THE ACCURACY OF PROFESSIONAL FORECASTS AND MONETARY POLICY IN AN EMERGING COUNTRY

Salminah Pulumo*, Leroi Raputsoane**

* South African Reserve Bank, Pretoria, South Africa
** Tshwane University of Technology, Pretoria, South Africa

Abstract

This paper analyses the accuracy of professional forecasts of monetary policy interest rate decisions in South Africa since 2008. This is achieved by examining the dissimilarity between the professional forecasts of monetary policy stance and the realised monetary policy interest rate on the basis of proximity, temporal structure and sensitivity to forecast horizon. The results show that the forecasts of South African insurance companies and international banks are closest to the realised monetary policy interest rate on average based on proximity, while the forecasts of South African banks and interest groups are closest to the realised monetary policy interest rate based on temporal structure. The results finally show deterioration of the professional forecasts the further away the forecast horizon and that the heterogeneity in forecast accuracy neither emanates from the country of primary listing nor primary business of the professional forecasts groups.***

Keywords: Forecast Accuracy, Dissimilarity, Monetary Policy

JEL Classification: C53, E43, E52, C54

Note: The views expressed in this publication are those of the authors and do not represent those of the South African Reserve Bank. Authors are fully liable for any omissions contained herein.

1. INTRODUCTION

Monetary policy is conducted against a backdrop of imperfect knowledge where central banks and market participants are uncertain about the structure and the nature of the shocks affecting the economy. Predicting the future path of the monetary policy interest rate is not an easy exercise, particularly the longer the forecast horizon, given that economic forecasts are associated with significant uncertainty according to Dale et al. (2008). This is because such prediction requires forecasting the future developments of the economy as well as the reaction of monetary policy to such developments. Central banks have recently become particularly concerned about the ability of market participants to anticipate and predict future monetary policy decisions. Woodford (2001) and Blinder (1998) assert that market expectations of the future actions by central banks significantly determine the effectiveness of monetary policy and hence policymakers observe transparency about their actions as important to improve the predictability of monetary policy. Bernanke (2004) and Blinder et al (2008) further argue that when policymakers regularly provide guidance about monetary policy objectives, the economic outlook, monetary policy strategy and the outlook for future policy decisions, the ability of markets to price assets efficiently is enhanced, while the expectations of market participants and those of the central bank become aligned.

According to Blinder (2009), central banks provide forward guidance regarding likely future monetary policy decisions in a variety of ways. These include indirect signals in policy statements and other communication about the bias of future policy stance given the balance of risks. Some central banks explicitly include an indication of the future path of monetary policy stance while others provide quantitative guidance by disseminating the numerical future policy rates together with other macroeconomic forecasts. Thus, Coibion and Gorodnichenko (2012) contend inflation targeting framework mainly provide forward guidance to the economy to anchor expectations regarding the future path of inflation and hence they suggest that it is important to assess market expectations to ensure that they are in line with the conduct of monetary policy. Bernanke (2007) asserts that managing expectations of future monetary policy decisions underscores their major role for macroeconomic fluctuations and lowers interest rate volatility and contributing to economic stability. Swanson (2006) and Hubert (2013) provide evidence supporting the recent increase in forward guidance by central banks. This evidence shows that the U.S. financial markets and private sector forecasters are better able to forecast the federal funds rate at horizons of up to several months and they are less diverse in the cross sectional variety of their interest

rate forecasts since the late 1980s. Middeldorp (2011) and Oliver and Pasaogullari (2015) also provide evidence that the predictability of monetary policy decisions has recently improved notably in many countries.

Middeldorp (2011) identifies several approaches for assessing predictability of monetary policy and one is to use predictions by professional forecasters. These forecasts are direct measure of expectations where the insignificant reaction of the market to monetary policy decisions, the accuracy of expectations of monetary policy implied by professional forecasts suggest that monetary policy is predictable. This paper follows a similar approach and analyses the accuracy of professional forecasts of monetary policy interest rate decisions in South Africa. This is achieved by examining the dissimilarity between the professional forecasts of the monetary policy stance and the realised monetary policy interest rate on the basis of proximity, temporal structure and sensitivity to forecast horizon. Dynamic time warping and discrete wavelet transform are used to analyse monthly Thomson Reuters Econometer survey data since 2008. The dissimilarity between the realised monetary policy interest rate and that which is predicted by professional forecasters is examined in two ways. Consequently, the paper will highlight the accuracy of professional forecasts of monetary policy decisions in South Africa on the basis of proximity, temporal structure and sensitivity to forecast horizon.

The literature on assessing predictability of monetary policy using professional forecasts include Berger et al (2006) who use surveys of professional European Central Bank monetary policy forecasters in 24 countries. They find significant differences in accuracy of the forecasts and that they are affected by country specific economic conditions. Mitchell et al. (2007) analyse forecasts of interest rates from the Wall Street Journal and find that, even though forecasts are unbiased, their accuracy is statistically indistinguishable from a random walk model. Sellon (2008) examines whether long horizon predictability has been associated with increased transparency using information from the Blue Chip long range financial forecasts and finds that there has been a remarkable improvement in survey forecast errors at short term horizons but less so at longer horizons. Goodhart and Lim (2011) uses forecasts of the Reserve Bank of New Zealand and those from money market yield curves in the United Kingdom and show that they are accurate for the immediate quarter, reasonable for the next quarter and impractical thereafter. Coibion and Gorodnichenko (2012) assess the validity of common and conflicting predictions of consumers, firms, central bankers and professional forecasters and find that mean forecasts fail to completely adjust to shocks on impact.

Beechey and Osterholm (2014) evaluate the forecasting properties of the central banks of Norway and Sweden of the monetary policy interest rate and its expectations that are inferred from financial market pricing and find that there are negligible differences in their relative forecasting precision even though they fail the tests for unbiasedness and efficiency at longer horizons. Drager et al. (2015) use survey data of consumers and professionals to analyse whether their expectations are consistent with the Fisher Equation, the Taylor rule and the Phillips curve and find that most are theory consistent. In South Africa, van Walbeek (2013) analyses the ex post forecasting ability of macroeconomic consensus forecasts by the Economist Intelligence Unit country report and the Media 24 Economist of the Year using the root mean square error as a measure of forecast accuracy and finds no substantial difference in the forecast accuracy of the two entities. Although one of the variables of interest is the short term interest rate, it is not necessarily the monetary policy interest rate. Media 24's Economist of the Year uses the 3-month rate for Negotiable Certificates of Deposit while Economist Intelligence Unit country report uses the interbank rate.

The paper is organised as follows. The next section discusses the data. This is followed by the methodology and then the discussion of the empirical results. Last the conclusion.

2. DATA

Monthly data was sourced from Thomson Reuters Econometer. It spans the period 2008-2014. The Thomson Reuters Econometer is a monthly poll of the monetary policy interest rate forecasts by professional forecasters in the current period, one year ahead and two years ahead. To facilitate the analysis, the professional forecasters were organised into groups based on the following criterion. They were first grouped as South African and international based on the country of primary listing of their companies. Then they were sorted into groups based on their primary business, for instance, banks, investment companies, parastatals, etc. The same criterion was followed in all the three forecast periods where Year 0 are same year forecasts, Year 1 are one year ahead forecasts and Year 2 are two year ahead forecasts. Table 1 presents the forecast groups. This grouping criterion yielded 13 forecast groups where Year 0, Year 1 and Year 2 comprised 34, 29 and 28 companies respectively. The forecast groups data series were constructed by aggregating the professional forecasters prediction of monetary policy decisions using the equal weighting scheme.

The Thomson Reuters Econometer survey includes more companies. However, not all companies have responded consistently for all the months of the sample period. Pigott (2001) and Higgins and Green (2006) argue that there are many principal options for dealing with missing data. These include ignoring the missing data and analysing only the available data or imputing the missing data with replacement values as if they were observed. In this particular instance, the following criterion was followed to include the selected set of companies into the sample. First, the companies that responded less than half the required time in any particular year were discarded. Then missing data for the remaining companies with responses for more than half the required time in any particular year were imputed by assuming that each forecaster will maintain the error from the last period into the present period hence the present period's realised monetary policy interest rate is multiplied by the proportion of the past period error to obtain the present value forecast.

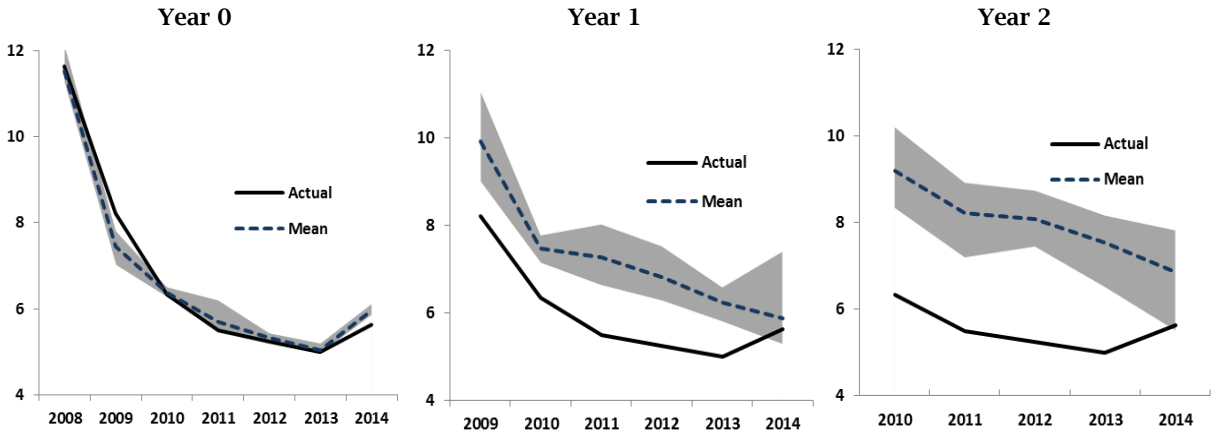
Table 1. Forecasters groups

Groups	Forecasters
South African banks	ABSA Capital, First National Bank, Nedbank, Standard Bank, Investec Bank, Standard Chartered Bank, Rand Merchant Bank
South African Big 4 banks	ABSA Capital, First National Bank, Nedbank, Standard Bank
South African insurance companies	Capital Economics, Credit Guarantee
South African interest groups	Bureau of Economic Research, NKC Independent Economists, Economists.co.za, Meganomics, University of Johannesburg
South African investment companies	Renaissance Capital, KADD Capital, Vunani Securities, Efficient Group, Thebe Stockbroking, BJM Holdings, Metropolitan Asset Management
South African parastatals	Eskom, Industrial Development Cooperation, Public Investment Cooperation
South African all companies	All South African forecasters
International banks	Citi Group, J.P. Morgan, Morgan Stanley, Merrill Lynch
International investment companies	Citadel LLC, Macquarie group, Nomura Holdings, Brait SE, ING Group
International other companies	IHS Global Insight, KPMG
International all companies	All International forecasters
All banks	All South African and International banks
All investment companies	All South African and International investment companies

Notes: Own grouping with data from Thomson Reuters Econometer

The evolutions of the variables are depicted in Figure 1. The actual monetary policy interest rate is represented by the solid line, the mean by the broken line and the graphs of the different forecast groups represented by the grey scale. In year 0, or the same year forecasts, the realised monetary policy interest rate was closely tracked by all the forecast groups even though they all predicted a lower than realised monetary policy interest rate in 2009 and a higher than realised monetary policy interest rate in 2014. In the 1 year ahead forecasts, all the forecast groups predicted a higher than the average actual monetary policy interest rate for most of the sample period except for in 2014. The year 2, or the two year ahead forecasts, are largely in line with those in year 1. Most professional forecasts were higher compared to the realised monetary policy interest rate for most of the sample period except in 2014. The evolution of the variables by the different forecast groups are also closer to the realised monetary policy interest rate in year 0 than they are in year 1 and year 2. This implies greater uncertainty the further away the forecast horizon, which is in line with expectations.

Figure 1. Variables plots



Notes: Own grouping with data from Thomson Reuters Econometer. The shaded graphs are the plots of all the forecast groups.

Table 2 shows the means of the forecasts groups as well as their correlations with the realised monetary policy interest rate. In year 0, or the same year forecasts, the predictions of most forecasts groups were close to the realised monetary policy interest rate. Meanwhile, the 1 year and 2 year ahead forecasts show that all the forecasts groups predicted a higher monetary policy interest rate than the realised monetary policy interest rate. On average, over the three forecasts periods, the means of the forecasts of South African interest groups and banks were closest to the realised monetary policy interest rate while the means of the forecasts of South African and international investment companies were furthest in relative terms. The correlations of the forecasts groups with the realised

monetary policy interest rate, show that on average over the three periods, the correlations of the forecasts of South African parastatals and investment companies with the realised monetary policy interest rate were the strongest while those of the South African big 4 banks and international investment companies were the weakest. The correlations are generally strongest in year 0 than they are in year 1 and year 2, in descending order. As with the variables plots, the correlations imply greater uncertainty the further away the forecast horizon.

Table 2. Descriptive statistics

	Average			Correlation		
	Year 0	**Year 1**	**Year 2**	**Year 0**	**Year 1**	**Year 2**
Actual	6.7917	5.9861	5.5417	1.0000	1.0000	1.0000
Mean	6.7708	7.2610	7.9747	0.9915	0.9797	0.9043
Median	6.7548	7.2839	8.0093	0.9917	0.9808	0.8998
Highest forecast	7.0537	8.0708	8.7700	0.9872	0.9726	0.9435
Lowest forecast	6.5837	6.6826	6.9917	0.9916	0.9817	0.7903
South African all companies	6.7763	7.2331	8.0236	0.9941	0.9802	0.9220
South African banks	6.7587	7.0183	8.1189	0.9874	0.9623	0.8363
South African big 4 banks	6.6884	7.1992	8.3141	0.9842	0.9529	0.7078
South African insurance companies	6.7070	7.2690	8.1339	0.9805	0.9931	0.9131
South African interest groups	6.9056	7.0396	7.3675	0.9987	0.9843	0.9115
South African investment companies	6.7305	7.3703	7.8633	0.9933	0.9838	0.9234
South African parastatals	6.8491	7.2742	8.0002	0.9937	0.9847	0.9420
International all companies	6.7753	7.3864	7.3656	0.9911	0.9678	0.8538
International banks	6.8212	7.2587	8.2001	0.9970	0.9812	0.7904
International investment companies	6.7066	7.5296	8.3596	0.9815	0.9262	0.8515
International other companies	6.8100	7.3243	7.4167	0.9962	0.9806	0.9221
All banks	6.7847	7.1057	8.1514	0.9922	0.9716	0.8122
All investment companies	6.7068	7.3848	8.3566	0.9890	0.9626	0.9206

Notes: Own calculations with data from Thomson Reuters Econometer.

3. METHODOLOGY

Two approaches were used to analyse the accuracy of professional forecasts of monetary policy decisions in South Africa. The first approach was the Dynamic Time Warping (DTW) proposed by Sankoff and Kruskal (1983) and Berndt and Clifford (1994) to find patterns between time series data based on their proximity. It finds a mapping between time series so that the distance between any two coupled observations is minimised. It is given by

$$d_{DTW}(X_T, Y_T) = \min_{r \in M}\left(\sum_{i=1}^{M}|X_i - Y_i|\right) \quad (1)$$

where d_{DTW} is the DTW distance, $X_T = X_1,...,X_T$ are the realisations of the time series X of length T and $Y_T = Y_1,...,Y_T$ are the realisations of the time series Y of length T, r is the mapping between the time series X_T and Y_T of a sequence of M pairs with observations

$$r = ((X_1, Y_1),...,(X_M, Y_M)) \quad (2)$$

Thus DTW allows the measurement of proximity between variables and hence it allows the measurement of dissimilarity in proximity between the monetary policy interest rate forecasts and the realised monetary policy interest rate in this particular instance. The recent detailed description of DTW can be found in Giorgino (2009).

The second approach was the Discrete Wavelet Transform (DWT) proposed by Crochiere et al (1976) and Vetterli and Le Gall (1989) to find patterns between time series data based on their structure. It replaces the original time series by their wavelet approximation coefficients and then it measures dissimilarity between the wavelet approximations. It is given by

$$d_{DWT}(X_T, Y_T) = \sqrt{\sum_{i=1}^{M}(A_{X,i} - A_{Y,i})^2} \quad (3)$$

where d_{DWT} is the DTW distance, $X_T = X_1,...,X_T$ are the realisations of the time series X of length T and $Y_T = Y_1,...,Y_T$ are the realisations of the time series Y of length T, $A_{X,i}$ and $A_{Y,i}$ are the smooth approximation coefficients of the time series X and Y of a sequence of M pairs with observations and represent the smooth, more low frequency, behaviour of the data series such that

$$X_T - A_{X,T} = D_{X,T} \quad \text{and} \quad Y_T - A_{Y,T} = D_{Y,T}$$

where $D_{X,T}$ and $D_{Y,T}$ are the detail approximation coefficients of the time series X and Y and represent the detailed, more high frequency, behaviour of the data series. Thus DWT allows the measurement of structure between variables and hence it allows the measurement of dissimilarity in temporal structure between the monetary policy interest rate forecasts and the realised monetary policy interest rate. The recent detailed description of DTW can be found in Percival and Walden (2006) and Zhang et al. (2006).

To validate the dissimilarity measures, first, the Known Ground Truth (KGT) validation measure was used following Zhang et al. (2006) and Pertega and Vilar (2010). KGT involves calculating an index that measures agreement between the realised partitions $\hat{G}_i = (\hat{G}_1,...,\hat{G}_M)$ and the experimental partitions $\tilde{G}_i = (\tilde{G}_1,...,\tilde{G}_M)$. Both the realised and experimental partitions are based on the time series distances. The KGT index is

$$KGT\left(\hat{G}_i, \tilde{G}_i\right) = \max_{\hat{G},\tilde{G}} \frac{1}{M} \sum_{i=1}^{M} \left(\hat{G}_i, \tilde{G}_i\right) \qquad (4)$$

and it lies between 0 and 1. The KGT index is closer to 1 the higher the agreement between the realised and the experimental partitions. Second, the One Nearest Neighbour (ONN) validation measure was used following Keogh and Kasetty (2003) and Tan et al. (2006). ONN is based on leave one out cross validation criterion where given the realised partitions $\hat{G}_i = (\hat{G}_1,...,\hat{G}_M)$ and some dissimilarity object $\tilde{D}_i = (\tilde{D}_1,...,\tilde{D}_M)$, it calculates the proportion of correctly classified data series by comparing stability of the realised partitions based on removing the column of a data series one at time. The ONN index is

$$ONN\left(\hat{G}_i, \tilde{D}_i\right) = \min_{\hat{G},\tilde{D}} \frac{1}{M} \sum_{i=1}^{M} \left(\hat{G}_i, \tilde{D}_i\right) \qquad (5)$$

The ONN index also lies between 0 and 1. The KGT index is closer to 0 the higher the stability of partitioning results in terms of consistency. The DTW and DWT dissimilarity measures and the KGT and ONN validation measures are implemented using the algorithm by Montero and Vilar (2014).

4. RESULTS

The accuracy of professional forecasts of monetary policy decisions in South Africa were analysed using DTW and DWT. As discussed above, DTW finds patterns between time series data based on their proximity, while DWT find patterns between time series data based on their temporal structure. Additionally, KGT and ONN were used to assess the validity of the dissimilarity results and the results are presented in Table 3. Both the KGT and ONN validation measures point to robustness of the estimated results based on the DTW and DWT dissimilarity measures. In particular, the KGT indexes, which measure agreement between the realised and experimental partitions for the DTW and DWT dissimilarity measures, are all above 0.50 in years 0, 1 and 2. Since they are closer to 1 than they are to 0, they predict relatively higher agreement between the realised and experimental partitions. The ONN indexes, which estimate the proportion of correctly classified data series by comparing the stability of the realised partitions based on removing the column of a data series one at time for the DTW and DWT dissimilarity measures, are all below 0.50 in years 0, 1 and 2. Since they are closer to 0 than they are to 1, they predict relatively higher stability of the realised partitions.

Table 3. Results validation

	Dynamic Time Warping			Discrete Wavelet Transform		
	Year 0	**Year 1**	**Year 2**	**Year 0**	**Year 1**	**Year 2**
Known ground truth	0.7370	0.6375	0.5816	0.8427	0.5827	0.6532
One nearest neighbour	0.1415	0.3972	0.2627	0.2470	0.4573	0.4163

Notes: Own calculations with data from Thomson Reuters Econometer.

The empirical results of the DTW and DWT dissimilarity measures are presented in Table 4. The results of the DTW dissimilarity measure of year 0, or the same year forecasts, show that the professional forecasters that were closest in terms of proximity to the realised monetary policy interest rate are the South African investment companies and interest groups as well as international banks, while the forecasts of South African banks and insurance as well as international investment companies are furthest. In year 1, or the one year ahead forecasts, the results show that South African banks are closest to the realised monetary policy interest rate, while the forecasts of both the South African and international investment companies are furthest. In year 2, or the two year ahead forecasts, the results show that the forecasts of most international companies, except investment companies, are closest to the realised monetary policy interest rate, while the forecasts of most investment companies, South African and international are furthest from the realised monetary policy interest rate. Over the 3 forecast periods, the forecasts of South African insurance and international banks are closest to the realised monetary policy interest rate, while those of South African and international investment companies are

furthest in terms of proximity to the realised monetary policy interest rate.

Table 4. The results of dynamic time warping and discrete wavelet transform

	Dynamic time warping			Discrete wavelet transform		
	Year 0	Year 1	Year 2	Year 0	Year 1	Year 2
Actual	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean	8.7872	41.8858	133.314	3.7943	13.2070	20.6109
Median	8.9797	43.7762	137.377	3.7783	13.3776	20.9260
Highest forecast	17.8004	116.987	241.712	7.2477	21.1375	28.2134
Lowest forecast	7.0619	10.2455	35.2497	4.3509	7.3771	13.8433
South African all	8.1234	34.9145	141.219	3.0648	13.1510	21.0332
South African banks	10.8965	11.8347	156.581	4.7361	10.6036	20.5768
South African big 4 banks	10.6612	15.2071	169.054	5.1025	12.0940	22.2126
South African insurance companies	17.3978	47.3401	78.0539	7.7331	12.6087	21.8912
South African interest groups	6.9776	47.7408	112.822	2.0233	14.2059	20.5590
South African investment companies	6.9766	60.3755	169.991	3.2433	12.6497	21.1788
South African parastatals	10.6167	43.5255	127.830	4.2709	17.7023	23.7663
International all companies	9.1264	46.9238	69.7231	3.9524	14.8117	15.4794
International banks	7.8205	30.2945	123.058	2.3828	14.4350	23.2061
International investment companies	12.0167	60.2658	194.850	5.9881	16.8640	22.7579
International other companies	8.4660	74.2494	99.6264	2.4604	11.2358	15.1299
All banks	9.3447	16.5421	141.519	3.7133	11.7845	21.5432
All investment companies	8.7121	59.4231	203.941	4.1782	14.4400	22.6588

Notes: Own calculations with data from Thomson Reuters Econometer.

The results of the DWT dissimilarity measure of year 0, or the same year forecasts, show that the monetary policy interest rate forecasters that are closest in terms of temporal structure to the realised monetary policy interest rate are the South African interest groups and international banks, while the forecasts of South African insurance companies and international investment companies are furthest. In year 1, or the one year ahead forecasts, the results show that the forecast of banks, particularly those in South Africa, are closest to the realised monetary policy interest rate, while the forecasts of South African parastatals and international investment companies are furthest. In year 2, or the two year ahead forecasts, the forecasts of most other international companies and South African interest groups are closest to the realised monetary policy interest rate, while those of South African parastatals and international investment companies are furthest. Over the three forecast periods, the forecasts of international other companies as well as South African banks and interest groups are closest to the realised monetary policy interest rate, while those of South African parastatals and international investment companies are furthest.

The DTW and DWT measures further show increasing distance of the monetary policy interest rate forecasts from the realised monetary policy interest rate at different forecast horizons. In particular, comparing the magnitudes of distances of the forecasts monetary policy interest rate from the realised monetary policy interest rate in Year 0, Year 1 and Year 2, it is obvious from Table 4 that the professional forecasts are closest to the actual monetary policy interest rate in Year 0 and furthest in Year 2. The magnitudes of distances of the professional forecasts from the realised monetary policy interest rate increase the further away the forecast horizon implying their deterioration the further away the forecast horizon. This finding is in line with the evolution of professional forecasts depicted in Figure 1 and the descriptive statistics in Table 2. In general, the study finds significant heterogeneity between ability of professional forecast groups to accurately forecast the monetary policy interest rate in South Africa. However, this heterogeneity neither emanates from the professional forecasters' country of primary listing nor specialisation of professional forecasters groups primary business.

5. CONCLUSION

This paper analysed the accuracy of professional forecasts of monetary policy interest rate decisions in South Africa using DTW and DWT dissimilarity measures. DTW found patterns between time series data based on proximity and DWT found patterns between time series data based on temporal structure. The results of the DTW dissimilarity measure show that the forecasts of South African insurance and international banks are closest to the realised monetary policy interest rate, while those of South African and international investment companies are furthest in terms of proximity to the realised monetary policy interest rate in the three forecast periods. The results of the DWT dissimilarity measure show that the forecasts of international other companies as well as South African banks and interest groups are closest to the realised monetary policy interest rate, while those of South African parastatals and international investment companies are furthest on the basis of temporal structure, on average in the three forecast periods. DTW and DWT dissimilarity measures have further shown increasing distance of the monetary policy interest rate forecasts from the realised monetary policy interest rate as the forecast period

increases implying the deterioration of the professional forecasts the further away the forecast horizon. In general, the study finds significant heterogeneity in the ability of professional forecast groups to accurately forecast the monetary policy interest decisions in South Africa that neither emanates from the professional forecasters groups' country of primary listing nor primary business.

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