



Investigation of Granger causality vision and process perspective of the balanced scorecard model in the banking industry

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Abstract

Balanced scorecard (BSC) is a quantified interpretation of organization strategy, which is delineated as a strategy map and describes the organizational performance on four perspectives of financial, customer, internal business process and learning and growth. The measures and objectives of BSC are derived from mission, vision and organization strategy. Organization strategy indicates how an organization creates value for the shareholders, customers and citizens. Furthermore, strategy is the very factor that guides an organization towards achieving its vision. In the same vein, the internal business process perspective describes the processes and measures that eventually lead to the desired level of performance in financial and customer perspectives. As a result, the existence of cause-and-effect relationships outlined in the form of strategy map are deemed as the guideline for the organization achievement. The cause-and-effect relationships determine the accurate route for strategy realization. Without having such associations, the organization is merely has access to a set of financial and non-financial measures. Taking the above into account, the present research has transformed the key measures in Iran's banking industry to quantified values and by using Granger causality test, it explores the cause-and-effect associations between the measures of process and financial perspectives. Eventually, it analyzes and describes how organization vision is associated with organization's operations processes.

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1. Introduction

In which processes should the organization improve in order to continue to create value for stakeholders? This question arises in the context of internal processes in a balanced scorecard. A balanced scorecard is a small interpretation of an organization's strategy that is described in the form of a strategy map. For this purpose, strategy maps are grouped into four part that includes: financial perspectives; customers; internal process and learning and growth, that it can design the objectives and measures of each category.so As numerous articles and books published on the performance evaluation as well as the practitioners in this field have argued, the objectives and their respective measures are advised to be defined based on four perspectives of BSC. To put it differently, they suggest that the cause-and-effect relationships should be formulated at the stage of defining the objectives and measures[1].

This method is theoretically sounds to be rapid and logical, but, practically, it suffers from some limitations. The notable point is that although this recommendation has been frequently repeated in the extant literature on the balanced evaluation, there is very limited information on the procedures for the successful implementation of this process. The reason behind is that a very challenging process to sit around a conference table and explain and define the organization's strategies logically through a set of objectives and interrelated measures. The major inadequacy of this approach is that it restricts the creativity of the group in designing powerful performance measures that can effectively transform the procedures of strategy implementation in organizations. To put it more exactly, most often, the first performance driver springing up spontaneously in the individuals " mind for a given objective or measure is selected without paying due attention to the available alternative options[2]. In this study, we tried by using the mathematical methods Measure the cause-and-effect relationships between internal process perspectives and financial perspective in order to explore the organization's ability to establish a causal chain with the organization's perspective. One of the most powerful tools of recent decades in implementing a Balanced Scorecard strategy. The organization's strategy clarifies how an organization creates value for the shareholders, customers and citizens. Without having a comprehensive description of strategy, the managers will not be able to execute it among themselves and their employees successfully. Indeed, the strategy balances opposite forces within an organization. Strategy balanced the strategy of the organization's contrasting forces. The starting point for defining a strategic plan is balancing and clarifying the short-term objectives to lower the costs and increase the productivity, targeting the long-term objectives of revenue profitability growth. Hence, the strategy map is aligned with the specific strategy adopted by the organization. The strategy map reveals how the intangible assets that place the greatest impact on value delivery to customers, shareholders and society can strengthen the performance of internal processes of an organization.[3]

2. Literature Review

BSC is, by definition, is a series of measures meticulously selected from the strategy adopted by the organization. BSC assesses the organizational performance in terms of four different but interrelated perspectives driven from one organization's mission, vision and strategy [4].

In other words, strategy is a factor that guides the organization toward the realization of its vision.

Thus, four perspectives of BSC articulate the organizational strategic objectives in all respects. If precisely and properly selected, the realization of these measures can be construed as the realization of organizational vision.

In balanced assessment development, managers identify the goals of the process and the criteria that are most important to their strategy. Companies that follow a product leadership strategy emphasize the excellence of their innovation processes. Companies that follow a low total cost strategy must have top-notch operations management processes. Companies that pursue a customer-centric strategy will focus on their customer management processes [5].

The process aspect determines the management of the main operation, customer management, innovation, and the legal and social processes that must be paramount in the organization to achieve customer goals, revenue growth, and profitability. Operations management processes are the main and everyday processes that introduce products and services and deliver them to customers. Financial goals and criteria express a small description of the organization's vision. Also, the goals of the customer perspective reflect the consequences of loyal customers resulting from receiving services from a strong and efficient internal process that originates from the organization's strategy. Customer satisfaction and retention requires excellent service and response to customer requests[5].

Thus, a brief literature review in this research area is provided. Following this, based on the general model, for example in some study "Measuring the Customers' Loyalty to Mehr-Eghtesad Bank with Balanced Scorecard Approach", by Hadi Keshavarznia ,and et.al (2017), tried to examine analysis of variance was analyzed in order to verify the existence of strategy as the core of balanced scorecard system. Loyalty components used in this research include: (1) Affective and emotional components; (2) Commitments; (3) Organizational appearance; (4) Satisfaction; (5) Perceived service quality; and (6) Trust. The study population consisted of all available customers who have received sustainable services from the selected branch of Mehr Bank during conducting the research. Thus, 124 customers were randomly selected as the sample. The results of the survey reflect the fact that there is no significant relationship between loyalty and income level of customers[6].

In the same vein, Jumpei Hamamura (2019), tried to examine the New Unobservable transfer price exceeds marginal cost when the manager is evaluated using a balanced scorecard. This study investigates the optimal level of transfer prices chosen by managers in a divisionalized firm when they are evaluated based on a balanced scorecard. A unique assumption of our model is that transfer prices are unobservable to a competing firm's managers. In contrast to the findings in several studies that examine strategic transfer pricing, this research shows that a manager who is evaluated using a balanced scorecard chooses a transfer price that exceeds marginal cost given a market competitor in a specific economic environment. This result is caused mainly by our model's assumption that a manager considers the competitor's profit in his/her in decision-making when the objective is to maximize long-term profit. This study makes a significant contribution to the strategic transfer pricing literature by showing that even if the transfer price is unobservable to rivals, the optimal transfer price exceeds marginal cost when the final product market is characterized by price competition, something not shown in previous analytical accounting research[7].

However, the approach aims in this research is to integrate this performance evaluation of sustainable development and use qualitative and quantitative information with the sustainability-balanced scorecard [8]. So we can investigate for the first time in iran the cause and effect relationship by using the Granger causality method.

3. Methodology Granger causality

In time series analysis, inference about cause-effect relationships is commonly based on the concept of Granger causality Granger [8]. Unlike the two previous approaches, this probabilistic concept of causality does not rely on the specification of a scientific model and thus is particularly suited for empirical investigations of cause-effect relationships. For his general definition of causality, Granger [8] evokes the following two fundamental principles [9]:

1. The effect does not precede its cause in time;
2. The causal series contains unique information about the series being caused that is not available otherwise.

Taking these studies into account, by using Granger causality test method, the present study was designed to examine the cause-and-effect relationships between the measures of customer perspective and those of financial perspective that have been derived from organizational vision.

Granger causality test was firstly introduced in Granger's study. In this test, causality, more appropriately, means precedence regarding explanatory power. For instance, if the time series X at $t-p$ time can forecast the time series behavior of Y at t time, then, X is said to Granger-causes Y . It is notable that this test has been designed for the time series. The simple and general form of Granger test is based on VAR equation that can be applied to the stationary time series. G-causality is normally tested in the context of linear regression models. It is formulated in the following way [10]:

$$X_1(t) = \sum_{j=1}^p A_{11j}X_1(t-j) + \sum_{j=1}^p A_{12j}X_2(t-j) + E_{1(t)} \quad (3.1)$$

$$X_2(t) = \sum_{j=1}^p A_{21j}X_1(t-j) + \sum_{j=1}^p A_{22j}X_2(t-j) + E_{2(t)} \quad (3.2)$$

Where p is the maximum number of lagged observations included in the model (the model order), the matrix A contains the coefficients of the model (i.e., the contributions of each lagged observation to the predicted values of $X_1(t)$ and $X_2(t)$, and E_1 and E_2 are residuals (prediction errors) for each time series. If the variance of E_1 (or E_2) is reduced by the inclusion of the X_2 (or X_1) terms in the first (or second) equation, then it is said that X_2 (or X_1) Granger-(G)-causes X_1 (or X_2). In other words, X_2 G-causes X_1 if the coefficients in A_{12} are jointly significantly different from zero. This can be tested by performing an F-test of the null hypothesis that $A_{12} = 0$, given assumptions of covariance stationarity on X_1 and X_2 . The magnitude of a G-causality interaction can be estimated by the logarithm of the corresponding F-statistic. Note that model selection criteria, such as the Bayesian Information Criterion (BIC), or the Akaike Information Criterion (AIC), can be used to determine the appropriate model order p [11].

As Granger has argued, this test is only valid when the variables are not cointegrated. In consequence, at first, the stationary or non-stationary nature of the variables should be checked. Then, the cointegration relationship between the variables should be examined. If the variables are found to be stationary and 1^{st} -order but non-integrated, a VAR model can be developed by taking 1^{st} -order difference for the variables and then the test can be performed [8]. It is also noteworthy that in Granger causality test, the stationary degree of the variables should be known. As a result, it is necessary to assess the stationary degree of the variables by using Augmented Dickey-Fuller test.

3.1. Spectral G-causality

By using Fourier methods, it is possible to examine G-causality in the spectral domain. This can be very useful for neurophysiological signals, where frequency decompositions are often of interest. Intuitively, spectral G-causality from X_1 to X_2 measures the fraction of the total power at frequency f of X_1 that is contributed by X_2 . For completeness, we give below the mathematical details of spectral G-causality. The Fourier transform of (1 and 2) gives:

$$\begin{pmatrix} A_{11}(f) & A_{12}(f) \\ A_{21}(f) & A_{22}(f) \end{pmatrix} \begin{pmatrix} X_1(f) \\ X_2(f) \end{pmatrix} = \begin{pmatrix} E_1(f) \\ E_2(f) \end{pmatrix} \quad (3.3)$$

In which the components of A are:

$$A_{lm}(f) = \delta_{lm} - \sum_{j=1}^p A_{lm}(j)e^{-i2\pi fj} \quad (3.4)$$

$$\delta_{lm} = 0 \quad (l = m)$$

$$\delta_{lm} = 1 \quad (l \neq m)$$

Rewriting Equation (3.2) as:

$$\begin{pmatrix} H_{11}(f) & H_{12}(f) \\ H_{21}(f) & H_{22}(f) \end{pmatrix} = \begin{pmatrix} A_{11}(f) & A_{12}(f) \\ A_{21}(f) & A_{22}(f) \end{pmatrix}^{-1} \quad (3.5)$$

Where H is the transfer matrix. The spectral matrix S can now be derived as:

$$S(f) = \langle X(f)X^*(f) \rangle = \left\langle H(f) \sum H^*(f) \right\rangle \quad (3.6)$$

In which the asterisk denotes matrix transposition and complex conjugation, Σ is the covariance matrix of the residuals $E(t)$, and H is the transfer matrix. The spectral G-causality from j to i is then:

$$I_{j \rightarrow i}(f) = -\ln \left(1 - \frac{\left(\Sigma_{jj} - \frac{\Sigma_{ij}^2}{\Sigma_{ii}} \right) |H_{ij}(f)|^2}{S_{ii}(f)} \right) \quad (3.7)$$

In which $S_{ii}(f)$ is the power spectrum of variable i at frequency f [11].

4. Data analysis

To assess the cause-and-effect relationships between the measures under study, firstly, the variables should be checked for stationary or non-stationary. One of the tests widely used for assessing the stationary degree of the variables is Augmented Dickey-Fuller test that has been used in this study as well.

As is evident from the findings of the foregoing table, the absolute values of Dickey-Fuller statistic obtained for the variables of “revenue to cost ratio of resources supply” and “number of outstanding claims files” at the desired level are greater than the critical values; hence, it can be deduced that the foregoing variables are stationary. Nonetheless, for other measures, the variables became stationary after calculating the 1st -order differencing.

Table 1: Objectives and performance measures of the financial perspective

Objectives	Measures
Equity (stocks') value increase (shareholder's wealth)	Economic value added (EVA) (revenue to capital costs ratio)
Improved structure of total cost	Revenue to resources supply cost ratio
Increased assets consumption	Revenue to loans ratio
Improved customer value	Outstanding claims percentage (Outstanding claims to loans ratio)

Table 2: : Goals and performance measures from the process perspective

Objectives	measure
Cost improvement; quality and time of product production	(Sales of high - yield products)(users- Outstanding claims / Resources)
	Revenue to resources supply cost to resource
	Revenue to resources supply cost to Facilities - granted facilities
improve the use of an asset	employ capacity (retained of granted facilities)
	Percentage of uses
Increase in sales to customers	Income and profit margin generated from the (remaining facilities (income / facilities granted

Table 3: - Results of Stationary Test Using Augmented Dickey-Fuller Test at Variables Level

Variable	ADF Statistic	Critical values		
		1%	5%	10%
Economic value added (EVA)	-2.225	-3.519	-2.900	-2.587
Revenue to resources supply costs ratio	-4.340	-3.519	-2.900	-2.587
Revenue to loans ratio	-2.188	-3.519	-2.900	-2.587
Outstanding claims percentage	-2.003	-3.519	-2.900	-2.587
(Sales of high - yield products)(users- Outstanding claims / Resources)	-3.695	-3.519	-2.900	-2.587
Revenue to resources supply cost to resource	-2.072	-3.519	-2.900	-2.587
Revenue to resources supply cost to Facilities - granted facilities	-2.066	-3.519	-2.900	-2.587
employ capacity (retained of granted facilities)	-0.334	-3.520	-2.901	-2.588
Percentage of uses	-1.778	-3.527	-2.904	-2.589
Income and profit margin generated from the remaining facilities (income / facilities granted	-2.180	-3.519	-2.900	-2.587

Table 4: Results of Stationary Test Using Augmented Dickey-Fuller Method at variables level (1st-order differencing

Variable	ADF Statistic	Critical values		
		1%	5%	10%
Economic value added (EVA)	-9.170	-3.520	-2.901	-2.588
Revenue to loans ratio	-9.149	-3.520	-2.901	-2.588
Outstanding claims percentage	-8.166	-3.520	-2.901	-2.588
Resource supplies on uses	-8.820	-3.520	-2.901	-2.588
providing resources on granted facilities	-8.800	-3.520	-2.901	-2.588
granted facilities	-4.025	-3.520	-2.901	-2.588
Percentage of uses	-3.980	-3.527	-2.904	-2.589
Profit margins - generated profit margin	-9.133	-3.520	-2.901	-2.588

5. Conclusion

Most of performance systems mainly focus on the gradual improvement of organization's current processes. In contrast, due to emphasizing on strategy and interaction between objectives and measures, balanced scorecard (BSC) technique may lead to the formation of completely new processes in order to realize the values desired by the customers and shareholders. In the initial stages of determining the performance measures for the balanced evaluation system, the financial objectives are identified to be translated into appropriate measures. In the next stage, the target customers and manner of service provision for them is determined. The manner of service provision for the customers and eventually, the desired financial objectives are managed and oriented by the performance measures. Hence, the internal process perspective illustrates the processes and measures that finally lead to the financial and customer performance. As a management tool in organization, the balanced evaluation system allows us to identify the new processes required for achieving the desired results in the financial and customer perspectives. Accordingly, for the optimum execution of the balanced evaluation system, the organizations must examine the cause-and-effect relationships between the defined measures. Taking these into account, in this research, the key performance measures in Iran's banking industry are derived by using balanced evaluation system so as to examine the cause-and-effect relationships between the financial perspective and business process perspective. Finally, the results and the obtained associations have been expressed and summarized in the following table:

Table 5: Results of Granger Causality Test

Measures	Hypothesis	F-Statistic	Probability	Result
Granger Causality Test for Economic Added Value (EDV) & Measures of internal process measures	High efficiency Products Granger-causes EVA.	3.24869	0.0756	Rejected
	EVA Granger-causes Selling high - yield products.	8.09734	5.80E-03	Accepted
	Total cost of Granger-causes EVA.	5.94925	0.0172	Accepted
	EVA Granger-causes resources on uses	5.91427	0.0175	Accepted
	Facilities - granted facilities amount Granger-causes EVA.	6.86511	0.017	Accepted
	EVA Granger-causes granted facilities amount.	6.65547	00.0119	Accepted
	Percentage of Facilities - granted facilities Granger-causes EVA.	47.5329	2.00E-09	Accepted
	EVA Granger-causes Percentage of uses claims files.	0.49932	0.482	Rejected
	Profit margin created Granger-causes EVA.	5.41308	0.0065	Accepted
	EVA Granger-causes profit margin created of Income	1.06052	03518	Rejected
	The margin of profits made by income is the granger cause of economic value added.	5.19535	0.0256	Accepted
	economic value added is the granger cause of profit margin created by income	6.52706	1.2E-02	Accepted
	Granger Causality Test for on cost of resource supply and internal process measures	Sales high - yield products Granger-causes revenue-cost ratio of resources supply.	2.31293	0.1326
Revenue-cost ratio of resources supply Granger-causes high - yield products.		4.85466	0.0307	Accepted
Resource supplies on uses Granger-causes revenue-cost ratio of resources supply.		9.07973	2.00E-06	Accepted
Revenue-cost ratio of resources supply Granger-causes Resource supplies on uses.		0.05343	0.9981	Rejected

	Resource supplies to facilities granted Granger-causes revenue-cost ratio of resources supply.	9.04204	82.00 E-0.6	Accepted	
		0.05473	00.05473	Rejected	
	Revenue-cost ratio of resources supply Granger-causes Resource supplies to facilities granted.				
	Granted facilities Granger-causes revenue-cost ratio of resources supply.	1.53993	0.2216	Rejected	
		2.37445	0.1005	Rejected	
	Revenue-cost ratio of resources supply Granger-causes of granted facilities				
	Profit margin created by income Granger-causes revenue-loans ratio.	8.30698	5.00E-0.6	Accepted	
		0.58328	0.7126	Rejected	
	Revenue-loans ratio Granger-causes profit margin created by income				
	Percentage of uses Granger-causes revenue-consumption ratio.	9.08273	0.0003	Accepted	
		1.56262	0.2168	Rejected	
	Revenue-consumption ratio Granger-causes Percentage of uses				
	Granger Causality Test for income ratios and internal process measures	Selling high - yield products Granger-causes revenue-loans ratio.	3.80672	0.0549	Rejected
			6.78296	0.0111	Accepted
Revenue-loans ratio Granger-causes Selling high - yield products					
Resource supplies on use files number Granger-causes revenue-loans ratio.		5.9982	0.0167	Accepted	
		2.83159	0.0967	Rejected	
Revenue-loans ratio Granger-causes number of Resource supplies on use					
Resource supplies to facilities granted Granger-causes revenue-loans ratio.		7.14752	0.0093	Accepted	
		3.45441	0.0671	Rejected	
Granger-causes revenue-loans ratio to Resource supplies to facilities granted					
granted facilities Granger-causes to The ratio of income to consumption		0.99353	0.3222	Rejected	
		49.2939	1.00E-0.9	Accepted	
The ratio of income to consumption Granger-causes to granted facilities					
The percentage of uses is the granger causality ratio.		5.19661	0.0079	Accepted	

	The ratio of income to expenditure Granger-causes is the cause of the percentage of expenditure	0.77596	0.4642	Rejected
	profit margin caused by the granger causality is the ratio of income to consumption	2.50583	0.1177	Rejected
	Income ratio is the granger cause of profit margin caused by income.	2.61573	0.1101	Rejected
Granger Causality Test for Percentage of arrears and internal process metrics	Percentage of uses Granger-causes Percentage of arrears	5.00751	0.0093	Accepted
	Percentage of arrears Granger-causes Percentage of uses	1.87323	0.1612	Rejected
	Profit margins of uses Granger-causes to Percentage of arrears	10.2233	0.0021	Accepted
	Percentage of arrears of Granger-causes Profit margins of income	2.61199	0.1104	Rejected
	Resources total cost Granger-causes outstanding claims percentage.	5.52768	0.0059	Rejected
	Outstanding claims percentage Granger-causes resources total cost.	2.18143	0.1205	Accepted
	Resource supplies on uses Granger-causes outstanding claims percentage.	10.6886	0.0016	Accepted
	Outstanding claims percentage Granger-causes Resource supplies on uses	1.89363	0.173	Rejected
	Number of outstanding claims files Granger-causes outstanding claims percentage.	4.06088	0.0214	Accepted
	Outstanding claims percentage Granger-causes number of outstanding claims files.	1.29182	0.2812	Rejected
	Facilities - granted facilities Granger-causes outstanding claims percentage.	7.98235	0.0008	Accepted
	Outstanding claims percentage Granger-causes Facilities - granted facilities	7.83133	0.0009	Accepted

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