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On the need for cognitive closure and judgmental trend forecasting

Introduction

There is vast literature on the judgmental forecasting related to the problem if judgmental forecast provides a value added to the statistical forecasts (see e.g. Lawrence et al., 2006). Many aspects may influence the judgmental forecasts, external factors as: the way the time series is presented (Weber at al, 2005), statistical properties of the time series (e.g. its variability) but also the internal characteristics of person giving the prognosis: expertise and psychological traits. In this research we concentrate on individual differences' influence on judgmental forecasting. There are previous studies showing that both individual differences as the way the generator of the trend is perceived shape the process of trends identification (Tyszka et al, 2017). As it is intuitively clear that higher expertise should lead to better forecasts there is the empirical evidence showing the contrary, e.g. Yates et al (1991). In their between-the-subject research Yates et al show that undergraduate students performed better than graduate students in terms of forecasts accuracy. The explanations for this observation, is that the graduates students were, due to higher economic expertise, more prone to include the cues in their forecasts, that in fact had no additional explanatory power. The other aspect of making judgmental forecast is refereeing to the historical data. Goodwin (2005) reports, based on the literature and the results of multiple regressions, that the heuristics for forecast is to include the last observation and the mean of last observations (for untrended series) and is to include the last observation and the trend (for trended series).

We have simulated an experimental environment that refers to different historical trends and different degree of available information. Instead of having the two groups of participants with different levels of expertise and letting them to forecast the same time series (between-the-subjects) like Yates et al (1991), we have let the same group of participants to forecast two different time series (within-the subject). One of such time series (domestic, from the perspective of participants, stock exchange index) is characterized by higher availability of additional information available (macroeconomic, political, experts opinions) than the other (foreign stock exchange index, from the perspective of participants).

Need for cognitive closure

Some individual differences may influence the forecasts reliance on the historical time series data and thus its ability and correctness. Kruglanski (1989) introduced into psychology concept of need for cognitive closure defined as "the desire for a definite answer on some topic, any answer as opposed to confusion and ambiguity" (Kruglanski, 1989, p. 14). Thus, someone in high need of cognitive closer reviles a high desire for clear-cut opinion, reached by obtaining any answers, even not the most optimal and correct one. Thus, such individuals are assumed to refrain from processing further information as soon as they already had closure (any answer). As a result individual with high need for cognitive closure are more likely to use early information in forming judgments, thus information processing is more superficial. Therefore we suspect that need for cognitive closure goes in line with tendency to skipping trend analysis (as a method of information simplification) or if anything - looking rather for trends in shorter periods than longer, as such people finish information processing faster, after initial check provides enough confirmatory support. The person with a high need for cognitive closure is characterized with high preference for order and structure, high desire for predictability, feels discomfort when confronted with ambiguity, is close-minded – with all this aspects covered in need for closure scale proposed by Kruglanski.

Our research contributes twofold. First we analyze the relation between inclusions of the historical observation in the judgmental forecast depending on the individual differences. Secondly we verify these relations for time series with the different trend situation: upward, sideways and downward trend. We suspect that need for cognitive closure plays important role in making judgmental forecast in sideways trends, not in upward or downward trends, we hypothesized

H: need for cognitive closure reduce the usage of historical observations in judgmental forecasts only in case of sideways trends.

The paper is organized as follows. We first analyze the statistical properties of forecasted time series and present the study. Than we analyze the relations between psychological traits and forecast making process.

Method

We have conducted 3 independent studies; two of them based on the real data (WIG and DAX indices) respectively Study 1A and Study 1B. The last study (Study 2) was based on the synthetic data generated using the assumption on the underlying autoregressive stochastic process for rates of return.

Participants

Students of the Capital Markets Major of Cracow University of Economics participated in this study during the one semester Technical Analysis course. Participation was voluntary; however, participating students were given bonus credits for the Technical Analysis course. Additionally, students were awarded with extra bonus credits depending on their results. This was intended to provide higher motivation than any minor monetary payoffs that might have been offered instead[1]. One group of students participated in Study 1A, whereas the second independent group of students participated in studies 1B and 2. There was 2 years interval between Study 1 and the other studies in order to minimize the information flow to the next year younger students from their older colleagues. Demographic characteristics of the participants are presented in Table 1. Participants were young with average age about 22 years, in three conducted studies men were in majority of the groups.

Table 1. Demographic data about the groups of students participating in Study 1A, 1B and 2.

Study	N	Number of:		Age	
		Women	Men	Mean	std. dev.
1A	58	18	40	22,57	3,24

[1] Students receive the monthly scholarship depending on the average grade, so there is a direct relationship between grades and monetary payments. Moreover good average grade is very important for the 3rd year students as it allows avoiding taking the entrance exams for MA studies.

1B & 2	66	21	45	22,29	2,90

Source: authors' own study.

Materials – Study 1A and 1B

Study 1A and 1B participants filled the battery of psychological tests of individual differences for the assessment of information processing and cognitive preferences among them there was 15 items version of Need For Cognitive Closure (NFCS, see Webster and Kruglanski, 1994 and Roets and van Hiel, 2011) covering the following subscales:

- Desire for predictability (NFC_FP)
- Preference for order and structure (NFC_OP)
- Discomfort with ambiguity (NFC_MI)
- Decisiveness (NFC_BD)
- Close-mindedness (NFC_CC)

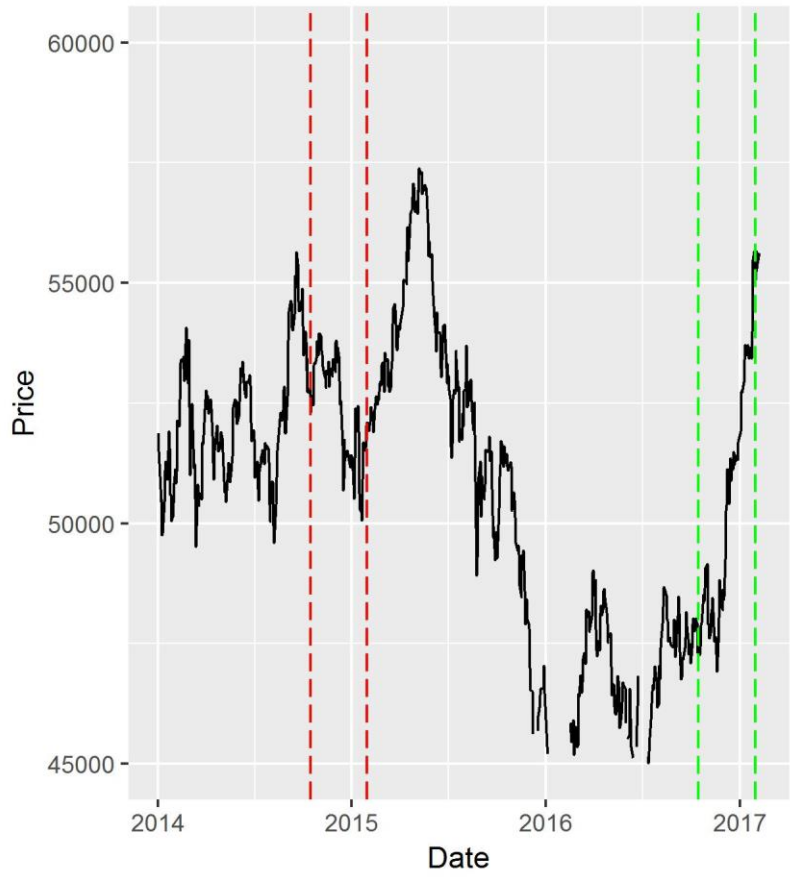
Procedure

Study 1A & 1B

In studies 1A & 1B students were asked to regularly provide the forecasts of the forthcoming week rate of returns for two selected indices: WIG and DAX. Within each study participants were randomly assign to two groups, one was forecasting for WIG, second was working with DAX. Study 1A was conducted each week, starting from 2014-10-01 until 2015-02-08, while Study 1B in the period starting from 2016-10-10 until 2017-01-30. The time series to be forecasted are presented in Figures 1 and 2. Time period of the Study 1A is shown between red dotted lines and respectively of Study 1B between green dotted lines.

Figure 1 DAX index time series. Red dots represents the timing of study 1A, while the green line – study 2B

Figure 2 WIG index time series. Red dots represents the timing of study 1A, while the green line – study 2B

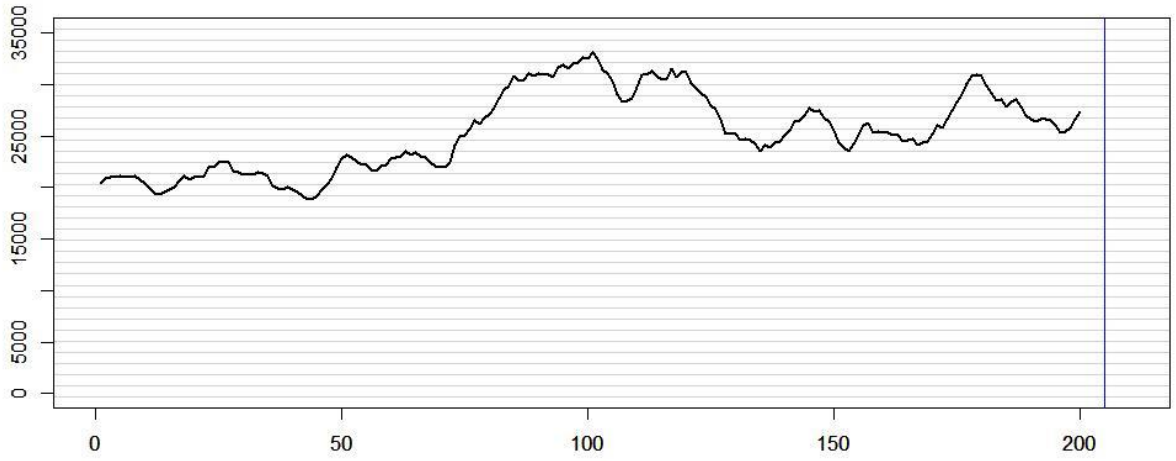


The study was conducted in Lime Survey during the classes. The students had access to historical prices of DAX and WIG indices. In particular, we have asked for the point forecast - r_f and the students were told that at the end of the semester the mean absolute deviation from the real observed rates of return will determine the number of extra credit points for the course. The top 30% of the students received 3 points, the next 40% in the ranking received 2 points, next 20% gained 1 point, and remaining 10% received no extra points.

Materials – Study 2

During the semester we conducted 5 independent studies in the period starting from 2016-11-06 until 2017-01-15. The same group of students that participated in Study 1B was asked to provide the forecasts of synthetically generated time series. The study was conducted in Lime Survey. Students were presented the graphs (as the one shown in Figure 3) and in some studies also histograms of weekly rate of returns and a data. The parameters in 9 (3 by 3) studies are identical as the studies differed only with respect to information availability: graph, graph plus histogram and graph plus histogram plus raw data.

Figure 3 Example of the time series presented to the students in Study 2



Results

Study 1A and 1B

First we have used Alexander filter (as implemented in R with ttr-package) with different parameters 20%, 10%, 5% and 2,5% to identify the trends in the forecasted time series, for each index and each forecasted period. The 20% parameter enabled identification of the longer time trends whereas on the contrary 2,5% parameter enabled identification of the short time trends. We have used different parameters as we did not know which time perspective the students are using for their forecasts. The filter enables identification of local extremes (minimum and maximum). We have defined the current trend as the average daily logarithmic return from the last identified extreme price until the forecast day (shall this period be too short, shorter than 10 days for 20%,10% and 5% parameters and 5 days for 2,5% parameter the second last identified extreme was considered instead). Than the correlations of forecasted returns with identified last trends returns of different time perspective were calculated. The trend with the highest absolute correlation with forecast was finally chosen for further analysis – the absolute value of the correlation between the selected trend value and the relevant point forecast is denoted by: RR. The variable PER denotes the correlation with the trend period (having the following values: 1=20%, 2-10%, 3- 5% and 4-2,5%) and relevant forecasting variable. The positive value means that the students use rather shorter trends for forecasts. Thus we could identify which time perspective (longer or shorter) is considered by the student for their forecast and to which extent. Secondly we used the absolute value as to treat the momentum (forecast

with the trend) and contrarian (forecast against the trend) strategies equal as we only investigate if the students use trends for their forecast and not how.

Table 2 Correlation of: absolute values of correlation coefficients between observed trend and forecasted value (RR), the period of the trend considered in forecasting (PER.), average time used for preparation of forecasts (TIME) and the psychological trait measured by Need for Cognitive Closure subscales tests (preference for order and structure OP, desire for predictability FP, discomfort with ambiguity MI, close-mindedness CC, decisiveness BD) for *Study 1A*.

Study	DAX			WIG							
1A	RR	PER.	TIME	RR	PER.	TIME	OP	FP	MI	CC	BD
RR	1	0,07	0	1	0	0,14	-0,22	-0,17	-0,18	0,09	0,14
PER.	0,07	1	-0,1	0	1	0,17	0,04	-0,14	-0,1	0,07	0,11
TIME	0	-0,1	1	0,14	0,17	1	-0,02	0,01	-0,03	-0,14	0,04
OP	-0,22	0,04	-0,02	-0,2	-0,09	-0,02	1	0,6	0,47	-0,17	-0,02
FP	-0,17	-0,14	0,01	-0,24	-0,05	0,01	**0,6**	1	0,64	0,03	-0,14
MI	-0,18	-0,1	-0,03	-0,19	-0,01	-0,03	**0,47**	**0,64**	1	-0,18	-0,16
CC	0,09	0,07	-0,14	-0,14	0,04	-0,14	-0,17	0,03	-0,18	1	0,25
BD	0,14	0,11	0,04	-0,17	0,16	0,04	-0,02	-0,14	-0,16	**0,25**	1

Legend: Significant values of correlation coefficient are bold (p-value<0,05). Source: authors' own study.

Analogue results for study 1B are shown in the following table.

Table 3. Correlation of: absolute values of correlation coefficients between observed trend and forecasted value (RR), the period of the trend considered in forecasting (PER.), average time used for preparation of forecasts (TIME) and the psychological trait measured by Need for Cognitive Closure subscales tests (preference for order and structure OP, desire for predictability FP, discomfort with ambiguity MI, close-mindedness CC, decisiveness BD) for *Study 1B*.

Study	DAX			WIG							
1B	RR	PER.	TIME	RR	PER.	TIME	OP	FP	MI	CC	BD
RR	1	-0,04	0,2	1	0	0,1	0,13	0,02	0,1	-0,16	0,15
PER.	-0,04	1	-0,22	0	1	0,12	0,03	0,12	-0,07	-0,06	0,07
TIME	0,2	-0,22	1	0,1	0,12	1	0	-0,09	0,06	-0,03	-0,29
OP	0,13	0,03	0	0,21	-0,01	-0,05	1	0,55	0,42	-0,13	0,12

FP	0,02	0,12	-0,09	0,02	-0,1	-0,2	**0,55**	1	0,52	-0,05	-0,04
MI	0,1	-0,07	0,06	**0,25**	-0,25	0,07	**0,42**	**0,52**	1	-0,06	-0,25
CC	-0,16	-0,06	-0,03	0,03	-0,11	-0,07	-0,13	-0,05	-0,06	1	0,11
BD	0,15	0,07	**-0,29**	-0,08	0,09	**-0,3**	0,12	-0,04	**-0,25**	0,11	1

Legend: Significant values of correlation coefficient are bold (p-value<0,05). Source: authors' own study.

To combine the results we apply Stouffer's Z-score method. The results of the one sided test are shown in the Table 5 below.

Table 4. One sided pvalues of estimated correlation coefficients between absolute values of correlation coefficients between observed trend and forecasted value and Need for Cognitive Closure subscales tests (NFC) for *studies 1A and 1B.*

Study	preference for order and structure OP	desire for predictability FP	discomfort with ambiguity MI	close-mindedness CC	decisiveness BD
1A	0,0443	0,0561	0,0796	0,3413	0,169
1B	0,1081	0,9553	0,0894	0,5202	0,3424

Source: authors' own study.

Within Study 1A we can observe that students with higher levels of order preference (OP) and desire for predictability (FP) use the identified trends for prediction to a lesser extent. Results of Study 1B did not confirmed this result, the relation between NFC subscales and using trends for forecasting is not significant in Study 1B.

Results Study 2

First, the Alexander filter has been used for randomly generated time series used in Study 2. Number of single round of the experiment as well as number of local optima (minimum or maximum of the time series, sometimes called support and resistance) for different parameters of the Alexander filter as well as total rate of return in the period considered are presented in Table 9. The parameters in the last 9 (3 by 3) studies are identical as the studies differed only with respect to information availability: graph, graph plus histogram and graph plus histogram plus raw data.

Table 5. Number of local optima (minimum or maximum) for different parameters of the Alexander filter as well as total rate of return in the period considered.

Exp	20%	10%	5%	2,5%	RR
1	4	9	18	22	0,29
2	4	7	21	29	-0,5
3	2	7	17	44	0,08
4	7	9	9	19	-1,12
5	2	8	13	31	1,08
6	2	6	14	34	0,01
7	4	10	14	26	0,05
8	4	8	12	26	0,92
9	2	9	17	33	-0,35
10	4	8	13	21	-0,73
11	4	7	19	27	0,28
12	1	5	11	32	0,29
13	7	15	23	45	1,05
14	5	16	24	34	1,36
15	7	17	33	57	0,35
16	7	15	23	45	1,05
17	5	16	24	34	1,36
18	7	17	33	57	0,35
19	7	15	23	45	1,05
20	5	16	24	34	1,36
21	7	17	33	57	0,35

Source: authors' own study.

Next we selected the study rounds in the side-ways trend situation (rate of return value in the whole period considered in between -30% and 30%) and the rounds in dominating up or down trends (rate of return value in the whole period considered lower than -70% or higher than 70%) the results are presented in tables below.

Table 6. Correlation of: absolute values of correlation coefficients between observed trend and forecasted value (RR), the period of the trend considered in forecasting (PER.), average time used for preparation of forecasts (TIME) and the psychological trait measured by Need for Cognitive Closure subscales tests (preference for order and structure OP, desire for predictability FP, discomfort with ambiguity MI, close-mindedness CC, decisiveness BD) for *Study 2*.

Study 2	sideway trend			up or down trend							
	RR	PER.	TIME	RR	PER.	TIME	OP	FP	MI	CC	BD
RR	1	0,02	0,23	1	0,64	-0,14	-0,02	-0,44	-0,11	-0,03	0,15
PER.	0,02	1	0,3	**0,64**	1	-0,04	0,51	0,17	0,2	0,2	-0,11
TIME	0,23	0,3	1	-0,14	-0,04	1	0,22	-0,12	0,1	0,11	-0,29
OP	-0,02	**0,51**	0,22	0,2	0,27	0,28	1	0,56	0,42	-0,15	0,14
FP	**-0,44**	0,17	-0,12	-0,09	0,04	0,09	**0,56**	1	0,53	-0,07	-0,06
MI	-0,11	0,2	0,1	-0,05	-0,01	0,28	**0,42**	**0,53**	1	-0,06	-0,25
CC	-0,03	0,2	0,11	-0,07	0,02	0,1	-0,15	-0,07	-0,06	1	0,05
BD	0,15	-0,11	-0,29	**0,48**	**0,49**	-0,18	0,14	-0,06	**-0,25**	0,05	1

Legend: Significant values of correlation coefficient are bold (p-value<0,05). Source: authors' own study.

We can observe significant differences in side-ways and dominant up or downtrend. Desire for predictability (FP) makes the students rather not to use trends in sideways trend situation as the basis for forecasting whereas has no impact in case of dominant trends. This confirms the observation we had when WIG and DAX indices were forecasted. In Study 1A timeframe both markets were in side-ways trends, on the other hand in the Study 1B timeframe both markets were dominant uptrend. Moreover the decisiveness (BD) makes the students use trends for forecasting to the larger extent.

Conclusions

We have confirmed the following hypothesis in this paper:

H: Need for cognitive closure reduce the usage of historical observations in judgmental forecasts only in case of side-ways trends

Using the synthetic data explained phenomenon observed in Studies 1A and 1B, namely that desire for predictability makes the people not to use trends or not to look for secondary trends in case of sideways trend market situation (which is ambiguous at the first glance). On the other hand in case of dominant upward or downward trend, decisiveness factor make people use the trends as forecasting base which may cause them to take too much risk. The further research will consider, the next study with synthetic data that differs with respect to overall trend (rate of return) and frequency of local minima and maxima.

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Abstract

We have considered the following hypothesis in the paper that need for cognitive closure reduces the usage of historical observations in judgmental forecasts only in case of side-ways trends. To verify the hypothesis we have conducted 3 studies. In each of the studies students were to forecast the next, unknown observation using the previous time series. We concentrated on the trend analysis. Moreover we analyze how the trends in historical data are used as the basis for forecasting depending on the observed psychological traits, in particular cognitive closure.

Key words: judgmental forecast, need for cognitive closure, time series analysis

Streszczenie

W niniejszym artykule została przedstawiona hipoteza mówiąca o tym, że potrzeba domknięcia poznawczego wpływa na ograniczone wykorzystanie informacji ujętych w historycznych danych podczas tworzenia prognoz tylko w przypadku trendów bocznych. Celem weryfikacji hipotezy 3 eksperymenty zostały zrealizowane. W każdym z eksperymentów uczestnicy prognozowali przyszłą wartość na podstawie dostępnego szeregu czasowego. Skupiono się na analizie trendów. Zbadano, w jaki sposób są wykorzystywane trendy w danych historycznych jako podstawa do tworzenia prognoz w zależności od psychologicznych inklinacji, w szczególności potrzeby domknięcia poznawczego.

Słowa kluczowe: prognozowanie, potrzeba domknięcia poznawczego, analiza szeregów czasowych.