# Judgmental Forecasting

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## 6.1. INTRODUCTION

Human judgment permeates forecasting processes. In economic forecasting, judgment may be used in identifying the endogenous and exogenous variables, building structural equations, correcting for omitted variables, specifying expectations for economic indicators, and adjusting the model predictions in light of new information, official announcements, or "street" talk. Studies with economic forecasters indicate that judgment is given more weight than the modeling techniques in constructing predictions (Batchelor and Dua, 1990). In fact, judgment is "the primary factor that the economist uses in converting mere statistical and theoretical techniques into a usable forecast" (McAuley, 1986, p. 384). As accentuated by Larry Summers (a former Harvard and MIT professor of economics who is currently U.S. Treasury Secretary), "ultimately there's no alternative to judgment – you can never get the answers out of some model" (cf., Fox, 1999, p. 66).

Judgmental forecasting focuses on the incorporation of forecasters' opinions and experience into the prediction process. Hence, it covers an extensive base, ranging from situations where there exists no quantifiable information so that the forecast is based exclusively on judgment, to cases where the econometric or extrapolative methods are heavily consulted, with judgment supporting the model building phase and/or fine-tuning the given predictions. Various surveys have indicated that judgmental forecasting methods enjoy the highest degree of usage by practitioners on a regular basis (Dalrymple, 1987; Mentzer and Cox, 1984; Rothe, 1978; Sparkes and McHugh, 1984; Winklhofer, Diamantopoulos, and Witt, 1996). Forecasters appear to be highly satisfied with judgmental approaches, preferring them over quantitative techniques due to reasons of accuracy and

difficulties in obtaining the necessary data for quantitative approaches. Judgmental methods are also stated to add a "common sense element" to the forecast, creating a sense of "ownership" (Sanders and Manrodt, 1994). Firm size does not seem to make a difference, only that larger firms appear to use more sophisticated judgmental techniques (Sanders, 1997b). Even when forecasts are generated quantitatively, judgmental adjustments are regularly performed (Fildes and Hastings, 1994), as they incorporate the forecaster's knowledge of special events and changing conditions, in addition to his/her general knowledge of the prediction environment (Jenks, 1983; Soergel, 1983). Furthermore, forecast users appear to rely more on judgmental methods than on quantitative techniques (Wheelwright and Clarke, 1976).

Given their extensive usage and significant consequences, judgmental forecasts offer challenging research venues across disciplines. This chapter aims to review the relevant work on judgmental forecasting, providing a synopsis of research findings to date, while highlighting issues that demand future scrutiny. Accordingly, the next section details the elicitation formats used in judgmental forecasting studies, followed by discussions of factors affecting accuracy, comparisons of judgmental versus model-based forecasts, issues of judgmental adjustments, and forecast combinations.

## 6.2. Forecasting Format

Judgmental forecasts may be expressed via various formats (for example, point forecasts, prediction intervals, or probability forecasts), the choice of which is dictated usually by the user specifications and/or the task environment. Although point forecasting is extensively used, providing only point predictions may convey a misleading message of precision. It could be argued, however, that the uncertainty surrounding the point forecasts may have a direct influence on the decision-making process (Eckel, 1987; Howard, 1988). Prediction intervals and probability forecasts provide alternative formats for revealing this uncertainty. The use of the latter in economics and finance is surveyed by Tay and Wallis in chapter 3 of this volume.

Studies have indicated a distinct preference for interval forecasts over point predictions for the communication of forecasts to users (Baginski, Conrad, and Hassell, 1993; Pownall, Wasley, and Waymire, 1993). Prediction intervals are reportedly influenced by the choice of the presentation scale, as well as the trend, seasonality, and variability in the series (Lawrence and O'Connor, 1993). Furthermore, judgmental prediction intervals are found to reflect overconfidence (that is, for intervals given a confidence coefficient of XX percent, less than XX percent of the intervals actually include the true value; Lichtenstein, Fischhoff, and Phillips, 1982; Russo and Schoemaker, 1992).

Probability forecasting serves as an alternative elicitation format in which the judgments are expressed via subjective probabilities. Probability forecasts reveal detailed information regarding forecaster's uncertainty, acting as a basic communication channel for the transmission of this uncertainty to the users of these

predictions, who can, in turn, better interpret the presented forecasts (Murphy and Winkler, 1984). From the forecast provider's point of view, a distinct advantage is that probability forecasting enables the forecaster to more completely express his/her true judgments, thus reducing any tendencies to bias the forecasts (Daan and Murphy, 1982). Probabilistic directional or multiple-interval forecasts are used extensively in economic and financial forecasting, with various measures of accuracy being developed to address diverse aspects of a forecaster's performance like calibration, over/underconfidence, over/underforecasting, and discrimination (Murphy, 1972a,b, 1973; Wilkie and Pollock, 1996; Yates, 1982, 1988). Using these measures to assess probabilistic forecasting performance, previous research has mainly examined predictions of financial variables like stock prices (Muradoglu and Önkal, 1994; Önkal and Muradoglu, 1994, 1995, 1996; Stael von Holstein, 1972; Yates, McDaniel and Brown, 1991) and exchange rates (Wilkie-Thomson, Önkal-Atay and Pollock, 1997), suggesting the importance of factors like contextual information, time-series characteristics, forecaster bias, and expertise for predictive performance. It is to these issues we turn next.

## 6.3. FACTORS AFFECTING THE ACCURACY OF JUDGMENTAL FORECASTS

Primary benefits of judgmental forecasting entail the incorporation of forecasters' contextual knowledge, including the identification of "special case insights" or "broken-leg cues"; that is, unusual pieces of information that cannot be modeled, despite their importance for prediction accuracy (Meehl, 1954). Hence, contextual information promises to be a critical factor influencing the relative performance of judgmental forecasts. If properly incorporated into judgment, such information could signal important changes like upcoming discontinuities in series (Kleinmuntz, 1990). Thus, contextual information could give judgmental forecasts a distinct edge over model-based forecasts since the latter necessarily treats such sporadic influences as merely noise, due to their infrequency (Goodwin and Fildes, 1999).

With most studies on judgmental performance utilizing constructed series with no contextual frames, the effects of such information remains underexplored. Only a few studies have controlled for contextual information, finding higher accuracy for judgmental forecasts constructed with contextual knowledge as opposed to predictions not benefiting from such information (Edmundson, Lawrence, and O'Connor, 1988; Sanders and Ritzman, 1992), and relative to statistical predictions (Edmundson, Lawrence, and O'Connor, 1988; Fildes, 1991). Further work to systematically investigate the sensitivity of judgmental forecasts to variations in factors like the accessibility, timing, and predictive contribution of contextual information would prove valuable for enhancing our understanding of judgmental predictive performance.

Exploring the potential effects of time-series characteristics on the accuracy of judgmental extrapolations constitutes another stream attracting research interest. In attempts to isolate the effects of time-series components on predictive accuracy, previous studies have mainly utilized constructed series, arguing that

this practice eliminates the effects of outside cues while enabling control of the pertinent time-series characteristics (O'Connor and Lawrence, 1989). Trend has been the most thoroughly investigated component, with its presence shown to affect the performance of judgmental point and interval forecasts (Lawrence and Makridakis, 1989; O'Connor and Lawrence, 1992; O'Connor, Remus, and Griggs, 1997). Furthermore, past work has found a distinct tendency of participants to dampen both upward and downward trends (Bolger and Harvey, 1993; Eggleton, 1982; Harvey, 1995). Recent evidence showing that forecasting performance could be contingent on the strength of trend (Wilkie-Thomson, 1998) suggests a clear need for detailed studies on the effects of the strength of time-series movements.

Judgmental performance has been reported to deteriorate in constructed series with high seasonality (Adam and Ebert, 1976; Sanders, 1992), and similarly for series with white noise (Adam and Ebert, 1976; Eggleton, 1982; Sanders, 1992; O'Connor, Remus, and Griggs, 1993). However, due to the nested factors in experimental designs, conclusive statements as to the superiority of judgmental versus statistical methods for differential levels of seasonality and noise cannot be made given the results of existing research. Past work on judgmental fore-casting for series with discontinuities or temporal disturbances have reported relatively poor performance as compared to statistical techniques (Sanders, 1992; O'Connor, Remus, and Griggs, 1993), and such findings have in part been explained by the absence of contextual information provided to participants. Interestingly, Wilkie-Thomson (1998) found that professionals and academics in currency forecasting outperformed various statistical techniques, sharing the same noncontextual information basis as the models. However, these participants were proficient with chartist forecasting techniques (that is, methods based on the belief that all indicators of change – economic, political, psychological, or otherwise – are reflected in the price series itself and, therefore, a study of price action is all that is needed to forecast future movements). Hence, the absence of contextual information in these circumstances may not carry the same connotations as in previous work, where contextual information may potentially constitute a more critical determinant of performance.

Judgmental forecasts have also been reported to be influenced by the data presentation format, with graphical presentation generally superior to tabular format (Angus-Leppan and Fatseas, 1986; Dickson, DeSanctis, and McBride, 1986), especially for trended series (Harvey and Bolger, 1996). However, forecast horizon (Lawrence, Edmundson, and O'Connor, 1985) and environmental complexity (Remus, 1987) are found to mediate the effects of presentation format, such that the tabular format appears to give better results for constructing long-term fore-casts on series with high noise.

Accuracy of judgmental forecasts could also be influenced by biases in judg-ment (Bolger and Harvey, 1998; Goodwin and Wright, 1994), potentially resulting from the forecasters' use of heuristics or simplifying mental strategies (Tversky and Kahneman, 1974). Heuristics like anchoring and adjustment (that is, giving too much weight to a particular reference point – for example, the last observed value in a time series – and making typically insufficient adjustments to it in arriving at a forecast) may be responsible for the common finding on participants'

underestimation of trends (Bolger and Harvey, 1993; Lawrence and Makridakis, 1989), although excessive adjustments from anchors are also reported (Lawrence and O'Connor, 1995).

Judgmental biases argued to be especially relevant to forecasting include: illusory correlations (that is, false beliefs regarding the relatedness of certain variables), hindsight (that is, the feeling that the forecaster knew all along that a particular event would happen anyway), selective perception (discounting information on the basis of its inconsistency with the forecaster's beliefs or expectations), attribution of success and failure (that is, the tendency to attribute good forecasts to one's own skill, while attributing inaccurate forecasts to environmental factors or chance), underestimating uncertainty, optimism, overconfidence, and inconsistency in judgment (Hogarth and Makridakis, 1981). These biases could also be related to the organizational incentive systems (Bromiley, 1987). For instance, forecasters mostly prefer to underforecast, justifying this tendency typically by their motivation to look better if the stated goals are surpassed (Sanders and Manrodt, 1994), or by their choice to be conservative (Peterson, 1991). In a similar motivational vein, Ehrbeck and Waldmann (1996) report that professional forecasters may not merely aim to minimize expected squared forecast errors, but rather, they may "strategically bias" their forecasts. That is, less able forecasters may try to balance their need for accuracy with their concern to appear competent by trying to mimic forecasting patterns typical of recognized experts. Whether real or imaginary, perceived controllability of outcomes could also have a powerful effect on judgmental predictions (Langer, 1982).

Economic forecasting is argued to be particularly vulnerable to belief and expectation biases; that is, there may exist tendencies to construct forecasts that conform to one's beliefs/expectations, while being critical of results that conflict with them (Evans, 1987). Given that in economics, ". . . rival theories are persistently maintained in the face of all evidence" (p. 43), Evans (1987) points out that "the world inevitably provides excuses for the failures of forecasts" (p. 44), promoting the maintenance of beliefs and expectations.

With debates surrounding the actual forecasting performance of experts, expertise provides another factor that has not received proper research attention in judgmental predictions. A review of studies on the quality of expert judgment reveals contradictory findings that could stem from differences in research methodology, as well as task differences (Bolger and Wright, 1994). The high accuracy of judgmental forecasts provided by financial experts (see Önkal-Atay, 1998, for a review) signals a clear need for detailed studies under realistic conditions; for example, where the forecast may affect the task environment or where the forecaster may have a distinct preference over certain outcomes (Goodwin and Wright, 1993).

## 6.4. MODEL-BASED VERSUS JUDGMENTAL FORECASTS

Comparisons of judgmental forecasts with model-based or statistical forecasts have appealed to researchers attempting to delineate conditions for their best

comparative use. Model-based forecasts enjoy consistency over repetitive settings as well as reliable combination of different information. They may also have immunity from organizational politics as well as from the motivational and cognitive biases, inconsistencies, and limitations that permeate individual judgments. Judgmental forecasts, on the other hand, benefit from human ability to evaluate information that is difficult to quantify, as well as to accommodate changing constraints and dynamic environments.

A number of studies have shown judgment to outperform model-based forecasts (Edmundson, Lawrence, and O'Connor, 1988; Lawrence, Edmundson, and O'Connor, 1985; Murphy and Winkler, 1992; Stewart, Roebber, and Bosart, 1997), especially when few data points are available and when the forecast horizon is extended (Bailey and Gupta, 1999). Other work has supplied evidence favoring statistical models (Armstrong, 1985; Makridakis, 1988; Carbone and Gorr, 1985; Holland, Lorek, and Bathke, 1992). In constructed series with high variability and major discontinuities, participants appeared to overreact to each data point as values were revealed, reading signal into noise, hence performing worse than statistical models (O'Connor, Remus, and Griggs, 1993). Even though predictive performance improved as the accuracy of information on discontinuities improved, individuals were found to overreact to immediate past information, thus not fully utilizing the information provided on the discontinuities (Remus, O'Connor, and Griggs, 1995).

Task characteristics and the differing nature of judgments elicited could account for the discrepancies in findings. Previous work has remained mostly confined to laboratory settings with artificial series constrained to various levels of noise and trend. However, extensive studies with security analysts have repeatedly shown superior accuracy as compared to model-based forecasts (Armstrong, 1983; Branson, Lorek, and Pagach, 1995; Brown, Hagerman, Griffin, and Zmijewski, 1987; Hopwood and McKeown, 1990; O'Brien, 1988), suggesting that real forecasting performance could be different. Regardless, "the evidence is that even if judgmental forecasts perform worse than a statistical model, it is often the former that will be used in any substantive decisions" (Goodwin and Fildes, 1999, p. 50). Practitioners' emphasis on judgmental forecasting is also pronounced in a survey of corporate planners from the 500 largest corporations in the world, where they clearly express the severe limitations of using only statistical techniques for forecasting (Klein and Linneman, 1984). To utilize judgment most effectively in improving forecasting performance for certain tasks, it might be preferable to use judgment in adjusting model-based forecasts, or to combine judgmental predictions with statistical forecasts. The main motivation behind judgmental interventions and combining forecasts involves capturing a richer information base, thus improving accuracy, as discussed in the following section.

## 6.5.  JUDGMENTAL ADJUSTMENTS AND COMBINING FORECASTS

Judgmental adjustments are frequently encountered in business (Sanders and Manrodt, 1994) and economic forecasting (Granger and Newbold, 1986; Young,

1984), and are mostly made informally (Bunn, 1996). The overall value of judgmental interventions to business and econometric forecasts has been well established (Donihue, 1993; Glendinning, 1975; Huss, 1985; Matthews and Diamantopoulos, 1986, 1989; McNees, 1990; Wallis, 1985–1988). Such modifications to statistical or. "baseline" forecasts serve the role of incorporating expert knowledge on variables omitted in the models, potentially due to the presumed insignificance of these variables, their judgmental nature, multicollinearity problems, and/or insufficient data (Bunn and Salo, 1996). These modifications can also be automatic, as with the "intercept corrections" discussed extensively in Clements and Hendry (1999).

Results from econometric models are frequently adjusted judgmentally for specification errors and structural changes (Corker, Holly, and Ellis, 1986; McAuley, 1986; Turner, 1990). When no contextual information is provided, the effectiveness of judgmental adjustment may depend on the quality of the statistical forecast (Carbone, Andersen, Corriveau, and Corson, 1983; Willemain, 1991). In particular, judgmental adjustments are argued to not harm the "good" or near-optimal forecasts, while generally improving the "not-so-accurate" predictions (Willemain, 1989). These results appear to be contingent on series characteristics, however. In particular, when regular time series are interrupted by sporadic discontinuities (that is, special events like government announcements, competitor's introduction of a new product, etc.), human judgment is found to be inefficient in using the supplied statistical forecasts. Model-based predictions appear to be modified when, in fact, they are reliable, and yet ignored when they would have provided a good base value for adjustment (Goodwin and Fildes, 1999). As expected, biases may surface again, with forecasters displaying a tendency to favor their own judgmental predictions over other information, suggesting a possible anchoring effect (Lim and O'Connor, 1995). It is also plausible that individuals may feel more "in control" when they use their own judgment (Langer, 1975) to supplement the model-based forecasts. With an insightful perspective, McNees and Perna (1987) contend that a basic advantage of judgmentally overriding the quantitative forecasts is the emergence of a forecast "story" (that is, explanations underlying the forecast and the risks accompanying the forecast); they argue that "most users need to know not only *what* will happen, but why it will happen" (p. 350).

The reverse issue of statistically correcting the judgmental forecasts has received scant research attention (Ashton, 1984; Goodwin, 1997; Moriarty, 1985; Theil, 1971). The role of statistical interventions on judgmental predictions is particularly emphasized in organizational settings where the motivational factors for biasing the forecasts may be quite apparent and where such corrections could also serve as feedback mechanisms (Goodwin, 1996).

In addition to forecast adjustments, the accuracy benefits of combining statistical and judgmental forecasts have been repeatedly demonstrated (Blattberg and Hoch, 1990; Bunn and Wright, 1991; Collopy and Armstrong, 1992; Clemen, 1989; Lawrence, Edmundson, and O'Connor, 1986). See also chapter 12 by Newbold and Harvey in this volume for a review of the literature on the combination of forecasts. Superior accuracy appears to especially hold when there is information

asymmetry; that is, when the experts have access to information not captured by the models (Hoch and Schkade, 1996; Yaniv and Hogarth, 1993). Combining could also lead to predictions that are inferior to judgmental forecasts, when statistical model performs poorly (Fildes, 1991). It appears that the contextual information can play an important mediating role in deciding when to combine, given the appraised value of the statistical model generating the forecasts. Supporting this assertion, Sanders and Ritzman (1995) have shown that, especially when the time series exhibits moderate to high variability, heavy emphasis should be given to judgmental forecasts based on contextual knowledge in making combination forecasts.

Mechanical combination is recommended over subjective combination (Goodwin and Wright, 1993; Lee and Yum, 1998; Lim and O'Connor, 1995), with some studies favoring regression-based weights (Guerard and Beidleman, 1987; Lobo, 1991; Newbold, Zumwalt, and Kannan, 1987) while others defend simple averaging of forecasts (Ashton and Ashton, 1985; Blattberg and Hoch, 1990; Bohara, McNown and Batts, 1987; Conroy and Harris, 1987). While the appropriate combination formula appears to depend on a myriad of factors, Armstrong and Collopy (1998) argue that the integration of statistical methods and judgment is effective when there exist structured methods for integration, when judgment brings information not captured by the statistical model, and when judgment is used as an input to statistical techniques (as in selecting variables and defining functional forms).

Combining individual judgmental forecasts provides another gateway for improving predictive accuracy (Ashton, 1986; Ferrell, 1985; Hill, 1982). Group forecasts commonly encountered in practice provide a variety of approaches to combining individual judgments (see Sniezek, 1989, for a review). Judgment accuracy has been found to change in the group process of combining individual assessments into a final group judgment, with group predictions displaying higher accuracy (Ang and O'Connor, 1991) as well as higher confidence (Sniezek and Henry, 1990), accompanied by increased member confidence following group discussion (Sniezek, 1992). Communication between group members can be beneficial as long as they are based on sharing differential information or insights about the possible variability of future outcomes, with measures taken to counteract "groupthink" and similar bias-inducing frames or dominating members (Lock, 1987).

Aside from the "interactive group forecasts" discussed above, statistical models could be used to aggregate individual judgments into "staticized group forecasts" (Hogarth, 1978), with the latter potentially yielding superior predictive performance than both the individual judgments (Einhorn, Hogarth, and Klempner, 1977) and the interactive group forecasts (Sanders, 1997a). Similarly, simple averaging of judgmental forecasts was found to display higher predictive accuracy than the judgmental combination of individual forecasts (Lawrence, Edmundson, and O'Connor, 1986). However, while improving performance aspects like calibration, simple averaging may simultaneously have deteriorating effects on other dimensions like discrimination (Wilkie and Pollock, 1994). Also, judgmental combinations of individual judgmental predictions are found to be

no better than the best individual forecast, with judgmental combinations of judgmental and statistical forecasts performing worse than the best individual judgmental prediction (Angus-Leppan and Fatseas, 1986). Fischer and Harvey (1999) assert that these conclusions are only valid if no error histories of individual forecasters are available to the person combining these forecasts. The authors show that when summaries of past errors are available, judgmental combinations perform better than simple averaging of forecasts.

When forecasts are constructed in groups, recognition of member expertise and use of expertise from differential domains may lead to effective utilization of such knowledge for improved group forecasting performance (Littlepage, Robison, and Reddington, 1997). Covering a wide application umbrella extending from forecasts in technology management (Ward, Daview, and Wright, 1999) to predictions in economics (Cicarelli, 1984; Gibson and Miller, 1990), the Delphi technique provides an exemplary group process that aims to benefit from effective judgmental combinations of forecasts. The technique consists of a successive series of forecasting sessions whereby each expert revises his/her predictions in light of other experts' forecasts. Main characteristics include anonymity, iterations of judgment elicitation, group feedback, and statistical aggregation of forecasts in the last session to represent the final forecast (for an extensive review, see Gupta and Clarke, 1996). As a judgmental forecasting technique, Delphi assumes an especially critical role when geographically separated experts with diverse knowledge bases need to interact under conditions of scarce data – an archetypical economic forecasting scenario given the globalization process.

## 6.6. CONCLUSION

Research reviewed in this chapter attests to the wide use of judgmental forecasts, with their role highlighted under conditions of scarce data or when data sources are dubious and data quality is debatable. Even when operating in information-rich environments, however, judgmental forecasts are typically elicited to enhance the model-based forecasts, given their edge in incorporating expectations on structural changes and/or sporadic influences, as well as assimilating information on contemporaneous factors. Extensive implications of judgmental forecasting performance necessitates detailed analyses targeted at educating the users and providers of forecasts to their benefits as well as shortcomings. Such research should aim to develop modular and credible platforms for methodical incorporation of judgment into forecasting processes. As succinctly stated by Goodwin and Fildes (1999), "the challenge . . . is to develop forecasting support systems that encourage forecasters to recognize those elements of the task which are best delegated to a statistical model and to focus their attention on the elements where their judgment is most valuable" (p. 50).

Evaluation of judgmental forecasting performance poses significant research questions. Previous work has primarily focused on comparative accuracy, delineating forecast errors. Interestingly, surveys of practitioners indicate that accuracy is rated lower than "does the forecast make sense" in the list of important

attributes (Huss, 1987), with academics assigning higher ratings of importance to accuracy (Carbone and Armstrong, 1982). Often, forecasts are intertwined with organizational concerns for establishing performance goals and reward systems (Welch, Bretschneider, and Rohrbaugh, 1998). Features of concern mostly center around forecast meaningfulness, intuition, and validation, thus stressing the importance of balancing data with judgment in the forecasting process (Bunn, 1996). In a similar vein, Geistauts and Eschenbach (1987) suggest validity (that is, forecast accuracy), credibility (that is, users' perceptions regarding the reliability of forecasts), and acceptability (that is, decision-maker's evaluation as to the utility and implementability of the forecast) as the prominent criteria for under-standing the implementation of forecasts. Implementation of judgmental fore-casts is argued to be especially difficult since (i) they appear less "scientific" than model-based forecasts, (ii) steps used in arriving at a judgmental forecast are more difficult to describe, (iii) judgmental biases are in effect, and (iv) such forecasts carry a "signature" so that the forecasters' personalities and qualifica-tions may overshadow the evaluation process. Organizational politics, reward systems, and communication processes interact with both the users' relations with forecast providers, and the users' goals and expectations to influence the implementation of a forecast (Geistauts and Eschenbach, 1987).

Regarding accuracy, it may be argued that forecast errors suggest windows of opportunity reflecting dimensions with an improvement potential. To promote learning, such aspects of accuracy may effectively provide mechanisms for indi-vidual feedback (Benson and Önkal, 1992; Önkal and Muradoglu, 1995; Remus, O'Connor, and Griggs, 1996; Sanders, 1997a), as well as group feedback for Delphi-like procedures (Rowe and Wright, 1996).

Feedback becomes particularly critical in rolling forecasts. Forecasts in organ-izational settings are not treated as permanent unchanging statements (Georgoff and Murdick, 1986) but, rather, they are revised to take into account new data, sporadic events like official announcements, and changing user needs. Similarly, economic forecasts are typically updates given periodic information releases or benchmark factors (McAuley, 1986). Rolling forecasts remain a promising topic, involving critical issues like timing decisions, contextual information sensitivity, feedback presentation, and organizational contingencies for effective judgmental adjustments. Relatedly, contextual information in both "hard" and "soft" forms assumes a critical role. It is not merely the continuity, consistency, and accessibil-ity of the information that is crucial for predictive performance, but also the reliability, completeness, and meaningfulness of the information that drives fore-casting accuracy, suggesting promising research agendas.

In revising predictions given new information, Batchelor and Dua (1992) report that economic forecasters assign too much weight to their own previous forecasts (as compared to previous consensus forecasts), interpreted as a tendency to appear variety-seeking instead of consensus-seeking. The authors speculate that this tendency could be due to perceived pressures to provide "worthy" forecasts, where forecasts close to the consensus are thought to be "valueless." They also note that it could be due to users not trusting the forecasters who revise their forecasts substantially, hence producing an anchoring effect on

the previously announced forecast. These reports may signal that, especially in rolling forecasts, forecast consistency may be more important than accuracy as a performance criterion for users, given tolerable error bounds (White, 1986). Interestingly, Clements (1995) finds that, although forecasters' revisions may influence accuracy, there appears no evidence of their effects on the rationality of forecasts. In any case, forecast evaluation could be flawed in the absence of detailed knowledge of the forecaster's loss function. That is, unlike the statistical models, forecasters may pursue goals other than minimizing a particular function of the forecast error (Ehrbeck and Waldmann, 1996). Credibility considerations or other motivational pressures may suppress, for instance, the immediate and complete reflection of new information in the revised forecasts. These issues highlight the critical role that the user perspective can play in forecast quality and attest to the importance of provider–user communication. Detailed research into formats that systematically acknowledge and disseminate the uncertainty in forecasts remains crucial.

When the statistical model has not been performing up to expectations or non-time-series information exogenous to the model is expected to affect future outcomes, judgmental adjustments are called for. It has been pointed out that there could be a double-counting bias in making unstructured judgmental interventions to model-based forecasts (Bunn and Salo, 1996). In particular, it is argued that the omission of a variable from a model may not necessarily imply that its effect is not conveyed via other variables (correlated with the omitted variable) already included in the model. Thus, using "model-consistent expectations" for such omitted variables is suggested as a means to explore whether judgmental expectations are different enough to warrant a need for model adjustment (Bunn and Salo, 1996). Adjustments could also be made for behavioral reasons such as to make the predictions appear "plausible," to adhere to certain targets, and to meet the users' expectations (Fildes, 1987). Given that judgmental modifications are often made under implied organizational and political contingencies, systematic work on ecologically valid settings is definitely needed to enable reliable conclusions in this important area.

Combining forecasts is a related topic with disparate findings. Mechanical combinations of judgmental forecasts do not permit any exchange of information among forecasters but avoid behavioral problems that could stem from group dynamics. In settings where group forecasts are deemed desirable, it is recommended that multiple forecasts are elicited from each forecaster, and whenever possible, multiple experts with diverse information backgrounds are used to minimize biases. Hogarth (1978) concludes that predictions from six to 20 forecasters should be combined, with the number increasing as the divergence between forecasters increases; with Ashton's (1986) study providing full support. Naturally, combining becomes redundant when one forecast encompasses all the relevant information in the other forecasts – there has to be unique information to justify the inclusion of each in the aggregated forecast.

Structured research on group techniques like Delphi are needed to resolve the disparities in research findings on behavioral combinations of forecasts (Rowe, 1998). It is argued that the content validity of scenarios used in Delphi methods

influences the performance of such groups (Parente and Anderson-Parente, 1987). Relatedly, scenario methods suggest a viable approach to enhancing the effectiveness of judgmental forecasting. These methods involve basing predictions on smoothly unfolding narratives that suggest plausible future conditions (van der Heijden, 1994). Conditioning scenarios, depicting various combinations of event outcomes, could be used for decomposition in the assessment of judgmental probability forecasts (Salo and Bunn, 1995). Given its emphasis on the wide range of plausible future outcomes, scenario analysis counterbalances the judgmental tendency to elide uncertainties (Bunn and Salo, 1993), providing a promising research direction for propagating and conveying uncertainties in judgmental forecasting.

In conclusion, the central tenet of judgmental forecasting is enhancing predictive performance via effectively incorporating nonmodel-based information into the forecasting processes. As shown by Clements and Hendry (1998), combination is valuable precisely when different sources are used, while leading to potentially poor results if all the forecasts are based on the same information set. In domains like economic forecasting, where the markets are in flux and where vast inflows of information permeate expectations, requisite flexibility in allowing for judgmental considerations will continue providing research impetus to benefit both the users and providers of forecasts.

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