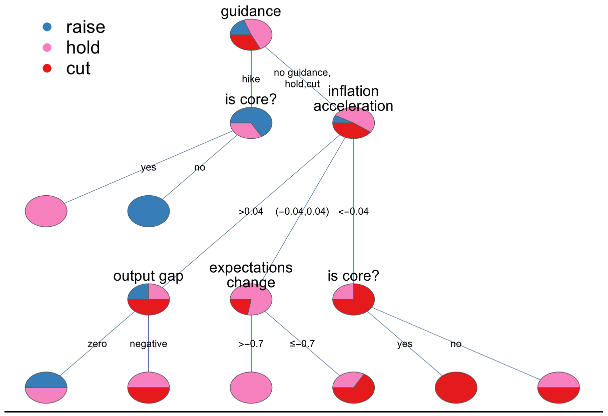
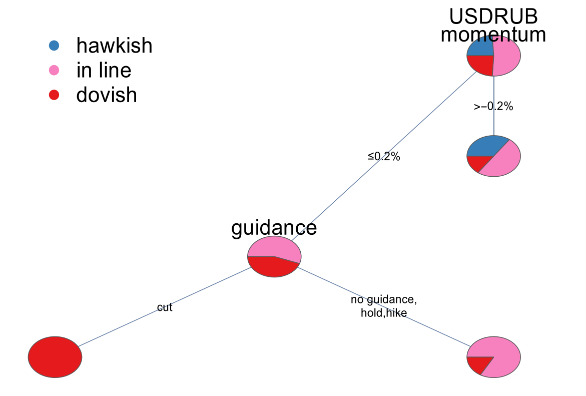
13 September 2017

Broad decision schema. See larger version on p.4 and interactive version here.



Source: Rosstat, VTB Capital Research

Scheme for choosing between relatively hawkish and dovish alternatives. Larger version on p.5.



Source: CBR, VTB Capital Research

Views

Technical Brief

Reading the leaves on the CBR's decision tree

In this note, we attempt to reconstruct the policy rule that the CBR's Board of Directors might be following. We do not take the path which has been well-beaten by the Taylor rule (see our old take on the latter here). Rather, we attempt to reverse-engineer the Board's 'decisions. We do this by embracing a wide range of inputs that could potentially be relevant and then applying certain statistical learning techniques. By doing this, we can capture a richer context than that which it is possible to assess using the Taylor rule modifications.

We identify nested 'if-then' structures which map those inputs into the meeting outcomes. Put more simply, we find an ordering of questions considered by the BoD, and their probabilistic characterisation (the likelihood of this or that further path 'down the decision tree' being taken at every node) that best approximates to the actual policy decisions that have been taken since February 2014. Our sample begins with the first modern press release from the CBR.

Click here to see an interactive demo of what this approach yields. A requisite caveat is that we do not, of course, relegate forecasting the key rate to any automated rule, instead viewing this as enhancing our toolbox.

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Macro

Discretion to Choose the Rule

The (not so deep) intellectual roots of modern monetary policy in general, and inflation targeting in particular, stem from the debate over which approach yields better welfare outcomes: discretionary *ad hoc* decision making or a more rigorous rule-based policy; see, for example, (Fischer, 1988). The present practice of central banking is built, to a large extent, on the consensus that a rule-based policy, with a commitment to achieve particular numerical goals, is preferable.

Yet no central bank is ever fully open about which precise rules it follows in practice. The commitment to rules-based policies, combined with the unwillingness to disclose internal decision-making algorithms to the public, raises a research challenge to try to identify such rules from the observable data. The best-known of the early such endeavours remains (Taylor, 1993).

The Taylor rule-type approach suggests fitting the interest rate path to expected deviations from the inflation target, output gap, lagged levels of the interest rate itself and potentially other variables as well. The approach can accommodate a lot of explanatory variables, but is restrictive in how it describes the decision-making process itself. There is always just one equation, and hence not much space to express contingent ('if-then') types of causal link.

In this note, we take a different route to the same destination. We fit what is called 'decision trees', which map key relevant parameters of the environment, into the outcome of the monetary policy meeting. This approach yields hierarchical nested structures of 'if-then' blocs which - by answering one question at a time and then moving 'down the tree' depending on the answer - lead to the most likely outcome. This is a well-established technique in the statistical learning literature described in (Tibshirani et al., 2001).

Selecting inputs

What can the Board of Directors realistically look at, when deciding on rates? And what should it look at? Both questions are non-trivial, and there is a degree of subjective preference in selecting the variables that we will be trying to model the CBR's behaviour with. We apply two filters to our inputs.

1. Common-sense filter: Real time availability

We only rely on the data available to the Board at the time of the meeting. To make our exercises more robust, we make sure that the data is available at least a week prior to the meeting to allow for processing. We avoid GDP growth indicators, not only due to their long publication lags, but also because flash estimates tend to be substantially revised. Instead we include the CBR's self-reported evaluation of economic activity levels contained in the monetary policy press releases.

2. Ideological filter: As little 'soft inputs' as possible

More interestingly, should we assume that forecasted values matter? Or that deviations from 'neutral' levels of key variables play a role in reaching the monetary policy decision? There have been periods during the last two years when it looked to us as if the CBR, operationally, was targeting a certain forward-looking real rate. Shall we assume something similar now, when inflation has come down and the target has been reached?

A good example is the estimates of the steady state real interest rate (the so-called *r**). One of the CBR notes (in Russian only), which we tend to think encapsulates the predominant staff thinking on this matter, explicitly admits that the estimates of the current *r** have extremely wide confidence intervals of 10pp.

The same note concludes that the long term *r** is probably within the range of 1.0-3.0%. To us, both the current *r** and the terminal *r** lack the degree of precision that would make them reliable operational inputs. Note that the CBR's management always quotes a much narrower range, of 2.50-2.75%, when asked about the long-term *r**. (There is nothing Russia-specific here – it is almost expected from the policy makers' communications to downplay the confidence intervals that surround their estimates and forecasts).

Similar arguments might be put forward with regard to the output gap, or how much slack in growth rates the economy exhibits. Estimating 'natural growth rates' is as tricky as with the *r** - and, moreover, they are prone to cyclicality themselves (see here and here for our earlier discussion of these topics). In short, references to *r** and the output gap might prove to be handy communication tools, when the regulator needs to explain its decision ex-post; but as an operational ex-ante decision-making factor, we view both of them as being of relatively little value.

A robust monetary policy rule, to us, would assume as little knowledge of the deep parameters of the economic system and 'unobservables' as possible. To some extent, this also means more weight needs to be given to reported data rather than forecasts. The only 'soft data' variable that we include in our list of inputs is the 12-month-ahead inflation guidance, which the CBR used to provide regularly during the disinflationary phase (and which we take as equal to 4% since December 2016). It is interesting that this variable, however, at the end of the exercise turned out to be an insignificant one.

Below we describe the inputs that we have decided to work with and then proceed to our results: two estimated decision trees.

Inputs: feeding the tree with qualitative and quantitative features

Guided by the two principles set out above, we feed the following set of variables into the decision tree: i) guidance given at the preceding monetary policy meeting; ii) current inflation deviations from the inflation target; iii) expected deviation from the inflation target in 12mo as reported in the CBR press release etc. (for the full list, see Appendix 1).

Arguably, the greatest judgement is involved in constructing the 'guidance' variable, as we need to reduce the particular (and changing) wording of the press release to just three grades: 'Cut', 'Hold' or 'Raise' (or, alternatively, mark the absence of guidance).

In practice, there is usually at least some difference of opinion on what precisely the CBR is committing to and under what conditions the Board "might consider" following this or that policy.

Our method is to classify guidance sentences that contain words denoting a particular decision (i.e. "tighten", "ease" or "leave on hold") as guiding for this particular outcome irrespective of the 'hedge words' surrounding them.

In the absence of any such marker words, we mark the press release as containing no guidance.

For examples of how statements are translated into markers see note to the table on the right.

For the complete input table set see Appendix 1.

Figure 1: Highlights of inputs (full table in Appendix 1)

	Indicator	Calculation	Comment	Chosen for	
				Decision tree	Tie breaking tree
1	Guidance	provided at the preceding meeting	See examples below	v	v
2	Inflation momentum	% MoM SA 3mo MA			
3	Inflation acceleration	Δ(2)		v	
4	Level of inflation expectations	median household response	12mo ahead, CBR/FOM survey		
5	Acceleration of inflation expectations	Δ(4)		v	
6	Exchange rate momentum	USDRUB % change 1 prior to meeting			v
7	Output gap	identified from text of the press release	negative/zero/positive	v	
8	Core meeting market	Yes if meeting is accompanied by press conf		v	

Example of constructing guidance markers.

Cut. 24 March 2017: "While assessing evolving inflation dynamics and economic developments against the forecast, the Bank of Russia admits the possibility of cutting the key rate gradually in coming Q2-Q3."

Hold. 28 October 2016: "For the trend towards inflation slowdown to become sustainable, according to Bank of Russia estimates, it is necessary to hold the current key rate throughout 2016, with its potential downgrades due in 2017 Q1-Q2."

Raise. 29 January 2016: "Should inflation risks amplify, the Bank of Russia cannot rule out a tightening of its monetary policy."

No guidance. 28 July 2017: "While making its decision hereinafter, the Bank of Russia will assess inflation risks, the inflation dynamics and economic developments against the forecast."

Source: CBR, VTB Capital Research

The Decision Tree: Cut Loudly, Raise Quietly

The decision tree relies on five key inputs: preceding guidance and the marker of the core meeting, as well as the CBR's evaluation of the cyclical slack and acceleration of inflation, plus inflation expectations.

Guidance: It is a warning, not a promise

Our interpretation of the results is that guidance is most significant when it warns of the likelihood of increases in the key rate. Otherwise the degree of dovishness does not strongly correlate with future decisions.

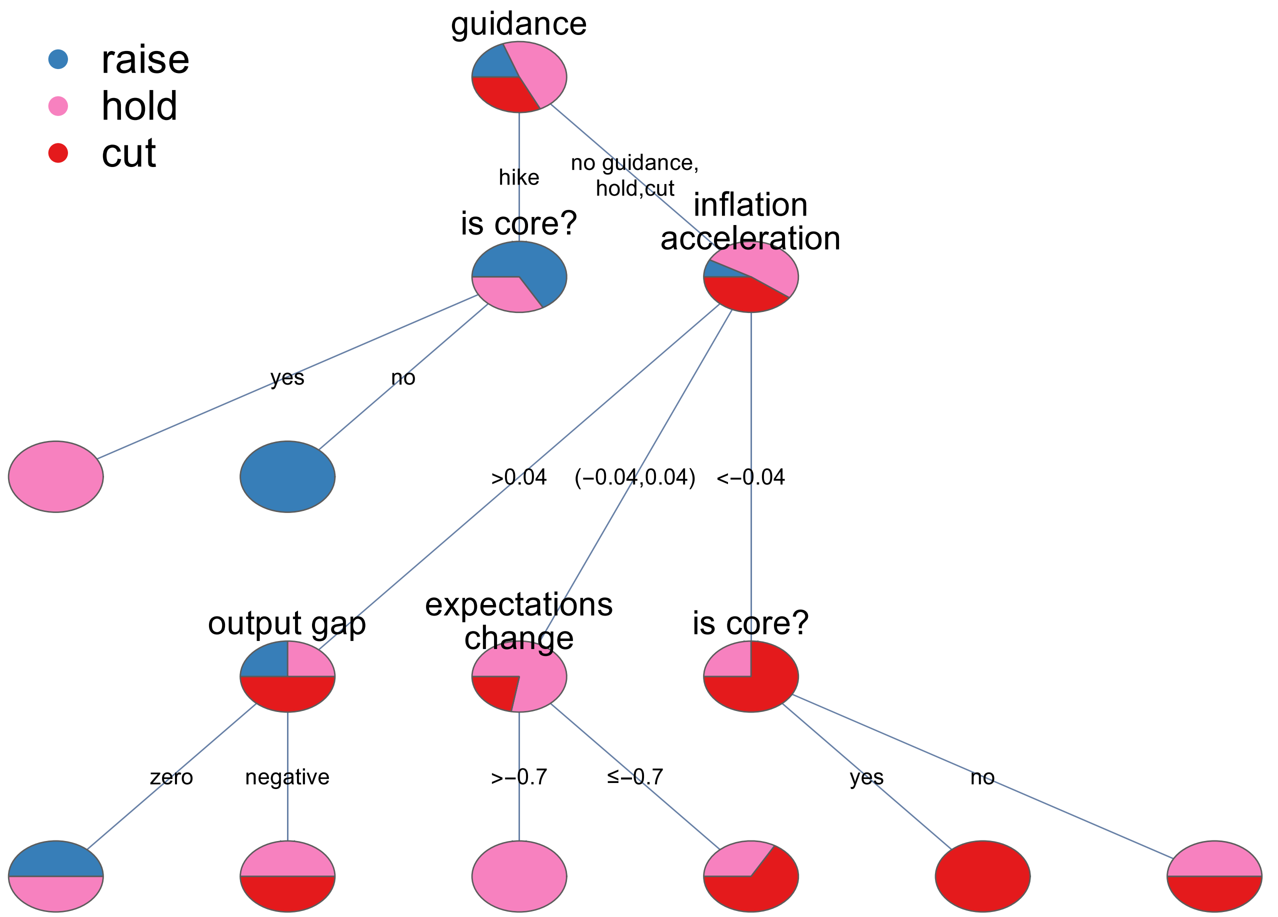
Core meeting marker: Cut loudly, raise quietly

Our estimates suggest that the fact that the meeting is accompanied by a press conference has an opposite effect when the decision is between on hold and either easing or tightening monetary policy. In particular, out of the six decisions to increase the key rate, five have been made at non-core meetings (and of these five, two were extraordinary meetings). Otherwise, if conditions are right, i.e. inflation momentum points south, the CBR is more likely to cut at the core meeting then if the meeting is interim.

Output gap: Positive output gap is only seen in hindsight

It seems to be that the central bank in general tends to underestimate the level of positive output gaps and identify overheating with the benefit of hindsight. Our reading of the press releases for the last three years allows us to identify periods where it is either negative or close to zero. Expectedly sizable output gap estimates tend to offset evidence of an acceleration in inflationary pressure and favour easier policy choices.

Outline of the general decision tree (for interactive version, click on this link)



Source: VTB Capital Research

The Tie Breaking Tree: Finer Choice Calls For Broader Thinking

We believe that our three-way decision tree provides a useful general description of the Board's mechanics. It is also true that at each individual meeting, the choice is generally made from a narrower set of alternatives.

It is only rarely that the Board genuinely faces uncertainty so great that both easing and tightening policy are plausible alternatives simultaneously.

For instance, as Governor Elvira Nabiullina noted on Friday 15 September, the Board would not be deciding *whether* to cut but *what* is the more appropriate step: 50bp or 25bp?

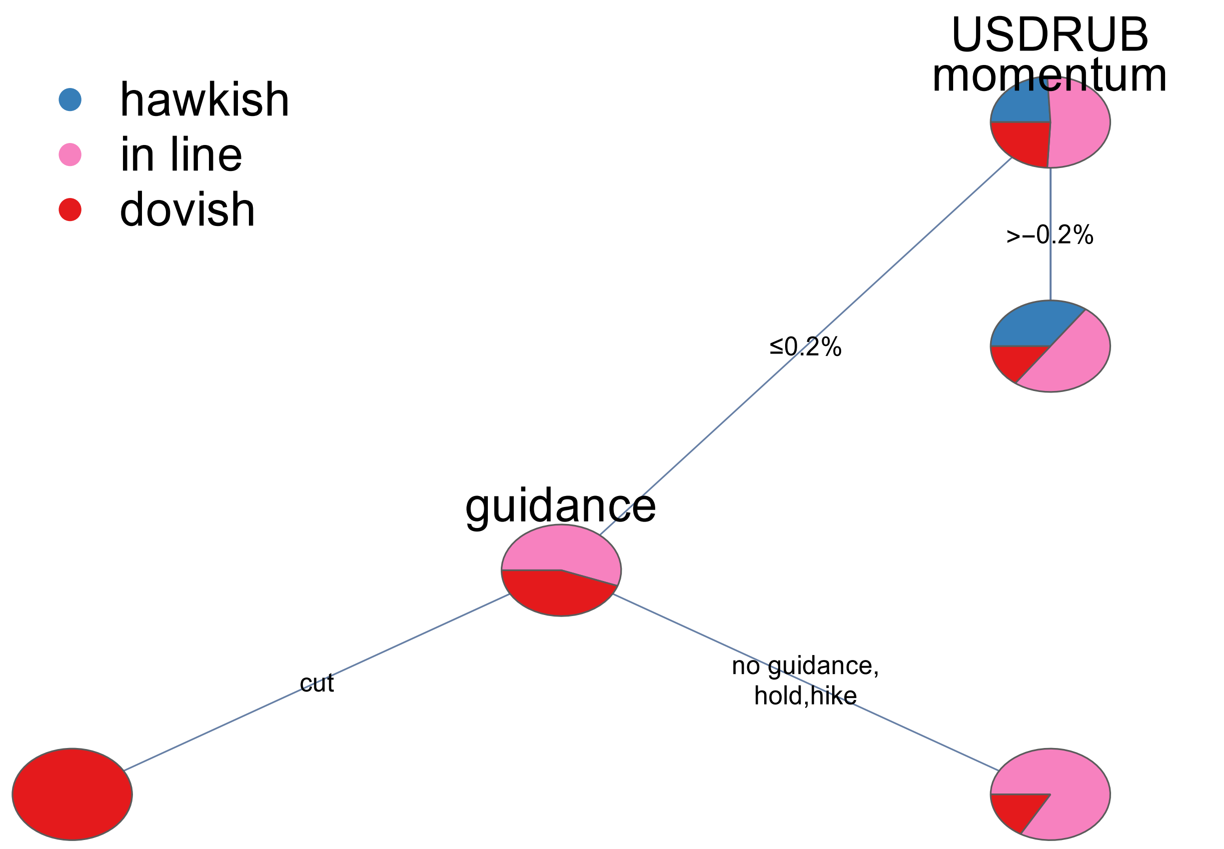
Identifying the rule for making such decisions is more challenging than our previous exercise, as we do not have any information about what choices were under consideration at most of the meetings. Announcements such as those made by the Governor last week or by some top officials in recent quarters are still a novel feature of the CBR's communication.

We thus have to construct an indicator of whether a relatively hawkish or dovish decision has been made our selves. We do that by looking at the distribution of the key rate forecasts provided by *Bloomberg*. We then calculate various measures approximating the value 'between' the likely choices: mean, median and middle of the range between the max and min.

The result that we arrive at is following: the most important variable differentiating between relatively hawkish and dovish outcomes is the FX trends in the run up to the meeting:

- If the exchange rate has been depreciating, then the odds favour relatively hawkish outcomes;
- If the exchange rate has been appreciating, then the odds favour relatively dovish outcomes.

Outline of the "tie breaking" decision tree



Source: VTB Capital Research

Seeing a Forest Behind the Tree

We conclude with a number of caveats.

First and foremost, the sample from which we attempt to extract the rules is small.

The problem is probably not so much the paucity of meetings in the modern format, but rather (and more dangerously) that we have not yet observed even one full and complete monetary policy cycle.

More data on how the Board handles the economy at or below the inflation target would make our results more robust.

Another issue is our assumptions that the Board has been making decisions systematically following a unique approach the last years.

For one thing the composition of the Board is gradually changing. Furthermore, the Board is "learning by doing" as it accumulates experience of the responses from the economy to its decisions and various external shocks.

Thus decision making might be gradually changing as well.

Such issues are usually treated by censoring the sample, assigning newer observations more weight etc.

We would argue that at present the sample is too short to allow such remedies.

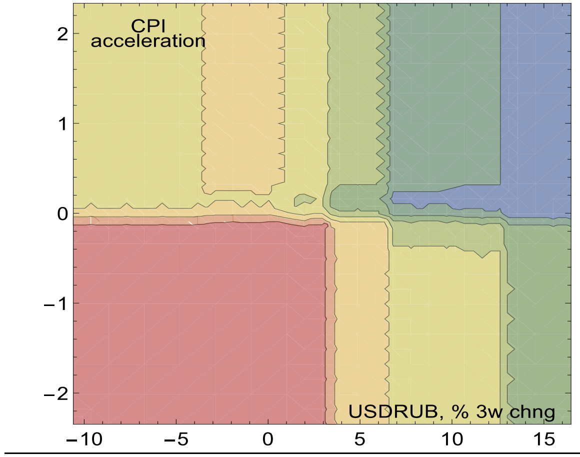
Another possible issue is the danger of overfitting – extracting a pattern which is simply not there, because the sample is wide but shallow.

One methodological cross check we have done, which is usually considered more robust to overfitting, is called random forests. This approach basically relies on fitting and then averaging over many 'small' decision trees which take into account only a narrow subsample of the variables.

Qualitatively, our estimates of the random forest model agree with the estimates of the decision trees.

We do not present these results in full here, as they do not lend themselves for such straightforward presentation as do the estimates of decision trees.

Probability of cut: sensitivity to inflation acceleration and FX (redder = more likely)



Source: VTB Capital Research

Appendix 1. Complete input table.

Date	Is core?	Extraordinary?	Decision	Key rate	CPI, % YoY		Guidance	Risk											Output gap	USDRUB, 3w % chng	CPI, 3 MoM sa 3mma	CPI, acc.	Expectations	
					t	t+12mo		FX	Expectations	Oil	Food	Fiscal	Regul. price	China recc.	Foreign CBs	Global food	Wage	Savings					Level	Change
02/2014	No	No	Hold	5.50	6.1	5	Raise												Negative	2.13	0.51	-0.02	13.00	0.50
03/2014	No	Yes	Raise	7.00	n/a	5.4	No												Negative	4.43	0.51	-0.03	12.43	-0.57
03/2014	Yes	No	Hold	7.00	6.4	5.7	Hold												Negative	2.01	0.50	-0.01	12.43	-0.57
04/2014	No	No	Raise	7.50	7.2	6	Hold	Yes	Yes	Yes									Zero	1.21	0.56	0.06	11.65	-0.15
06/2014	Yes	No	Hold	7.50	7.6	6	Raise	Yes	Yes		Yes		Yes						Zero	0.91	0.78	0.09	12.70	1.20
07/2014	No	No	Raise	8.00	7.5	6.25	Raise	Yes	Yes			Yes	Yes						Zero	0.76	0.32	0.12	10.30	0.00
09/2014	Yes	No	Hold	8.00	7.7	7.25	Raise												Zero	2.31	0.61	-0.06	11.30	-0.40
10/2014	No	No	Raise	9.50	8.4	8.25	Cut		Yes										Zero	6.68	0.63	0.03	12.50	0.70
12/2014	Yes	No	Raise	10.50	9.4	10.25	Raise	Yes	Yes										Zero	15.27	0.84	0.18	13.80	1.30
12/2014	No	Yes	Raise	17.00	n/a	10	No	Yes	Yes										Zero	29.20	0.84	0.18	13.10	-0.70
01/2015	No	No	Cut	15.00	13.1	9.75	No												Negative	10.86	1.20	0.36	15.50	2.40
03/2015	Yes	No	Cut	14.00	16.7	9	Cut		Yes			Yes	Yes						Negative	0.88	2.08	0.28	16.60	1.10
04/2015	No	No	Cut	12.50	16.5	8	Cut		Yes	Yes		Yes	Yes						Negative	-3.19	2.06	-0.02	15.70	-2.40
06/2015	Yes	No	Cut	11.50	15.6	6.75	Hold		Yes	Yes		Yes	Yes						Negative	10.15	0.93	-0.75	14.00	-1.70
07/2015	No	No	Cut	11.00	15.8	6.75	No		Yes	Yes		Yes	Yes						Negative	4.89	0.51	-0.42	15.00	0.70
09/2015	Yes	No	Hold	11.00	15.8	7	No		Yes	Yes		Yes	Yes						Negative	0.99	0.38	0.04	13.90	-1.10
10/2015	No	No	Hold	11.00	15.6	6.75	Cut		Yes	Yes		Yes	Yes						Negative	4.85	0.55	0.17	16.00	1.20
12/2015	Yes	No	Hold	11.00	14.8	6	Cut		Yes	Yes		Yes	Yes	Yes	Yes				Negative	6.61	0.82	0.11	16.30	0.30
01/2016	No	No	Hold	11.00	10	6.75	Hike		Yes	Yes									Negative	5.54	0.78	-0.04	16.40	0.52
03/2016	Yes	No	Hold	11.00	7.9	5.75	Hold		Yes	Yes		Yes	Yes			Yes			Zero	-7.03	0.62	-0.09	15.70	-1.00
04/2016	No	No	Hold	11.00	7.3	5	Cut	Yes	Yes	Yes		Yes					Yes		Zero	-3.89	0.51	-0.11	14.70	-1.00
06/2016	Yes	No	Cut	10.50	7.3	4.75	No		Yes	Yes		Yes					Yes		Zero	-2.31	0.49	-0.11	14.60	-0.10
07/2016	No	No	Hold	10.50	7.2	4.75	Cut		Yes	Yes								Yes	Zero	2.96	0.38	-0.03	14.20	0.60
09/2016	Yes	No	Cut	10.00	6.6	4.5	Hold		Yes	Yes		Yes					Yes	Yes	Zero	0.04	0.37	0.01	12.60	-1.70
10/2016	No	No	Hold	10.00	6.2	4.25	Hold		Yes	Yes		Yes					Yes	Yes	Zero	-0.21	0.40	0.03	14.20	1.60
12/2016	Yes	No	Hold	10.00	5.6	4	No		Yes	Yes		Yes						Yes	Zero	-5.91	0.47	0.04	13.70	1.40
02/2017	No	No	Hold	10.00	5.1	4	Hold		Yes	Yes								Yes	Zero	1.36	0.41	-0.06	12.40	-1.30
03/2017	Yes	No	Cut	9.75	4.3	4	Cut		Yes	Yes								Yes	Zero	-1.32	0.32	-0.10	12.90	1.40
04/2017	No	No	Cut	9.25	4.25	4	No	Yes	Yes	Yes									Zero	-0.22	0.20	-0.12	11.20	-1.70
06/2017	Yes	No	Cut	9.00	4.2	4	No		Yes	Yes		Yes				Yes	Yes	Yes	Zero	1.71	0.19	-0.04	10.30	-0.70
07/2017	No	No	Hold	9.00	4.4	4	No		Yes	Yes		Yes				Yes	Yes	Yes	Zero	-0.55	0.32	0.12	10.30	0.00

Source: CBR, VTB Capital Research.

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Restricted	0	0.0%
Not Rated	0	0.0%
Under Review	14	11.8%
	119	

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Sell	1	4.2%
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Not Rated	0	0%
Under Review	4	16.7%
	24	

Source: VTB Capital Research as at 31 August 2017

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