 1130) and that "in general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors." (p. 1124).

Tversky and Kahneman (1974) have shown that, when required to make a numerical prediction, in many cases people start from a *relevant initial value*, which they see as an anchor and *which they adjust* in order to yield the final estimate. This initial value may result from "the *formulation of the problem* or it may be the result of a *partial computation*" and, very importantly for the reasoning here, "in either case, adjustments are typically insufficient. That is, different starting points yield different *estimates, which are biased toward the initial values*." (Tversky and Kahneman, 1974, pp. 1128-1129). This is the *anchoring* heuristic.

The insufficient adjustment hypothesis formulated above can now be explained by the fact that, in the process of estimating the natural rate of interest or potential output, *economists that calibrate models or make Bayesian estimates employ anchoring* to a larger or smaller extent. They can do that either directly, starting from previous estimates of potential GDP, or indirectly, using judgment and experience to impose limits, for instance, on the volatility of an estimated series, which may lead to insufficient adjustments in some situations. The wider the difference between the volatility of the observable series and the judgment-limited volatility of the unobservable series, the higher the likelihood that adjustments will be insufficient.

In order to be clearer on this mechanism, let us assume that, using the actual (observable) GDP series, the unobservable series regarding the potential GDP level (trend) is estimated on a quarterly basis and that the timing of the estimation is the fourth quarter in which the economy is mired into a deep recession. Experts have available all previous levels of actual (effective) GDP, including the relatively high ones during the boom period, and the four relatively low levels of actual GDP during the downturn.

The latter data could point to a decline in the *de facto* level of potential GDP during the slump, brought about by "permanent" negative shocks, for instance in productivity or in the propensity to save. In order to reflect this drop in their estimations, experts can make the new data series on potential output come down, in the concerned period, to certain levels; alternatively, they can impose the condition for the trend to display a certain volatility, either higher or lower. Nevertheless, according to the anchoring mechanism, "adjustments are typically insufficient". In the end, the estimated values for the potential GDP level exceed the *de facto* ones, i.e. they are overestimated, during the entire recession period. As a consequence, the absolute values of negative output gaps will be overestimated as well. This would be an overestimation induced by "a partial

computation"[7] which, for instance, results from the condition imposed on the trend volatility.

Looking at the natural rate of interest, the insufficient adjustment may emerge just like in the case of GDP, starting from the previous levels. However, as far as the natural rate is concerned, the "relevant initial value" may also frequently occur for the other reason mentioned by Tversky and Kahneman (1974), namely the "formulation of the problem". Until the early 2000s, economists assumed that the *natural rate of interest was almost constant*[8]. The underlying reason for such an assumption was the need for the natural rate to be compatible with normal average resource utilization over the long term, both being influenced by demographics, technology, the time preference rate and the fiscal policy. Taylor (1993) included a 2 percent steady state real rate[9] in his monetary policy

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7 The explanation based on insufficient adjustment is different from that provided by Orphanides and Norden (1999), who explain the severe bias around business cycle turning points of the real-time estimates of output gap through "the pervasive unreliability of end-of-sample estimates", without specifying the direction of the bias. The insufficient adjustment hypothesis also implies "data of limited validity" (Tversky and Kahneman, 1974, p. 1124), but in this case estimates are biased because anchoring systematically hinders the achievement of the de facto levels, either via overestimation or underestimation. Moreover, insufficient adjustments occur irrespective of the econometric estimation technique, even though the insufficiency of the adjustment can admittedly be higher or lower depending on the econometric technique employed. Hence, the insufficient adjustment explanation is not at odds with, for example, the findings of Berger et al. (2015), according to whom a multivariate filter that includes credit and house prices suggests that, in general, "sustainable output adjusted for the ups and downs of financial variables moves more steadily during financial 'boom and bust' periods than implied by conventional estimates such as univariate HP filters". This statement only claims that the estimation of sustainable output with the multivariate filter in the said conditions during the "boom and bust" period moves more steadily than the estimation yielded by an HP filter. The insufficient adjustment hypothesis merely states that the estimation of the potential level is typically lower (undervalued) or higher (overvalued) in relation to a potential de facto value, i.e. to a sustainable value.

8 This approach existed in spite of Wicksell's argument that the natural rate is variable: "Changes in the (average) natural rate may be presumed (on the basis of the Law of Large Numbers) to be continuous, while the money rate of interest is usually raised or lowered only in discontinuous jumps of one-half or one percent, at any rate insofar as it is regulated by the large monetary institutions." (Wicksell, 1936 [1898], p. 106).

9 The steady state rate equals the natural rate only if there are no shocks to the determinants of the real interest rate, i.e. in the deterministic view. The natural rate of interest is the same, both for systems with perfect competition and flexible prices and for systems with monopolistic competition and flexible prices. The natural rate is the prevailing rate under monopolistic (or perfect) competition, with fully flexible prices and shocks to determinants. Setting the interest rate at the natural level does not guarantee price or wage stability, because of shocks to the dynamic markups of prices or wages, which may affect the wedge between the efficient output level and the natural rate of output. Thus, this wedge does not remain unchanged, leading to a tradeoff between inflation and output-gap stabilization. Dynamic markup distortions can be interpreted as inefficient or efficient. This is difficult to measure (Woodford, 2003, p. 451). If interpreted as efficient, these distortions (shocks to price and wage markups) are included in the definition of the natural rate of interest. If these shocks to markups are included in the definition of the natural rate, then the natural rate is defined as the rate that would prevail in the economy in the absence of nominal rigidities. If the shocks to markups are not included in the

rule. Several papers employed similar hypotheses[10], so that the prevailing view over the said time horizon was that, if not a constant, *the natural rate is*, at best, *a variable with relatively low volatility* (which is tantamount to the "formulation of the problem"). In this case, almost any significant decline in the *de facto* natural rate "produces" an overestimation of the "estimated" natural rate, which is either constant or diminishes insufficiently because of anchoring.

The reduction in the growth rates seen in the developed economies as of the 1970s was reflected starting the 90s in studies that have shown *changes in economic growth rate trends*[11]. This, together with Woodford's (1999) inclusion of the natural rate in the demand equation of the new Keynesian model, and hence in the analysis of inflation, has sparked interest in highlighting the *time-variable nature of the natural interest rate*[12]. Much more recently, Hamilton et al. (2015) have shown that the natural rate does not display a tendency to converge over the long term towards a constant value and that there is only a weak link between the natural rate and the growth rate of actual or potential output, since other factors, such as personal discount rates, inflation trend, financial regulation and, eventually, bubbles have an influence on the natural rate of interest.

Finally, another concern was to determine whether the natural rate of interest is more volatile than the actual real rate of interest. Garnier and Wilhelmsen (2005) show there are two types of results in the studies investigating the contribution of the natural rate (the trend) to the change in the real interest rate. The papers that associate fluctuations in the natural rate with the determinants of real GDP and with preferences identify a *relative stability of the natural rate over the short term and a higher volatility of the real interest rate gap*. With such a "formulation of the problem", it is easy to imagine that experts may impose on the HP univariate filters or the multivariate filters that the values estimated for the natural interest rate display subdued volatility over the short term, thus leading to the insufficient adjustment of the natural rates of interest.

On the other hand, the studies that do not contain judgments about the fundamental determinants of the natural rate (but rather pure statistical techniques) show that *variations in the natural rate are more pronounced compared with the interest rate gap*, suggesting that the natural rate moves more in line with the economic cycle and hence with the actual real rate of interest. The latter conclusion has been recently confirmed by the findings of Laubach and Williams (2015) with their model of 2003, as well as by Barsky et al. (2014) and Cúrdia (2015), who have estimated DSGE models, showing that the natural rate of interest is volatile and pro-cyclical. A DSGE model for the

natural rate definition, then the natural rate is the prevailing rate in the absence of nominal rigidities and markup shocks in the economy (Galí, 2002; Blanchard and Galí, 2007; Veltov et al., 2011; Barsky et al., 2014).

10 For instance, Henderson and McKibbin (1993); Orphanides and Wieland (1998); Reifschneider and Williams (2000); Rudebusch (2001).

11 Maddison (1995 and 2001); Oliner and Sichel (2000); Gordon (2000).

12 King and Watson (1996); Rotemberg and Woodford (1997); Larsen and McKeown, 2002; Laubach and Williams (2003); Giammarioli and Valla (2003); Mésonnier and Renne (2004); Neiss and Nelson (2001); Manrique and Marqués (2004); Basdevant et al., 2004; Cuaresma et al., 2004; Cour-Thimann et al., 2004; Horváth (2006); Lombardi and Sgherri (2007); Humala and Rodríguez (2009).

Romanian economy was estimated by Copaciu et al. (2015), with the caveat that it does not supply the real natural rate, but the real interest rate gap vis-à-vis the steady-state value.

The relatively high volatility of the natural rate of interest does not eliminate the issue of overestimation during a downturn or during the recovery from a deep recession, but merely diminishes the role of the "formulation of the problem" factor in favor of the "partial computation" one in determining the relevant initial value. A crisis such as that of 2008 may trigger a sharp decline in the natural interest rate, for instance under the influence of the steep reduction in the time preference rate, which translates into stronger propensity to save[13]. Nonetheless, in most cases, anchoring controls the estimation process and makes both economists and policymakers work with insufficient declines in the natural interest rate.

Thus, if – in order to stimulate the economy – the central bank wants to bring the monetary policy rate down by a certain number of percentage points below the natural rate, the overestimation of the natural rate makes it so that either the actual (*de facto*) negative (stimulative) gap[14] is lower than the desired (overestimated) level[15], as in Figure 1a, or the *de facto* gap is even positive (recessionary), as in Figure 1b, contrary to the central bank's desire. This might not be a real problem, given that – as already shown – the negative (recessionary) output gap is overestimated as well, with the *de facto* gap standing lower than the apparent one. It is possible for a relatively narrower *de facto* GDP gap to be matched by a proportionally lower *de facto* interest rate gap. However, there is no guarantee that the level of potential output and that of the natural interest rate are overestimated in the same proportion[16]. The insufficient adjustment of the natural rate is probably one of the explanations for the fact that, as shown by Orphanides and Norden (2005), real-time estimates of the output gap cannot be successfully employed in explaining inflation.

In Figures 1a and 1b we have chosen positive values for interest rates, but the same reasoning also holds true if the shocks associated with a deep recession push the *de facto* natural rate into negative territory.

[13] For an estimation of the contribution to constructing the natural rate of interest in the US made by the change in the propensity to save, see Del Negro, Giannoni, Cocci, Shahanaghi and Smith (2015). A decomposition of shocks that affected the UK's natural rate of interest is available in Goldby, Laureys and Reinold (2015).

[14] *Determined as the difference between the actual real interest rate and the de facto natural rate, with the latter being lower than the (over)estimated rate.*

[15] *Defined as the difference between the actual real interest rate and the (over)estimated natural rate.*

[16] *The simultaneous overestimation of the natural interest rate and of the potential output level is possible. Considering these (over)estimated levels, policymakers set the interest rate in line with the monetary policy objectives.*

Fig. 1a: Overestimation during a downturn or during the recovery from a deep recession leads to a less stimulative de facto gap

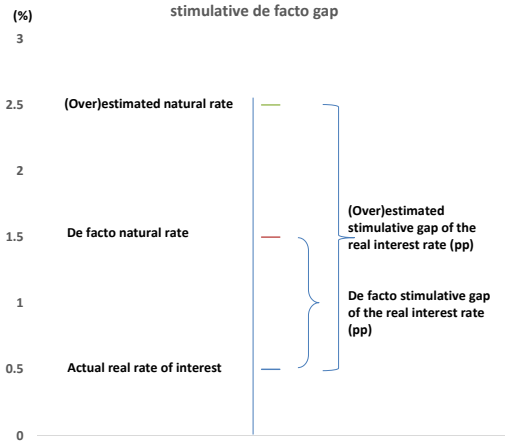
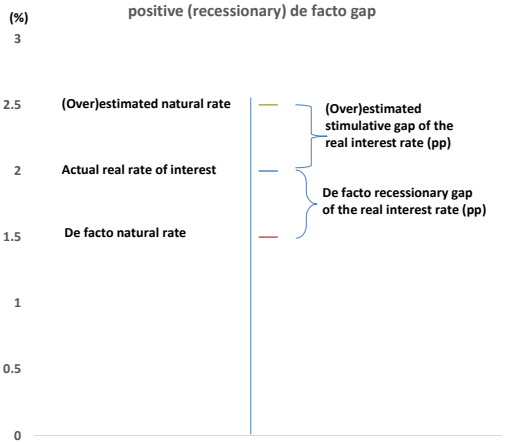
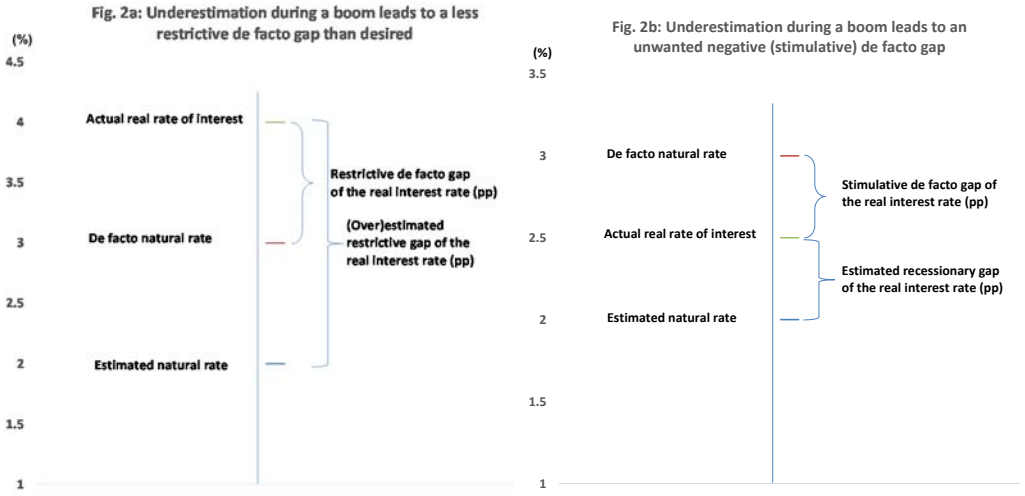


Fig. 1b: Overestimation during a downturn or during the recovery from a deep recession leads to an unwanted positive (recessionary) de facto gap



In the examples above, we have chosen the cases in which the economy is either in a recession or in a period of recovery from a severe crisis and therefore the focus lay on the overestimation that occurs in real time. However, one may equally speak of *underestimation* in real time during boom periods. When making these estimates, experts know all the relatively high levels recorded by actual GDP (or by the interest rate) previous to the downturn, plus the relatively low levels of GDP during the recession and the recovery period. Now, in the boom period, unlike during the recession, both the actual and the potential levels go up, for example under the influence of positive shocks to productivity or to the propensity to consume. In this case, in order to reflect these increases in their estimates on potential output, experts will raise, also based on judgment, the potential GDP level in the concerned period or will impose the condition that the trend display minimum volatility. But again, *ceteris paribus*, adjustments are probably incomplete due to anchoring, so that, in the end, the estimated levels of potential GDP – while relatively high – are lower than the *de facto* ones, i.e. they have been underestimated[17]. Hence, in "good times", it is possible that, based on anchoring, output gaps be overestimated. Figures 2a and 2b depict theoretically possible situations regarding the underestimation of the natural interest rate.

[17] One might claim that the series regarding the potential variables is accompanied by sufficiently wide uncertainty intervals to cover underestimation/overestimation. While this is possible, high uncertainty is a serious reason for which the said variable might not be taken into consideration in the economic decision-making process. Referring to the high degree of uncertainty surrounding the estimates of the natural interest rate, Mésonnier and Renne (2004) believe that it hinders the direct integration of this rate in the decision-making process.



In a market economy, almost 85 percent of the time the economy is in "good times" and almost 15 percent of the time in a recession[18]. Hence, if anchoring is a good explanation, the actual data from good times are much more likely to be closer to a low-volatility trend than actual data from recession periods. This means that, during good times, potential output or the natural rate are much more likely to be underestimated to a lower extent than they are overestimated during downturns or during the recovery from a deep recession.

Beyond these consequences, however, there is also the issue of changes in rationality induced by pessimism and optimism, which emerge around the turning points of the business cycle. These changes give rise to the question whether anchoring is resilient to the fall in confidence during a recession, i.e. to *pessimism*, or to the rise in confidence during a boom or, particularly, to *optimism* during a financial bubble. In other words, the question arises whether anchoring is employed in the estimation process in the presence of both pessimism and optimism, as we have assumed in this section, or only in either one of the cases or neither. Then, assuming that anchoring is not compatible with either of the two sentiments, the question still needs to be answered: what other explanation is there for the estimate bias? Finally, if anchoring is compatible with only one of the two sentiments, we need to explain how the change in rationality leads to the change in the heuristic employed by the judge in the process of adopting the result (final estimation).

We will answer these questions in the following two sections.

[18] *See Greenspan (2008), who shows that this time distribution was valid for the US in the past 50 years, prior to the 2008 crisis. In the case of Romania, an emerging economy, the time distribution for the past 25 years has been 65 percent "good times" and 35 percent downturn.*

III. Checking the assumption with Romania's economic data

In order to answer the questions concerning the resilience of anchoring to the business cycle changes, we proceed by checking if the insufficient adjustment hypothesis is validated by with the national economic data. We consider the anchoring-based insufficient adjustment hypothesis to be valid if the natural rate and the level of potential output have been underestimated during a boom or asset price bubble and overestimated in periods of recession and recovery.

We will review the *estimates of potential levels at two different moments in time* in order to see the underestimation or the overestimation. These moments should be sufficiently spaced out to capture a significant change in the same-moment estimates of the unobservable variable. According to data analysis, it is adequate that the two moments are 2010 and 2015 Q3. 2010 is the last year of recession after the 2008 crisis. Subsequently, a notable change has been visible in the trends estimated by the NBR. 2015 Q3 is the last quarter for which data were available upon drafting this study.

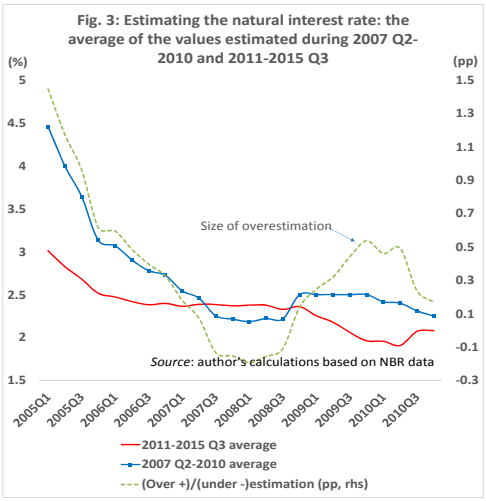
The anchoring heuristic, the same as any other type of heuristics, acts in real time, namely at the moment of the forecast. As already mentioned, monetary policy shifted to inflation targeting no sooner than August 2005. Until then, no estimates of potential output had been systematically made for the purpose of guiding monetary policy, namely in order for the estimation to be assessed in terms of the pursued objective. Consequently, prior to 2005, there was no concern either for determining the "just" level of potential output. For this reason, we left aside the estimates for the period from 2000 to 2004.

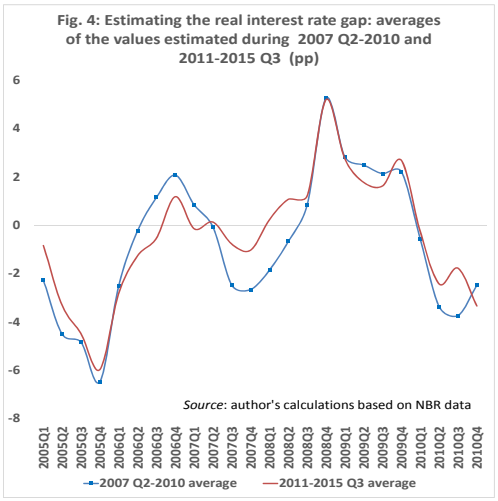
Two data series were calculated for both the natural interest rate and potential output. The first series comprises the average quarterly estimates during 2007 Q2-2010 made for each quarter in the period from 2005 to 2010. The second series consists of the average quarterly estimates during 2007 Q2-2015 Q3 made for each quarter in the period from 2005 to 2010. Additionally, we calculated a second "second" series containing the average quarterly estimates during 2011-2015 Q3 made for each quarter in the 2005-2010 period, also to be compared with the first series. The second series (in any of its versions – estimates of 2007 Q2-2015 Q3 or 2011-2015 Q3) includes the latest estimates and, according to statistical rules, the longer series is considered more reliable than the short one and, thus, closer to the *de facto* level.

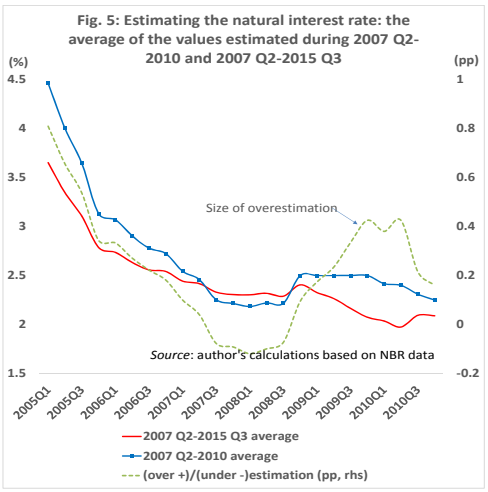
During periods when the averages in the first series are lower than those in the second one, the unobservable values have been underestimated. Conversely, overestimation occurs in periods when the averages in the first series are higher than those in the second series. We expect that the effects of better data quality in the second series and its broader time range will show, when compared with the first shorter series, forecast errors for the time period common to the two series (2005-2010), in each cycle stage. In the absence of or in the "timid" presence of judgment, errors (overestimations and underestimations) should alternate. To the extent to which, instead of alternation, there is systematic overestimation or underestimation, we assume that the systematic shift of the estimate in a certain direction is caused by subjective judgment.

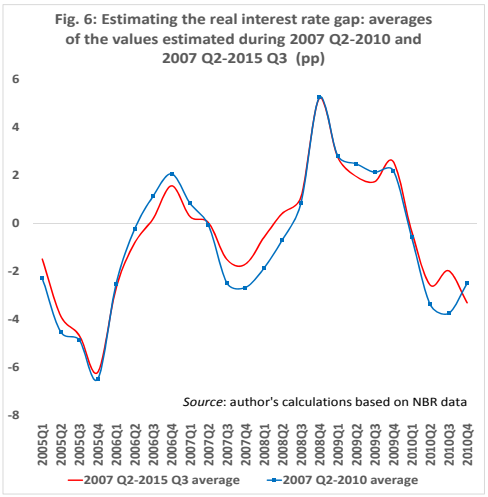
For the recession period, comparing the two series *validates the overestimation assumption*. Both the natural interest rate and the level of potential output have been

overestimated since 2008 Q4, when the economic recession started. Based on our assumption, these data confirm the use of the anchoring heuristic in the estimation process. Overestimation is depicted for the natural rate in Figures 3 and 5 and for potential output in Figures 7 and 9. In all these figures, overestimation is illustrated by the blue line standing above the red one[19]. Complementarily, Figures 4 and 6, as well as Figures 8 and 10 show the evolution of interest rate and output gaps respectively, which are influenced by both potential and actual levels of the interest rate and GDP respectively.

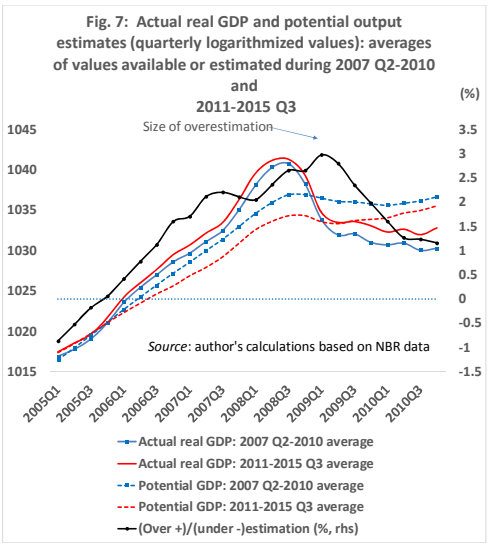


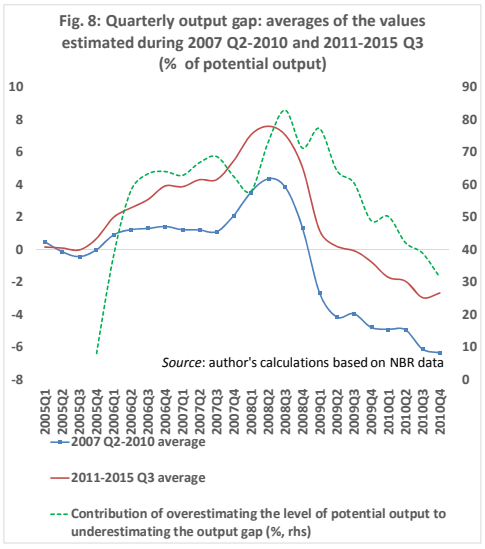


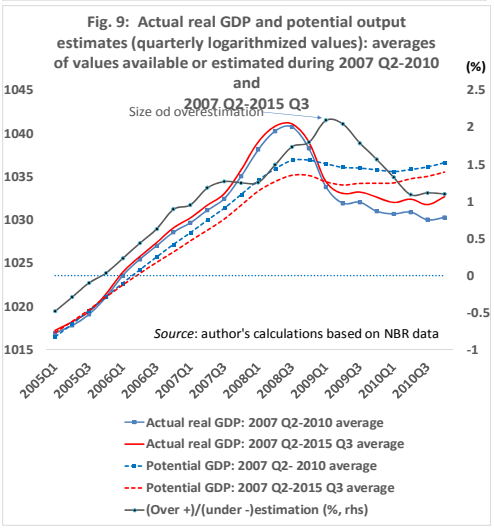


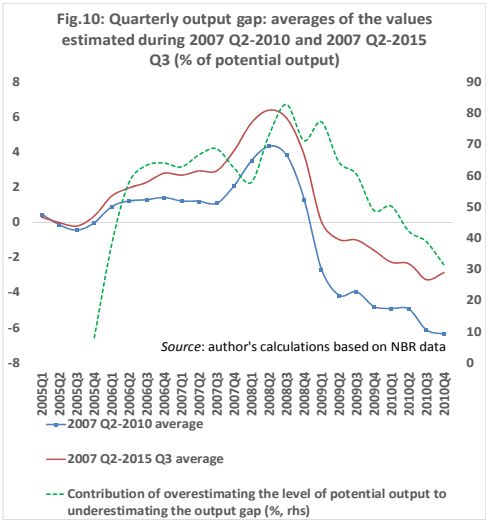


[19] *The size of overestimation or underestimation for the natural interest rate is measured as a percentage point difference between the values of the second and of the first series for each quarter. For the potential output, the size of overestimation or of underestimation is measured, for each quarter, by expressing the difference between the estimated potential GDP in the first series and the estimated potential GDP in the second series as a percent of the former.*









During the boom or the real estate market bubble, a comparison between the two series invalidates the hypothesis of underestimation predicted by the anchoring heuristic for both the natural rate and the level of potential output.

Figures 3 and 5 show that the natural interest rate was underestimated solely during 2007 Q3-2008 Q3, but the size of underestimation (of 0.2 percentage points at most) is marginal, invalidating the hypothesis of insufficient adjustment induced by the anchoring heuristic. In addition, comparisons between Figure 3 and Figure 4 or Figure 5 and Figure 6 reveal that the main changes in the real interest rate gap have been mostly generated by real interest rate changes.

The level of potential output has been systematically overestimated after shifting to inflation targeting, while the size of overestimation has increased almost steadily. *During the boom*, the overestimation of the potential output level ended up from quasi-nil in 2005 Q4 to about 2.7 percent in 2008 Q3, contradicting the insufficient adjustment hypothesis by a comfortable margin (Fig. 7). With the entry *into recession*, overestimation rose to nearly 3 percent in 2009 Q1 and decreased relatively swiftly afterwards to around 1.2 percent in 2010 Q4, thus confirming our assumption also by a comfortable margin. Figure 8 indicates that overestimating the level of potential output had a significant contribution to underestimating the output gap throughout 2006-2010. The contribution ranged between 31 percent and 83 percent of the gap underestimation, the remainder being accounted for by actual data revision.

IV. Overestimation by representativeness, rather than underestimation by anchoring

With the anchoring-based prediction for the boom period or asset price bubble invalidated, the need arises to find another explanation for the systematic overestimation of potential output and natural interest rate in the respective stage of the cycle. Since the *emergence of optimism* is an essential change in between a recession and a boom, our assumption is that the anchoring heuristic, manifest during the downturn, has been replaced by some heuristic causing a strong reliance of the final estimate (the outcome of heuristic as a prediction technique) on optimism. We will argue that, during periods of boom or asset price bubbles, to the extent to which it interferes in the final estimate of potential output and natural interest rate, judgment tends to rely on the heuristic coined "representativeness" by Tversky and Kahneman.

Representativeness is employed "to assess probabilities and to predict values" (Tversky and Kahneman, 1974), irrespective of statistical rules, as is the case with heuristics in general. The representativeness-based judgment makes predictions or evaluates probabilities based on similarities between objects, events, processes. The more representative an object, event or process is to another, the higher the likelihood, for example, for that object, event or process to derive from the other. Accordingly, representativeness is "insensitive to prior probabilities", sample size and predictability and may lead to systematic errors.

In order to show the role of optimism in replacing anchoring with representativeness, we reiterate that one can generally distinguish the "*strength of the evidence*" (extremeness) from credence (weight, *predictive validity*; see, for instance, Griffin and Tversky, 1992) in the case of a *result* (*an estimate, a prediction*). Instances of evidence strength are the proportion in a sample or the cordial tone of a letter of recommendation, while examples of predictive validity are the sample size or the epistemic authority of the author of recommendation.

Integrating these two components irrespective of statistical rules may lead to *overconfidence* or *underconfidence*. According to Griffin and Tversky (1992), people exhibit overconfidence when they are highly sensitive to variations in the extremeness of evidence (i.e. inputs such as the description of events, objects, processes) and not sufficiently sensitive to variations in its predictive validity. Otherwise put, overconfidence occurs when the result (estimate) largely depends on evidence strength and

underconfidence when the result relies mainly on the predictive validity of inputs. For instance, Griffin and Tversky showed very evocatively that, when focusing on the warmth of a letter of recommendation with insufficient regard for the credibility of the writer, people will exhibit overconfidence when faced with a very positive letter, even though the writer does not have epistemic authority. In this case, the result (estimation of the candidate's quality) largely depends on the warmth of the letter. Conversely, if the recommendation is less warm, underconfidence occurs, even though the letter is signed by someone with epistemic authority.

Similarly, if – during upswings of the economic cycle – attention is attached particularly to favorable economic data, comments and news, but insufficiently to their predictive validity, then the results (estimates, prediction) depend on such positive inputs. Eventually, if many people pursue this course of action, then a large number of individuals become overconfident in their optimistic expectations. Thus, euphoria sets in (Croitoru, 2013, pp. 76-81) and, once in place, it dominates behaviors.

Even those who estimate the level of potential output turn overconfident and adjust their estimates made exclusively on algorithmic bases, using representativeness. Basically, potential output estimates obtained, for instance, with a multivariate filter under the condition of relatively low volatility of the estimated series may prove, during a boom or a bubble, insufficient vis-à-vis the result indicated by the very positive description of the economy. In other words, experts and policymakers judge the algorithmic estimates. If they had made insufficient adjustments under the influence of anchoring when they were not overconfident, now, that they are overconfident in optimistic results, they can make excess adjustments. Thus, the level of potential output can be systematically overestimated.

Confidence in the final estimate chosen based on representativeness is all the greater the higher the internal consistency (Tversky and Kahneman, 1974, p. 1126) of the description of positive events during a boom or an asset price bubble. This causality is to be expected, as the outcome (prediction) was chosen paying attention almost entirely to the description (strength of evidence, inputs, extremeness) and almost ignoring its predictive validity (description, inputs). In turn, the internal consistency of inputs increases with the higher incidence of redundant inputs contained (Tversky and Kahneman, 1974, p. 1126).

These being said, we can state that our assumption according to which, during a boom or asset price bubble, representativeness contributes to final estimates, leading to overestimations, is in line with the results we presented for Romania's economy.

Conversely, the representativeness heuristic could not explain the overestimation during the downturn that occurred in Romania starting 2008 Q4. To understand why, let us presume, the same as in the case of periods of boom or asset price bubble, that the outcome (prediction) is yielded by considering the strength of evidence (description, inputs) and by ignoring its predictive validity. In this case as well (recession), the judge is overconfident in the outcome he has chosen. And the outcome depends on the strength of evidence, represented, during downturns, by negative news, negative comments and negative indicators. This will result in a very low, probably underestimated, level of potential output, which would contradict the results for Romania presented in the previous section. If he were underconfident, i.e. largely pay attention

to the predictive validity of facts, rather than to negative news, comments and indicators, the judge would probably leave the algorithmic-based estimates unadjusted.

Before reaching a conclusion on the mechanism that enabled the overestimation of the natural rate of interest and the level of potential output in the period from 2005 to 2010, it should be clarified whether the two heuristics cannot act symmetrically, in principle, in the two stages of the business cycle, or that was the case of Romania alone. To shed light on the matter, it should be recalled that optimism prevails over time and is widespread. For instance, although entrepreneurs are aware that more than 50 percent of small-sized enterprises come to fail in five years or more since their establishment (SBA, 2012), they are not discouraged and proceed to opening new firms. This could translate as an overestimation of their probabilities of success. Similarly, it is unlikely, given the broad-based optimism manifest during a period of euphoria, that the values are insufficiently adjusted upwards, by employing anchoring.

The same happens when entering a recession. In general, policymakers pay insufficient attention to negative news, comments or indicators. For instance, in November 2008, when the economic recession had already set in, as evidence would later prove, many policymakers were of the opinion that Romania's economy would gather momentum in 2009. For this reason, it is unlikely for downward adjustments to be made by focusing on negative news, comments and indicators, namely that the natural rate of interest and the level of potential output will be underestimated, during a downturn, by employing the representativeness heuristic.

The idea that the two heuristics cannot act symmetrically in the two stages of the cycle needs to be understood as a very high likelihood of asymmetry. The high level of this probability is closely linked to the idea that optimism is very likely to draw the attention to the strength of evidence (positive news, comments and indicators), selecting the representativeness heuristic, whereas pessimism is very unlikely to yield a similar outcome. The asymmetry between optimism and pessimism concerning the manner in which judgment integrates the strength of evidence with its predictive validity is the basis of the asymmetry between the two heuristics. Basically, the idea is that pessimism is very likely to make room for the anchoring heuristic during downturns, whereas optimism is very likely to suppress it during upturns, leaving room for overconfidence and thus for the representativeness heuristic.

Nevertheless, the possibility that each heuristic may very rarely work symmetrically cannot be ruled out. In those cases, we will see that only one of the heuristics explains the systematic bias of the estimated levels of potential output and the natural rate of interest, in both stages of the business cycle. Therefore, it is possible that optimism may occasionally fail to impose overconfidence, so that anchoring prevails in both business cycle phases. Then, overestimation will occur during downturns and underestimation during boom periods. Conversely, it is possible that, on very rare occasions, pessimism might not make room for anchoring during downturns, so that overconfidence will be manifest in both stages of the business cycle. Then, overestimation will occur during boom periods and underestimation during downturns. Finally, on even rarer occasions, optimism and pessimism may concurrently fail to impose overconfidence during a boom or anchoring during a downturn. On this extremely rare occasion, underestimation will occur in both stages of the economic cycle, generated by overconfidence during downturns and by anchoring during boom periods.

We can now adjust the theory we presented in Section 2 in order to complete it. When estimating the natural rate of interest and the level of potential output, the manner in which algorithmic-based estimates combine with judgment has the following pattern: (i) during downturns, the final values of the natural rate of interest and the level of potential output are very likely to be overestimated by integrating the algorithmic extrapolations with the results from employing the anchoring heuristic; (ii) during booms, and particularly in times of financial bubbles, final values are very likely to be overestimated by integrating the algorithmic extrapolations with the results from employing the representativeness heuristic. The overestimation thus generate can be a serious hurdle to the proper conduct of monetary policy.

V. Economic policy implications

If correct, the hypothesis of systematic overestimation has a series of consequences, which are visible during periods of boom and asset price bubbles, when experts tend to overestimate the natural rate and the level of potential output, as well as during downturns or periods in which the economy recovers from a deep recession, when experts tend, once again, to overestimate these unobservable variables. The analysis of these consequences allows us to offer an *alternative explanation* instead of the conventional one presented at the beginning, according to which the relatively high increase in output and credit during the period from 2013 to 2015 did not fuel demand-pull inflation as the interest rate and output gaps were negative.

During periods of boom or asset price bubbles, one of the implications is that, given the actual (observable) values, the overestimation of potential levels by employing representativeness causes the estimated (positive) output gaps and interest rate gaps (when positive) to be narrower than their *de facto* levels[20].

With overestimated natural interest rate levels, monetary policy is *de facto* tighter than indicated by the underestimated (positive) interest rate gap[21]. However, as mentioned before, the level of potential output is also overestimated, so that the *de facto* (positive) output gap is wider than estimated, which basically makes it possible for the *de facto* natural interest rate gap to be compatible with the *de facto* output gap. Nonetheless,

[20] *The hypothesis of overestimating the level of potential output, which we propose in this study, is compatible with the findings of Berger et al. (2015), showing that a credit-fueled house price bubble "can lead to a period of exceptionally strong GDP growth that (…) might be misinterpreted as a sustainable acceleration of potential output growth." The hypothesis of overestimation does not answer the question whether certain GDP developments are sustainable or not, but refers to the increased probability that the estimated level of potential output is higher than the de facto level of potential output, i.e. higher than a sustainable level, whichever it is. Also, the hypothesis of overestimation is compatible with the conclusion of the aforementioned authors, according to which, in periods of downturn following asset price bubbles, " the ensuing drop in GDP could wrongly suggest an equally steep decline in potential or sustainable output", (Berger et al., 2015, p. 20).*

[21] *The positive interest rate gap calculated as the difference between the monetary policy rate and the (under)estimated natural rate is wider than that determined as the difference between the policy rate and the de facto natural rate, the latter being higher than the (under)estimated one.*

neither in the case of overestimation during a downturn, nor in that of overestimation during a bubble, there is no guarantee that the levels of potential output and natural interest rate are proportionally overestimated vis-à-vis their *de facto* levels.

Before the 2008 crisis, monetary policy in Romania (and even in developed countries) was criticized for not being tight enough (Croitoru, 2014). Based on the analysis made in this paper, it can be assumed that overestimation was present and, thus, the *de facto* positive (restrictive) interest rate gap in the period from 2008 Q2 to 2008 Q4 may have been even more restrictive than the NBR intended (as in Figure 2b, where data are not real, but only for illustrative purposes). However, this is nothing else but a mere possibility. It needs to be qualified considering that, due to the overestimation of the potential output level, the *de facto* (positive) output gap was wider than the (under)estimated one, being in principle compatible with the relatively high *de facto* interest rate gap. Nevertheless, as highlighted before, it is impossible to determine which of the two trends – potential output or natural interest rate – has been overestimated to a higher degree relative to their *de facto* levels, in order to see if monetary policy has indeed been more restrictive than the NBR intended.

Figures 4 and 6 show that, after 2006, the real interest rate gap was stimulative, on average, solely in the period from 2007 Q3 to 2008 Q1, but the stimulative nature of the gap was too little weakened by the (statistically insignificant) underestimation of the natural rate which seems to have occurred during 2007 Q3-2008 Q3.

Fiscal policy also faces its own challenge, as it needs to take account of the (stimulative) GDP gap overestimation when calculating the structural deficit, which is, by definition, an unobservable measure, but is, at the same time, the fiscal policy "target", the same as inflation is the monetary policy target.

During downturns or in periods when the economy recovers from a deep recession, as is the current stage of Romania's economy, the implications of overestimating the natural rate of interest and the level of potential output are similar, except for the diverging (restrictive/stimulative) action. The most relevant implication at the current juncture, as already mentioned in Section 2, is probably that, given the *de facto* levels of these two unobservable variables, their negative gaps close faster. In Romania's case, the output gap may have turned positive ever since 2013, although no one could have realized that in real time, since overestimation is involuntary.

If this assumption is correct, then the 2013-2015 developments – above-potential GDP growth, faster increase in lending, relative stability of demand inflation and lower anticipations – should be explained at least as well as with the hypothesis of negative gaps (conventional explanation) presented at the beginning (footnote 1).

The explanation we propose (based on the hypothesis of overestimation by anchoring) takes into account the fact that the current estimates of the potential output level and the natural interest rate are upward-biased. Therefore, in our explanation, judgment relies on *de facto* levels of potential output and the natural interest rate, which are presumed to be significantly lower than those estimated and considered in the conventional explanation, presented at the beginning.

In our explanation, the natural interest rate and potential output went down to low levels, under the influence of the increased propensity to save, which was more visible in 2013, when the current account deficit (excess investment) collapsed. The fall was triggered

by the tendency towards secondarity (Croitoru, 2015), whereby private and public agents in economies less capable of managing the crisis-induced risks tend to record excess savings. Under the influence of liquidity management, of the interest rate policy and of the plunge in excess investment, the actual (observable) interest rate declined, however, even more, standing below 1 percent since 2013. Thus, the interest rate gap was stimulative (negative), albeit less stimulative than it appears to be in the conventional explanation scenario, in which the natural rate is overestimated, according to the insufficient adjustment hypothesis. The stimulative interest rate gap supported economic growth and contributed to the emergence of positive (expansionary, inflationary) net-of-overestimation output gap ever since 2013.

The proposed scenario, in which *the output gap unaffected by overestimation is positive* (stimulative), while *the interest rate gap unaffected by overestimation is still negative* (stimulative), does not seem, at first sight, to be compatible with the developments recorded since 2013. If the interest rate is below the natural rate, then both credit and prices should rise. In fact, increases were reported by credit alone, not by inflation. In 2013, 2014 and 2015, demand-pull inflation[22] stood at 1.76 percent, 1.93 percent and 1.82 percent respectively. Why didn't the stimulative interest rate gap also fuel inflation ever since 2013, when the volume of new loans started to grow?

The favorable impact of supply-side shocks (lower oil prices, good agricultural years, indirect tax cuts) is one significant part of the answer, the same as with the conventional explanation. These developments supported the slight reduction in inflation expectations, which, in turn, had a negative, albeit marginal contribution to the change in demand-pull inflation. The other part of the answer is different from that provided by the conventional explanation, according to which the demand deficit explains why inflation is not accelerating. Now, on the one hand, the decline in inflation expectations may have created insufficient room for a possible flare-up in excess demand-pull inflation to be offset. On the other hand, *excess demand was particularly met through imports*, feeding through to inflation only marginally.

The current account deficit share to GDP shrank from 4.8 percent in 2012 to 1.1 percent in 2013, while the goods balance deficit as a share in GDP fell from 6.9 percent in 2012 to merely 4.0 percent in 2013. After the first VAT rate cut in September 2013, *the ensuing additional demand was met through imports*[23], widening the goods balance deficit[24] to 4.2 percent of GDP in 2014 and to 4.8 percent of GDP in 2015. Therefore,

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[22] *We proxied this type of inflation by the non-food items and market services inflation. The figures in the text refer to the December/December inflation.*

[23] *Basically, a balance of payments deficit allows domestic absorption (demand) to grow without creating severe inflationary pressures, as the increased demand for consumer goods or investment is covered by imports, without putting pressure on the use of domestic resources, thus avoiding the emergence of inflation, at least for some time. Conversely, when domestic demand is weak, a surplus enables the aggregate demand rise based on the demand for exports, namely on external demand.*

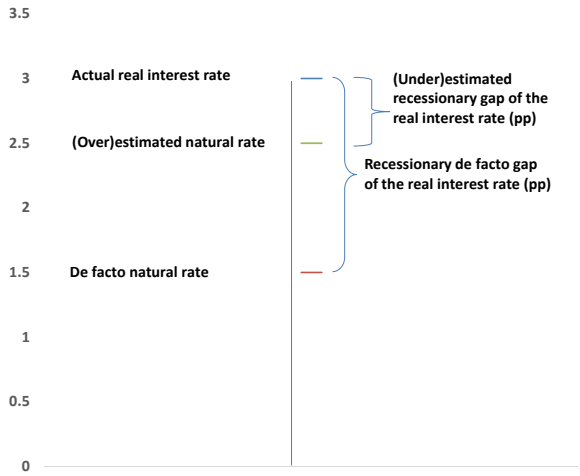
[24] In September 2013, the VAT rate was cut from 24 percent to 9 percent for bread, flour and bakery products. Starting June 2015, the scope of the reduced VAT rate was extended to all food items. Due to the low demand-price elasticity for these staples, the real income growth driven by the cut in the VAT rate on these products can be channeled to purchases of other costlier goods, rather than to the real increase in consumption. However, the volume of food

the interbank rate standing below the natural rate of interest fostered the increase in leu-denominated credit, without fueling inflation, but contributing to the wider positive output gap after 2013. Nevertheless, at a certain point in time, as credit grows, *demand will partly target domestic goods*, which will alleviate the worsening trade balance, but fuel inflation. From this standpoint, the answer to the question at the beginning of this article, i.e. if the 2016 fiscal easing was necessary, is negative.

Another implication is that, during downturns as well as during periods of boom or asset price bubbles, the overestimation of potential levels causes the apparent negative gaps of the natural interest rate (Figure 1a) and output to be relatively wide (in absolute terms) as compared with the *de facto* ones. For this reason, monetary policymakers may have the illusory conviction that the policy rate is low enough in terms of the need to stimulate the economy.

However, from time to time, as it was also Romania's case in 2009 (Croitoru, 2014), recession and inflation expectations may coexist, which makes it necessary for the interest rate gap to be positive (contractionary-disinflationary). Specifically, due to the natural rate overestimation as shown in this article, the *de facto* positive (restrictive) interest rate gap[25] in 2009 may have been even more restrictive than the NBR intended[26] in its attempt to cool the relatively high inflation expectations (this assumption is presented in Figure 11, where data are not real, but only for illustrative purposes). Nevertheless, in order to be sure, we should know if and which of the two levels – of potential output or of the natural rate – has been overestimated to a higher degree relative to its *de facto* level.

Fig. 11: Romania 2009 - Overestimation during a downturn or during the recovery from a deep recession leads to a more recessionary de facto gap than desired



consumption grew significantly larger, i.e. 19 percent in 2015 versus 2014, as compared with 5 percent in 2014 versus 2013.

[25] *Calculated as the difference between the policy rate and the natural rate unaffected by (over)estimation.*

[26] *Calculated as the difference between the policy rate and the (over)estimated natural rate.*

In what concerns fiscal policy, assuming that the structural deficit is desired to be maintained at zero, overestimating the level of potential output during a downturn leads to overestimating the cyclical component of the budget deficit necessary for offsetting the contraction in private demand, having as a result the unjustifiably high (excessive) increase in public debt. This will happen the other way round during the upturn, meaning that the necessary budget surpluses will be underestimated.

VI. Conclusions

In this study, we proposed and analyzed the assumption that, in real time, estimates of the natural interest rate and the level of potential output tend, with a high likelihood, to be systematically *overestimated*, irrespective of the economic cycle stage. The NBR estimates for each quarterly forecast cycle confirm this hypothesis for the latest business cycle, when the values of the two variables were systematically overestimated.

We claim that the overestimation tendency occurs as *the econometric models* together with expert *judgment* generally lead to the overestimation of the natural interest rate and of potential output. Using subjective judgment in the estimation processes is natural and inevitable, due to the uncertainty associated with these variables and the absence of the *ceteris paribus* clause in economic and social processes. This produces systematic biases, *irrespective of the estimators*, i.e. central banks, independent expert groups, investment banks, etc.

During downturns or periods of recovery from deep recessions, the algorithmic extrapolations and expert judgment tend to *convert the decline in the actual values of the two variables* into *insufficient adjustments of the estimated levels* of potential output and the natural interest rate. The *anchoring* heuristic plays an essential part in overestimation, accounting for the insufficient downward adjustment of potential levels.

Conversely, during boom periods and especially in times of financial bubbles, the algorithmic extractions and the expert judgment tend to *convert the increase in the actual values of the two variables* into *excessive adjustments of the natural interest rate and the level of potential output*. The *representativeness* heuristic contributes to overestimation through the excessive upward adjustment of potential levels.

Overestimation has several important consequences. One of them is that the interest rate gap and the output gap close earlier than visible in real time. We showed that, given the overestimation and the available data at the moment of the conclusion of this study, the idea that the output gap has closed ever since 2013 cannot be discarded. Demand-pull inflation remained stable in the period from 2013 to 2015, as the excess demand revealed by the positive output gap and by the relatively fast increase in credit was met by imports. This process cannot last, and in the end, the demand-pull inflation (demand inflation) will go up. In this context, the 2016 measures, i.e. the 4 percentage point cut in the VAT rate and the substantial rise in wage costs, are unsustainable. They put upward pressure on the current account deficit and inflation. Consequently, monetary policy tightening should be firmer and occur earlier.

Another consequence is that, during downturns, monetary policy can be less stimulative than intended by the central bank, while it can be more restrictive than intended during boom periods or in times of financial bubbles. The monetary policy stance deviations from the intended one depend on the individual overestimations of the natural interest

rate and the level of potential output vis-à-vis their *de facto* levels, which are not cognoscible. The data show that the output gaps were underestimated during the housing price bubble of 2006-08.

Subjective overestimation does not mean that the insufficiently long series or the quality of the latest real-time data do not have their own impact, with the caveat that this influence is more likely to work both ways in any of the cycle stages. This backs the assumption that the systematic nature of overvaluation is caused by the anchoring and representativeness heuristics. Nevertheless, more business cycles are necessary to establish if the overestimation we have referred to is truly systematic in nature.

The systematic overvaluation of the natural interest rate and of potential output is equivalent to the *low probability of preventing the upward bias of estimates*. However, minimizing these biases could be a challenging objective for monetary policymakers.

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