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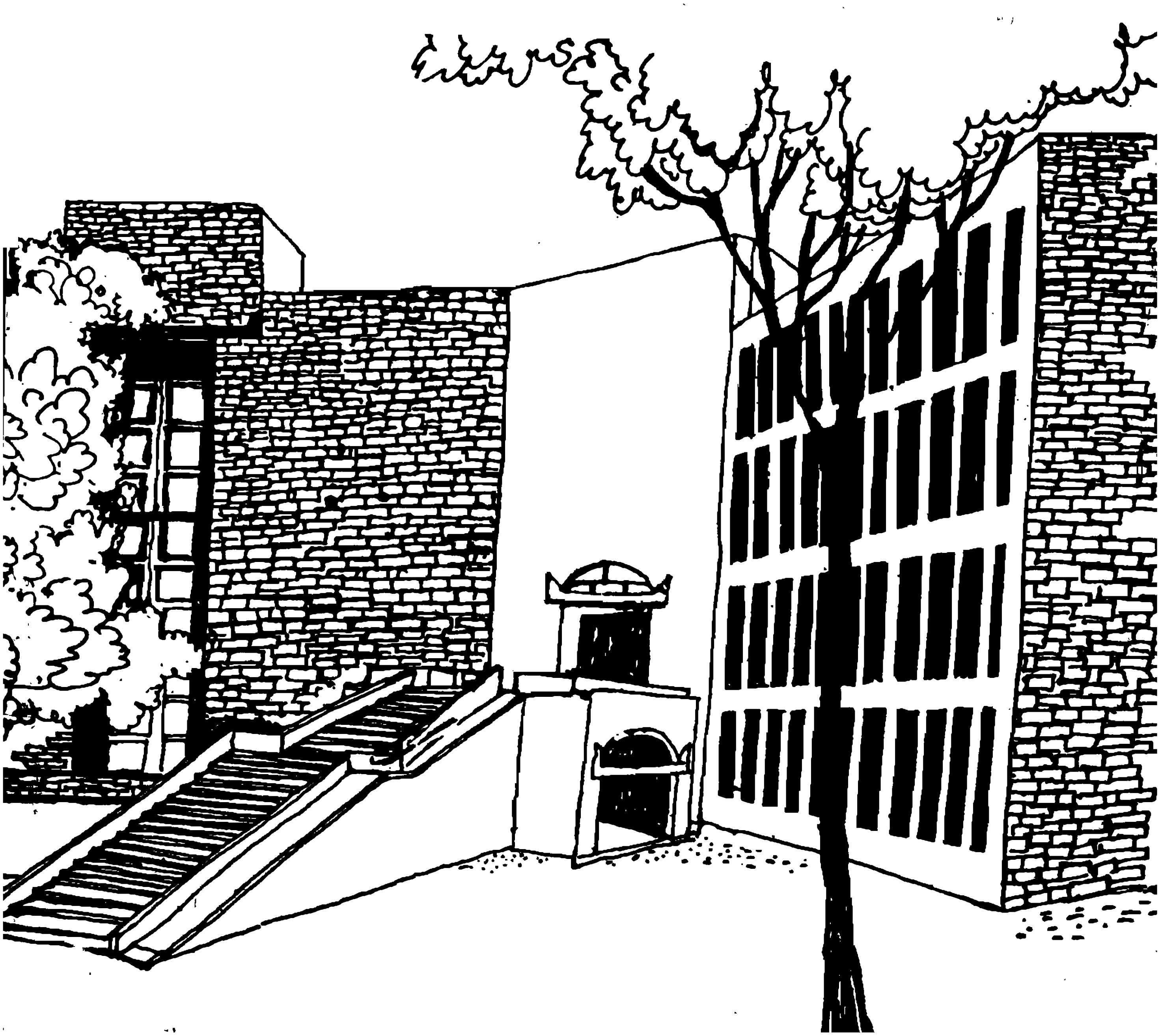

Structural Qualitative Method of Forecasting

Gopal Naik

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INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
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Abstract

The growth rate model of forecasting used so far by business organizations in developing countries can no longer generate satisfactory results owing to maturing markets. Lack of availability of sufficiently long time series data with these organizations limits the use of time series or causal models. While qualitative methods are suitable in such situations, previous studies have suggested systematic use of information to improve the accuracy of forecasts generated from these methods.

This paper develops a new model called the structural qualitative method, which generates forecasts using quantitative and qualitative data. Using this method forecasts at disaggregate levels can also be generated. It is suitable for use by both large and small organizations and does not require any expertise. It can also be used for decision-making since some variables are endogenous in the model.

Introduction

The economic liberalization process initiated in many developing countries in the 90s has facilitated markets to mature for many consumer products. Business organizations are, therefore, compelled to look for better methods of forecasting than the ones used so far, as these can no longer generate satisfactory forecasts. However, many of these companies have not maintained long enough time series data required for using popular forecasting methods such as time series analyses and causal models. In addition, expertise required to use these models is seldom available within the organization. The methods based on market research such as buyer intention survey are good only in certain situations such as estimating demand for industrial production, consumer durables, new products, and products whose purchases require advanced planning. Also, market research techniques are difficult to use when forecast needs to be generated frequently as in the case of rolling forecasts. Therefore, the only alternative available to many organizations is to generate forecast through qualitative methods. Qualitative methods are widely used in

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1 Gopal Naik is Professor at the Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad 380015, INDIA.

incorporate extensive market knowledge available within the organization, and ability to incorporate recent information.

The qualitative method often used to forecast variables such as sales is sales force composite. However, Kotler (2000) lists a number of difficulties with forecasts generated through this method. These forecasts need adjustment as sales representatives might be optimistic or pessimistic or they may have recency bias. The forecasts may not have incorporated the influence of larger economic developments or the marketing plan of the company. The sales force may deliberately underestimate the forecast with the expectation that the company will set low sales quota. Kotler suggests that to encourage better estimation by the field force the company could supply certain aids such as records of their past forecasts compared with their actual sales, a description of company assumptions on the business outlook, competitor behavior and marketing plan. Another problem experienced in developing countries is that sales force personnel often are unable to think in ways other than the familiar method of growth rate model. Qualitative methods such as expert opinion, where opinions of an individual or group of individuals are obtained at the corporate level, may yield varying forecasts depending on the background, ability and opinion of individuals. Surveys in developed countries (Dalrymple, 1987; Mentzer and Cox, 1984; Sparkes and McHugh, 1984) have revealed that judgmental forecasts are widely used in business and industry. Goodwin and Wright (1993) suggest that understanding the process employed by people when producing judgmental forecasts would help in improving forecast accuracy. Makridakis *et al* (1998) have listed a number of biases that may be found in judgmental forecasts such as inconsistencies in the process followed, relying upon specific events easily recalled to the exclusion of other pertinent information, unduly influenced by initial information, etc. Therefore existing qualitative methods need improvements in order to generate better forecasts.

Combining forecasts from qualitative and quantitative methods is considered to generate more accurate forecasts as the individual methods could be using different sets of information and different procedures to process the data (Clemen, 1989; Granger, 1989). Such combined forecasts are particularly useful when time series have discontinuities caused by sporadic events, such as promotion campaigns for a product (Kleinmuntz, 1990; Armstrong and Collopy, 1998). Many studies (Fischer and Harvey, 2000; Goodwin, P. 2000; Armstrong and Collopy, 1998; Bunn, 1992; Lawrence *et al*, 1986) have examined the question of how to combine these forecasts. Goodwin and Fildes (1999) suggest to develop forecasting support systems (FSS) which effectively utilize the strengths of statistical models and judgmental method. In this paper we propose a method which provides a structure to the generation of qualitative method and enables generation of forecasts using both quantitative and qualitative information. We call this structural qualitative method. We first describe the method and then discuss the advantages and limitations.

Structural Qualitative Method (SQM)

The qualitative methods generally used are either heavily expert oriented or too subjective. Forecasting of variables needed for operational decisions such as demand requires a forecasting system to be able to generate forecasts quickly with reasonably high accuracy at disaggregate levels and update them as and when new information is available. Many companies use judgmental methods with the help of internal experts in such situations. However, studies have suggested that inconsistencies and biases can occur in the forecasts generated from such mental models as there is no uniform process followed in identifying, assessing, and processing information. Studies have found that accuracy of judgmental methods can be improved by utilizing information systematically such as utilization of forecasts generated from statistical methods. Lilien and Rangaswamy (1998) point out that formal models based on subjective data outperform intuition. Russo and Schoemaker (1979) demonstrate that subjective decision models are closer to true outcomes than intuitive mental models. The method proposed here is based on the assumption that using a proper structure in the qualitative method for forecasting on a continuing basis helps generate accurate forecasts. The method involves developing a structural model of forecasting for a given situation and calibrating the model judgmentally. This qualitative method uses both qualitative and quantitative information and the calibrated model to generate forecasts.

Theoretical Background

Causal structural models assume that forecast variable (Y) is dependent on a number of independent factors (X_i). A general model representing this structure can be written as

$$Y_t = \Sigma a_i X_{it} + e_t \qquad (1)$$

where $e_t \sim N(0, \sigma^2)$. Following (1) we can write

$$Y_{t+1} = Y_t + \Sigma a_i(X_{it+1} - X_{it}) + v_t \qquad (2)$$

and the forecast value of Y_{t+1} denoted by FY_{t+1} can be written as

$$FY_{t+1} = Y_t + \Sigma a_i F\Delta X_{it}, \qquad (3)$$

Where $F\Delta X_{it}$ is forecast of ($X_{it+1} - X_{it}$). In equation (3) the unknowns are a_i and ΔX_{it} $\forall$i. As quantitative estimates of a_i and ΔX_{it} are not available, we can resort to qualitative assessment of these components. In the absence of any information about the magnitudes of these components we can qualitatively assess them on a convenient scale and transform the resultant product into its actual level through an appropriate method. That is, let us say x_{it} is the interval scaled assessment of X_{it} and α_i is the subjective assessment of importance of x_{it} in determining Y_t. We can write

$$\Sigma a_i F\Delta X_{it} = f(\Sigma \alpha_i F\Delta x_{it}, P) \qquad (4)$$

where α_i is scaled such that $0 \leq \alpha_i \leq 1$ and $\Sigma \alpha_i = 1$, and $-M \leq \Delta x_{it} \leq M$ where **M** is the end value of the interval scale. The direction of impact of x_{it} on Y_t is captured in the measurement Δx_{it} instead of in the measurement of α_I. P is the difference between the maximum (lowest) level of Y_t that could occur when Δx_{it} is equal to M (–M) $\forall$I and Y_t. Therefore P has two values, P_U the difference between the estimated upper limit (UL) of Y_{t+1} and Y_t indicating maximum achievable gain of Y, and P_L the difference between the estimated lower limit (LL) Y_{t+1} and Y_t indicating maximum loss that could occur in Y. Since $-1 \leq (\Sigma \alpha_i F\Delta x_{it}) / |M| \leq 1$ one alternative is to write equation (4) as

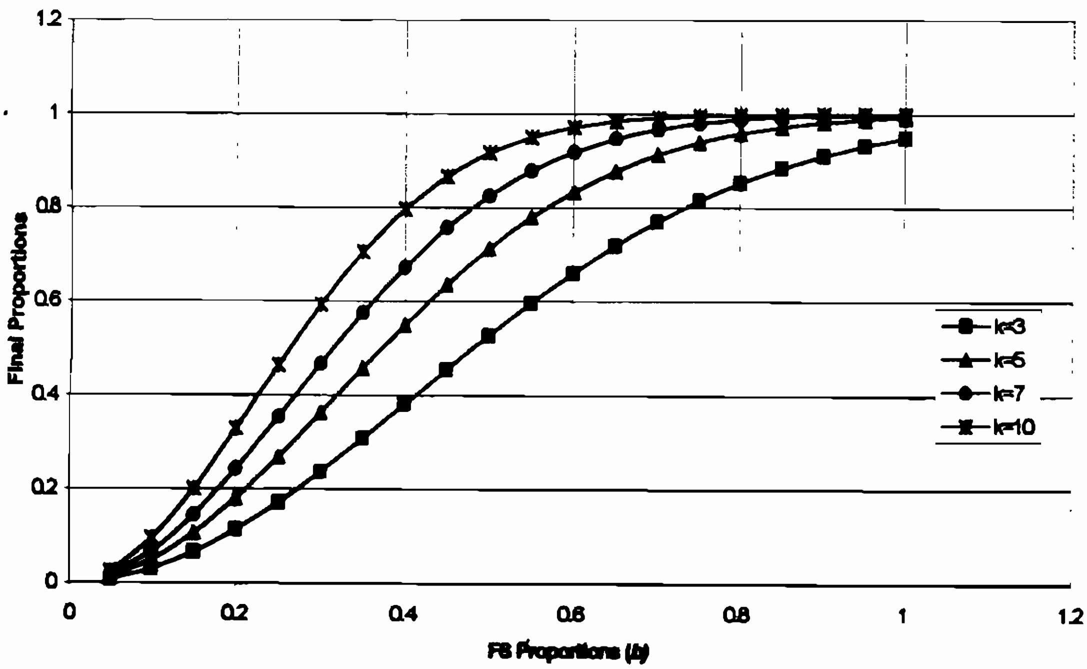
$$\Sigma a_i F\Delta X_{it} = b\,P \qquad (5)$$

where b is the factor score proportion, i.e., $(\Sigma\alpha_i F\Delta x_{it})/|M|$. It is also possible to utilize other forms than linear in equation (5) such as exponential form which is

$$\Sigma a_i F\Delta X_{it} = P(1- exp(-kb^2)) \qquad (6)$$

where the value of k, generally between 3 and 10, can be chosen depending on the situation. Figure 1 shows the nature of final proportions $(1- exp(-kb^2))$ for different values of factor score proportions and k. The value of k can vary directly with the relative size of Y_t with respect to UL or LL and the expected direction of change. When Y_t is closer to UL (estimated $Y_t > Y_t$) or LL (estimated $Y_t < Y_t$) smaller k may be assumed if the change is expected in the same direction (i.e., estimated $Y_t > Y_t$ and $b>0$, or estimated $Y_t < Y_t$ and $b<0$) as a large change in Y_t in the same direction is more difficult. On the other hand, if estimated $Y_t > Y_t$ but $b<0$ or estimated $Y_t < Y_t$ and $b>0$ a large k can be assumed. Therefore as a thumb rule if Y_t is within 1σ of its estimated value, the value of k could be 5, for Y_t values outside 1σ and the expected change in the same direction k could be 3, for Y_t between 1σ and 2σ and the expected change in the other direction the value of k could be 7 and so on. However, these thumb rules, as of now, are only indicative as adequate testing would be needed to firm them up.

Figure 1. Relationship Between FS Proportions and Final Proportions for Different Values k



Application of the Method

This method follows a two-step procedure for forecasting variables such as sales. In the first step an industry level forecast is generated, and in the second stage company level forecast is obtained. Each of these steps is described below. We take an example of demand forecasting for pesticides sales for demonstrating the processes involved.

Generating Industry Level Forecasts

The first step followed in generating industry level forecast is to identify various factors influencing demand. The factors include both direct and indirect. A flow chart could be prepared for this purpose. The demand at the industry level is the product of number of buyers and size of their purchase. The number of buyers in turn is influenced by factors such as the adoption rate, technology, acreage under different crops, intensity of pests, etc. The size of purchase is influenced by factors such as financial conditions of farmers, availability of credit, type of crop, crop outlook and intensity of pests, etc. These are in turn influenced by other factors. In the case of pesticides the factors are:

1. Government policy which includes, credit, subsidy, price support, technology, and imports and exports.
2. Crop performance in the previous year
3. Agricultural performance in the previous year
4. Crop outlook for the next season
5. Prevailing and expected agro-climatic conditions
6. Changes in technology

For these factors we need to assess their importance and conditions. Weights are attached to each factor based on the importance in effecting changes in the level of forecasted variable and these weights are assessed qualitatively. With the assessment of weights and conditions the following table can be generated for the pesticides industry.

Table 1: Format for Recording Qualitative Data

Factors	Weight	Condition	Factor Score
Government Policy			
Crop Performance			
Agricultural Performance			
Crop Outlook			
Agroclimatic Conditions			
Changes in the Technology			

Weights of the factors (α_i) can be measured using the constant sum scale in which a constant sum is apportioned among the factors reflecting the importance of the factors in influencing the forecasted variable. The conditions, expected changes in the factors, ($\alpha_i F\Delta x_{it}$), can be measured subjectively on an interval scale. Factor score is a product of weights and conditions. The interval scale used for measuring condition could be 5-,7-, 9-, 11-, or 21-point scales. For lower width scale it is possible to explain each level though the explanation may vary from factor to factor. For example, while a five-point scale for changes in government policy and technology can be explained by indicating the extent of favorableness, the scale for changes in other factors could be explained by indicating how good the changes are (Table 2).

Table 2: Explanation of Levels for a Five-Point Scale

Government Policy and Technology Changes	Scale Level	Other Factors
Favorable drastic changes	+2	Very Good
Favorable slight changes	+1	Good
No change	0	No Change
Unfavorable slight changes	-1	Poor
Unfavorable drastic changes	-2	Very Poor

An illustration of data obtained is presented in Table 3.

Table 3: Weights, Conditions and Factor Score for Pesticides Demand

Factors	Weight	Conditions	Factor Score
Government Policy	0.15	0	0
Crop Performance	0.30	-1	-0.3
Agricultural Performance	0.15	-1	-0.15
Crop Outlook	0.10	2	0.2
Agro-climatic Conditions	0.15	1	0.15
Changes in the Technology	0.15	1	0.15
Total	1.00		0.05

Total factor score (***b***) gives the extent of potential Y that can be realized in the next period. We need to find out the value of **P** to compute $\Delta \mathbf{Y}_t$. $\mathbf{P}_U$ and $\mathbf{P}_L$ can be computed by first ascertaining UL and LL and then subtracting Y_t from them. UL and LL can be obtained subjectively by assuming that Δx_{it} is equal to **M(-M)** $\forall$i. If ***b*** is positive (negative) $\mathbf{P}_U$ ($\mathbf{P}_L$) will be used for computing $\Delta \mathbf{Y}_t$. For this purpose a linear form as in equation (5) or a nonlinear form as in equation (6) can be used. The forecast $\mathbf{FY}_{t+1}$ is obtained by adding $\Delta \mathbf{Y}_t$ to current sales $\mathbf{Y}_t$. In our illustration, ***b***=0.025, $\mathbf{P}_U$ = 30 kl, and $\mathbf{Y}_t$ = 100 kl. Therefore using (5) we get the industry forecast $\mathbf{FY}_{t+1}$ = 100.75 kl and using (6) we get 100.09 kl.

Determining Weights and Assessing Conditions

Weights have to be determined based on the evaluation of importance of each factor in influencing sales. Experience and careful assessment of previous period data will help in assessing these weights. The weights can be narrowed down using either a Delphi or panel of experts method. Some factors such as government policy and technology may have to be examined at the company level for assessing weights appropriately at the field level. Assessing weights and conditions of other factors can be done at local level as well. For assessing UL and LL, past data can be used. If there are situations where Δx_{it} is close **M(-M)** ∀I, that level projected to the current level could serve as a sound basis for determining UL and LL.

Company Level Forecasts

For variables such as sales, the industry level forecast is only one component in the forecasting exercise. Company level forecasts can be generated using the industry level forecast **(FY_{t+1})** and forecast of the market share of the company **(FMS)**. Then the forecast of the company sales **(FS)** can be obtained as

$$FS = FMS * FY_{t+1}$$

The forecast of the share of the company is made in a similar way as industry level forecasts. The first step is to identify factors that influence the share of the company. Following factors affect market share.

1. Performance of the product of the company during the last period
2. Performance of the competitor's product during the last period
3. New entrants/brands
4. Planned marketing effort of the company
5. Expected marketing efforts of the competitors
6. Channel strength

The next step is to determine the weights and assessing the conditions of each factor. The weights have to be determined based on the importance of the factor in determining the share of the company. This is done subjectively. The conditions are assessed subjectively on an interval scale and can have the same number of levels as in the case of industry forecasts. Performances of factors and channel strength can be measured based on a scale varying from very poor to very good and market efforts can be measured on a scale varying from very low to very high compared to last period efforts. New entrants or products can also be assessed on a five-point scale varying from very weak to very strong. Table 4 contains illustrative data for pesticides.

Table 4: Weights, Conditions, and Factor Score for Market Share of a Pesticide Company

Factors	Weight	Conditions	Factor Score
Performance of company's product last period	0.25	1	0.25
Performance of competitor's product last period	0.20	-1	-0.20
New entrant/brand	0.10	0	0
Planned marketing effort	0.20	2	0.40
Expected marketing efforts of competitors	0.10	1	0.10
Channel strength	0.15	1	0.15
Total	1.00		0.70

Forecast of the market share can be made using a similar method as industry level forecasts. If the last period market share is .2 and potential share is .4 the forecasted market share is 0.27 using equation (5) and .29 using equation (6). Therefore, company sales forecast is 27.2 kl if we follow equation (5) and 29 kl if we follow equation (6).

Organizational Perspective in Using this Method

Forecasts are collective and need fine tuning

It is important to note that forecasts are generated collectively within an organization. While this method allows field level people to forecast at their level of operations, assessment of macro level factors may have to be given by the corporate level specialists who can assess more accurately.

Fine-tuning of weights requires revision of weights based on the experience of individuals within the organization as well as experiences over time. Therefore fine turning of weights would be needed, especially in the initial years.

Advantages

The method presented above is suitable for both small and large organizations and does not need any special expertise. Forecasts can be generated at any disaggregate level and can be updated as and when new information is available. The method can generate both short- and long-run forecasts with available information available in the organization. The method also helps to assess individual's ability to forecast and identify their areas of strengths and weaknesses. Therefore constant feedback on individual's assessment could help the person in improving his forecasts. The model can also be used for decision making as some variables such as internal marketing efforts are endogenous in the model.

Limitations

While it is possible to generate forecasts with very little information, it is important to understand that collecting more information systematically would aid in generating accurate forecasts. For this purpose the components of factors for which information should be collected periodically should be identified and a worksheet could be developed to record the information as and when it is available. Validation of the model will have to be done after observing it for several periods during which forecasts may have to be used with adequate precaution.

Conclusions

As competition increases in developing country markets, business organizations may have to look for methods other than the one based on simple growth rates for generating forecasts. In the absence of time series data organizations are forced to look for qualitative methods of forecasts. Even in developed countries judgmental methods are widely used by business and industry. Literature suggests that accuracy of such judgmental forecasts can be improved by generating them systematically. The method proposed here suggests a structural model. Calibrating the model subjectively and using qualitative and quantitative information could provide forecasts with acceptable accuracy. The structure of the model involves identifying factors influencing the variable at industry and company level and calibrating weights for these factors and assessing conditions of these factors based on quantitative and qualitative information. Methods for processing this information into forecasts are also proposed. The advantage of this method is that forecasts can be generated with available information and at disaggregate levels such as product item, short-run, and local market. Efforts to develop a comprehensive structure of a given situation will be able to include more information and process them appropriately. However, fine tuning of the calibration of the model could take some time during which forecasts will have to be used with caution. The calibration of the model also involves high degree of involvement of executives at least in the initial phases of model development. While this method is more useful in developing country situations owing to non-availability of time series data, it could nevertheless be used in developed countries as well.

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