A Non-Linear Regression Modeling is used for Asymmetry Co-Integration and Managerial Economics in Iraqi Firms

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***Abstract*—This paper analyzes the cost asymmetry through managerial expectations in a nonlinear regression function. Two development determinants, asymmetry co-integration and managerial expectations are also considered. The results revealed that managerial expectation had an impact on the wholesale cost asymmetry response. The managerial optimism is pronounced that show cost asymmetry response for sales, and inventory assets increased higher than decreased with the changing of the expectation basic coefficient and the values of contract parameters. Finally, the impacts of the managerial expectations, cost basic coefficient, and values of the contract parameters are analyzed for illustrating the results of the proposed nonlinear models with the help of numerical experiments. The research examined the short-run and the long-run effects of asymmetry co-integration and managerial expectation changes on the cost behavior in Iraq using the nonlinear regression function.**

Keywords—Cost asymmetry; managerial expectations; co-integration; nonlinear regression function

I. Introduction

In the critical business environment, interdisciplinary concepts like the behavioral theory of the firms, which draws on economics, political science and organization theory, are imported in accounting works since the beginning of the research stream [1], [2]. Management expectation might be managerial optimism strengths or be managerial pessimism strengths about resource adjustments called sticky or anti-sticky behavior on cost asymmetry [3]. Managers likely rely on additional signals when their expectations are positive in the current period, and the activity level realization is high. They like to adjust capacity resources [4]. Moreover, many studies argued that relationship between cost and activity is not linear, but they depended on one driver to measure cost behavior [5], [6] found that traditional cost behavior model unsuitable to measure cost behavior, they provide an asymmetric response to cost and sales changes. Second explanation examined the managerial expectations about the future activity level, which is in turn driven by future demand that relates managerial optimism and pessimism [7]. Some studies focused on the agency problem when managers make self-maximizing decisions that might not be in the best interest of the stockholders [8], [9].

Recently, literature has discussed the scientific question is there asymmetry co-integration between managerial expectations and cost response? To explain empirically how costs behave when management adjusts its costs and makes deliberate decisions as responding to certain factors [10], this evidence ignores the model of fixed and variable cost that assumed a mechanical relation between costs and activity change, and argues that the traditional model of cost behavior is not a fit framework to determine a benefit of the current period for future. Kama and Weiss [11] found the deliberate decisions to lessen the degree of costs sticky rather than induce cost sticky. While Bradbury and Scott [12] documented the deliberate managers decisions have not effect on costs respond to activity changes. In this study, we build a model of costs asymmetry by Cannon [13] and Chen, et al. [14]. Furthermore, costs are likely to vary with the levels of price, inventory, and demand differently than the level of sales [15]. The adjustment of costs in response to changes in activity volume is a primary issue in the company [16]. Chen, et al. [17] expected the managerial confidence has affected the degree of sticky costs. This adjustment may be cut or keep excess cost resources when sales increase and decrease because of future demand. This thinking considers that conscious adjustment of costs in the short term will be delayed. Management has an adjustment plan related to operational activities in the company [18].

In this context, this study attempts to provide some basis for responding to the evaluation of the impact of the managerial expectations and asymmetric cost information. One approach to addressing this problem is to employ the matching methods originally developed by Banker, et al. [19], credited by offering an interesting alternative to the analysis through these of nonlinear estimators. The works mentioned above studied the cost asymmetry in two determinants from sales and assets, and considered the actors as managerial expectations. The study extends their works to asymmetry co-integration and managerial expectations using nonlinear regression function, and analyze the impact of the managerial expectations, the cost basis coefficient, and the values of contract parameters on the market policies. The paper is organized as follows. In Section II, we developed the centralized managerial expectations. In Sections III, two numerical examples are given to illustrate the solutions for proposed models. Section IV, summarizes the work.

II. Models and Soulation Approaches

The paper has applied an established methodology to develop the costs and activity relationships [13], [20], managers understand and performance in different situations [11], [21].

A. Sampling

Research examined monthly data for the Iraq over the period of 1 January 2006 to 31 December 2015 using industrial firms. The final samples consisted monthly of 600 usable observations of each variable but inventory assets were 400. We calculated all changes using the financial and performance statements across periods as indexes of total costs (Iraqi dinner), sales volumes (Ton) and output selling price and inventory value for using a non-linear function of multiple regression analysis. This data is described in Table 1.

TABLE I. Data of Sampling from 2006 - 2015

Number	Factory	Total cost. C/q	Sales	Inventory value. q*C
1	Najaf	120	120	64
2	Kufa	120	120	64
3	Smeawa	120	120	64
3	Busra	120	120	64
5	Karbala	120	120	64
Total sample		600	600	320

These items are determined from monthly statements of factories. Total costs are collection from operations costs plus selling and administrative costs by five activities (manufacturing, engineering & services, quality control, marketing, and administration). Sales revenue is (P*V). Inventory value is store quantity from produce last period based on factories statements.

B. Empirical Models

It is now a well-established fact to include the measures of economic activities in five industrial firms as well as a measure of managerial expectations. Sales and inventory assets level change as two main determinants of the cost stickiness. Therefore, we have designed our model with the following long-run specification [3], [14]:

$$\ln \frac{\mathrm{TC_{i,t}-TC_{i,t-1}}}{\mathrm{TC_{i,t-1}}} = \varphi_0 + \varphi_1 ln(\frac{\mathrm{REV_{i,t}-REV_{i,t-1}}}{\mathrm{REV_{i,t-1}}}) + \varphi_2 DEC_{i,t} ln(\frac{\mathrm{REV_{i,t}-REV_{i,t-1}}}{\mathrm{REV_{i,t-1}}}) + \alpha_{i,t} \quad (1)$$

Where: $TC_{i,t}$ is a total cost for firm i time t. $R_{i,t}$ is sales revenue for firm i time t. $DEC_{i,t}$ is an indicator variable set value of 1 when $R_{i,t}$<$R_{i,t-1}$ for firm i time t, and set value of 0 otherwise. φ_0 is a parameter that estimates the asymmetric cost changes unassociated with revenues change. φ_1 is the parameter that estimates the association between cost change and revenue increase. φ_2 is the parameter of "asymmetry measure" that estimates the association between cost response and revenue change during increasing and decreasing. $\alpha_{i,t}$is an error term for variability cost change estimation for firm i time t. As argued by Anderson et al. [5], this measure of the cost stickiness is unit free and it allows us to specify the model in the logarithmic form that fits the macro data better. Furthermore, the measure is defined as the ratio of revenues over cash flows so that if this measure is to improve due to a depreciation of firm's performance, an estimate of φ_2 to be negative. However, as argued by Kama and Weiss [11] , these income elasticities could also be negative and positive respectively, if prior sales decrease and increase as it grows. The parameters of activity function and manufacturing cost are all characterized as fuzzy variables [22].

Proposition 1: Optimistic expectations generate stickiness behavior of cost by sales change. The cost response is a non-linear function for managerial expectations.

The coefficient estimates we discussed above are the long-run estimates. In order to also infer the short-run effects of all the exogenous variables we need to turn (1) into an error-correction specification [23].

Prior to the introduction of asymmetry co-integration by Chen et al. [14] it was a common practice to just estimate (2) and judge the managerial expectations as a short-run positive or insignificant β_1 coefficient combined with a significant negative− β_2 coefficient. However, as mentioned before, Balakrishnan et al. [24], [25] demonstrated that the insignificance of the short-run and long-run estimates could be due to assuming the effects of asset intensity changes to be symmetric. They then followed Shin et al. (2014) and modified (2) so that one can assess the asymmetry effects of Asset Intensity changes. Under this new method, we first form ΔLnINVAS which includes negative values reflecting decreasing prior flows and positive values, reflecting increasing current flows. Using these changes, we then construct two new parameters and define them as ΔLnINVAS, partial sum of positive changes and DEC*ΔLnINVAS, partial sum of negative changes. These two new variables now reflect only prior and current flows, respectively. Thus, we estimate variables to arrive at:

$$\ln\frac{\mathrm{TC_{i,t}-TC_{i,t-1}}}{\mathrm{TC_{i,t-1}}} = \beta_0 + \beta_1 ln(\frac{\mathrm{INVAS_{i,t}-INVAS_{i,t-1}}}{\mathrm{INVAS_{i,t-1}}}) + \beta_2 DEC_{i,t} ln(\frac{\mathrm{INVAS_{i,t}-INVAS_{i,t-1}}}{\mathrm{INVAS_{i,t-1}}}) + \vartheta_{i,t} \quad (2)$$

Since construction of ΔLnINVAS and DEC*ΔLnINVAS variables using partial sum methods introduce non-linearity to the adjustment process, Chen et al. [26] and Chen et al. [14] call specification (2) as the non-linear regression model.

Where: $INV_{i,t}$ is a total inventory assets value for firm i time t. $DEC_{i,t}$ is an indicator variable set value of 1 when $INVAS_{i,t} < INVAS_{i,t-1}$ for firm i time t, and set value of 0 otherwise. β_0 is a parameter that estimates the asymmetric cost changes unassociated with inventory assets changes. β_1 is the parameter that estimates the association between cost response and inventory assets change during periods when inventory asset is increasing. β_2 is the parameter of "asymmetry measure" that estimates the difference in the association between cost response and inventory assets change during increasing and decreasing. $\vartheta_{i,t}$ is an error term for variability cost change estimation for firm i time t.

Proposition 2: Optimistic expectations generate stickiness behavior of cost by assets change. The cost response is a non-linear function for managerial expectations.

This is expected to be the case in most cost stickiness models due to the fact that assets increase and decrease in five different firms that are subject to different business rules and regulations. Second, the long-run asymmetric effects of managerial expectations on the cost stickiness will be established if Max Eigenvalue Statistics coefficient is higher than scheduled coefficient, at each variable .Third, impact asymmetry will be established if Σ ΔLnINVAS, $\Delta LnREV_{i,t} \neq$ Σ DEC*ΔLnINVAS, $DEC * \Delta LnREV_{i,t}$ 1,2. Finally, long-run asymmetric effects of Managerial expectations on the cost stickiness will be established if φ_2 , β_2 have negative values. The cost behavior is stickiness when the average percentage increase is higher or less than average percentage decrease in costs. The empirical hypothesis for sticky behavior means that φ_2 , β_2 <0 and opposite that means anti-sticky behavior. This finding provides an empirical test of H1 and H2. The variables definitions are presented in Table 2.

TABLE II. DATA DEFINITION AND RELATIONS AMONG VARIABLES IN MODELS

Variable	Calculation	Description
$\ln(\frac{TC_{i,t}-TC_{i,t-1}}{TC_{i,t-1}})$	Percent total cost change	Log-change in total costs by dinar .Payments of all industrial, marketing and administration activities.
$ln\left(\frac{R_{i,t}-R_{i,t-1}}{R_{i,t-1}}\right)$	Percent total sales revenue.	Log-change in total net revenue by dinar.
$ln\left(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}\right)$	Percent total inventory asset	Log-change in total inventory asset by dinar.

C. Preliminary Analysis

Descriptive statistics from a sample for costs, capacities, and their changes are presented in Table 3. The mean sales revenue is IQD 1932 million (median IQD 1332 million). The mean total cost is IQD 2131 million (median IQD 1433 million). The mean inventory assets is IQD 7 million (median IQD 0.37 million). On average, the magnitude of changes in total cost, sales and assets, mean (median) sales revenue is 3579 (0.00) percent. Total cost is 42 (13) percent. Inventory asset is 1328 (0.00). Consistent with prior studies [6], [13].

TABLE III. DESCRIPTION STATISTICS

Variable	Mean	Standard Dev.	Median	Maximum	Minimum
Total costs	2131174860	1813379509	1433865019	9973095303	36103999
Total costs %	0.423	2.223	0.130	27.750	0.000
Sales revenue	1932273460	2020397695	1332414963	8982796000	0.000
Sales revenue %	3.579	41.212	0.000	899.64	-1.00
inventory assets	7685291	11012039	372882	41347328	230
inventory assets %	1.328	20.07	0.000	356.65	-1.00

All numbers of costs reported in Iraqi dinar (IQD).

TABLE IV. RESULTS OF AUGMENTED DICKEY-FULLER TESTS: STATIONARY ANALYSIS

Variable	Coefficient	Standard Error	Critical value	t-statistics (Prob.*)
$\ln\frac{TC_{i,t}-TC_{i,t-1}}{TC_{i,t-1}}$	-1.179 (-)	0.04	(-2.866)	-29.28*** (0.000)
$ln\left(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}\right)$	-1.009 (-)	0.04	(-2.866)	-24.65*** (0.000)
$DEC_{i,t}ln\left(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}\right)$	-1.15 (-)	0.04	(-2.866)	-28.61*** (0.000)
$\ln\left(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}\right)$	-1.004 (-)	0.06	(-2.87)	-17.88 (0.000)
$DEC_{i,t}ln\left(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}\right)$	-0.86 (-)	0.05	(-2.87)	-15.46*** (0.000)

Reject the null of non-stationarity at the 5% level, significant indicates *, **, *** at the 1%, 5%, 10% level respectively.

D. Test of Stationarity

The stationary test is a good econometric practice to restricted co-integrating vectors to establish whether relevant restrictions are rejected or not [25], [27]. Table 4 presents the results of Augmented Dickey-Fuller tests. All variables are rejected the null hypothesis of a unit root that the empirical variables are stationary. Next, we test for co-integration applying the Johansen technique in four separate models.

As expected, all empirical variables were negative (δ_1 (0.04 = -1.179, p<0), and the results from the test for existence or not of a unit root in the log levels of our variables. The statistical values are greater than the critical values rejecting the null hypothesis of the unit root. Therefore, all our variables are integrated [28].

E. Co-integration Tests

Multivariate results are from the Johansen trace and maximum eigenvalue statistics on co-integration for the empirical models are presented in Table 5. The theory of co-integration provides a natural setting for testing cross-variables relationships in permanent output movements [29]. The two statistics for the test give full co-integrating vectors for study variables. The cointegrating test explains that the relationship between managerial expectation and costs asymmetry is long-run. The Johansen trace and the maximum eigenvalue statistics are rejected the null hypothesis implies that there are co-integrating vectors at the 5% level for the entire two-model variables (r≥0, r≥1 andr≥2).

TABLE V. RESULTS FROM JOHANSEN CO-INTEGRATION TESTS

Model	Null	Eigenvalue	Trace Statistics	Max. Eigen. Stat.
$\ln\frac{TC_{i,t}-TC_{i,t-1}}{TC_{i,t-1}} = \varphi_0 + \varphi_1 ln(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}) + \varphi_2 DEC_{i,t} ln(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}) + \alpha_{i,t}$	None * At most 1 * At most 2 *	0.49 0.24 0.14	15.54** (0.050) 4.50** (0.033) 91.56*** (0.000)	10.95 (0.156) 4.50** (0.033) 91.56*** (0.000)
$\ln\frac{TC_{i,t}-TC_{i,t-1}}{TC_{i,t-1}} = \beta_0 + \beta_1 ln(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}) + \beta_2 DEC_{i,t} ln(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}) + \vartheta_{i,t}$	None * At most 1 * At most 2 *	0.23 0.17 0.091	175.47*** (0.001) 91.57*** (0.000) 30.09*** (0.000)	83.89*** (0.000) 61.47*** (0.000) 30.09*** (0.000)

Reject the null of no co-integration among empirical variables at the 5% level.

The results indicate that co-integration is accepted all of the empirical models in the full estimates of co-integrating vectors at the 5% level. This suggests an evidence of nonlinear modeling linkages between managerial expectation and costs asymmetry relationship and allows examining the hypotheses by nonlinear regression analysis in the next part.

TABLE VI. ESTIMATED REGRESSION MODEL AND LONG RUN COEFFICIENT: NONLINEAR ANALYSIS

Variable	Parameter	Coefficient	Standard Error	T-ratio [prob]
Panel A:Regression analysis: effects of sales revenue – model 1				
Intercept	φ_0	0.55 (?)	0.03	1.77[0.038]**
$ln\left(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}\right)$	φ_1	0.792 (+)	0.25	3.096 [0.022]**
$DEC_{i,t} ln\left(\frac{REV_{i,t}-REV_{i,t-1}}{REV_{i,t-1}}\right)$	φ_2	-0.753 (-)	0.13	-5.71[0.00] ***
Adjusted R²		0.36		
F-value		45.32		
Significant level		0.000		
Panel B:Regression analysis: effects of inventory asset – model 2				
Intercept	β 0	0.084 (?)	0.06	1.45[0.146]**
$\ln\left(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}\right)$	β 1	0.854 (+)	0.41	2.08[0.029] **
$DEC_{i,t} ln\left(\frac{INVAS_{i,t}-INVAS_{i,t-1}}{INVAS_{i,t-1}}\right)$	β 2	-0.208 (-)	0.04	-4.55[0.00] ***
Adjusted R²		0.40		
F-value		16.51		
Significant level		0.000		

All t-statistics were calculated by using significant indicate *, **, *** at the 1%, 5%, 10% level respectively.

III. Numberical Examples

In this section, we provide two numerical examples to show determinants of Asymmetric effects of managerial expectations on cost response. Results of non-linear regression analysis show the effect of managerial expectations on cost asymmetry (H1-H2). Results show the models are significant as a whole (F-value 45.32, 16.51 for model 1 and 2, respectively, *p*-value <0.001), and reasonably explains the dependent variables (Adju.R^2 31 and 36 percent for two models respectively). All explanatory variables show the significant main effects. Their details are shown above in Table 6.

As Table 6 shows, sales change is asymmetrically and significantly related to asymmetric behavior of costs, costs behavior is sticky ($\varphi_1 >0$, $\varphi_2<0$, p<0.01) and different from zero at the 1% (t-statistics -5.71), the adjusted R^2 is 36%. On average, costs increase 0.80% per 1% increase in sales revenues (φ 1) and they decrease by 0.05% per 1% decrease in sales revenues (φ 1+ φ 2); see model 1. The result shows a direct effect of sales change on cost behavior during increasing and decreasing periods. Thus, proposition 1 is supported.

Model 2 shows, inventory assets change is asymmetrically and significantly related to asymmetric behavior of costs, costs behavior is sticky ($\beta_1 >0$, $\beta_2<0$, $p<0.001$) and different from zero at the 1% (t-statistics -4.55), the adjusted R^2 is 40%. On average, costs increase 0.85% per 1% increase in inventory change (β 1) and they decrease by 0.64% per 1% decrease in inventory change (β 1+ β 2); see model 2. The results show a direct effect of sales change on cost behavior during increasing and decreasing periods. The difference between these coefficients captures the degree of cost asymmetry. Thus, proposition 2 is supported.

IV. Discussion

These results proved that costs are the description of a broader pattern of asymmetric cost behavior, which extends to all the major components of costs for physical input quantity (sales and assets) for cost behavior. Results suggest that asymmetric behavior of costs may be difficult to reduce inventory assets costs related to managerial expectations in the short term, the evidence provides direct support for the managerial expectations on the cost structure. On the contrary, Bradbury and Scott [12] found no differences between actual and forecast sample when sales revenues increase and decrease, The estimated value of φ2 in actual and forecast regression is equal to -0.35%, and -0.21%, respectively. Whilst [11] agree with our results they found there is an effect on cost asymmetry with and without sensitive. The estimated value of φ2 regression is equal to -0.025%, and -0.092%. Furthermore, Ibrahim [21] agrees with results found that the costs behavior is sticky in prosperity periods, and cost behavior is anti-sticky in recession periods. The estimated value of φ2 regression is equal to -0.48%, and 0.20% during prosperity and recession respectively. This finding means estimation of costs asymmetry has associated with inventory changes by setting the cost based on competition and considers the inventory changes are a new driver to measure asymmetric cost behavior. Inventory increase relates to sales increase may the demand for capacity utilization is falling or there are positive expectations about future [30]. Anderson, et al. [20] Argue when we add the asset's elements to the basic asymmetric cost behavior model, we can find economic meaning. The effect of demand uncertainty on the order quantity and wholesale price has investigated by fuzzy random methods, and compared to the conditions of buyback policies [31]. The significant anti-sticky costs made when activity changes decrease in previous periods, and significant sticky costs when activity changes increase in previous periods [3]. These differences in estimates of cost behavior due to managers do not consider the effect of managerial optimism about future [20]. This finding applies the managerial optimism future and moves asymmetric behavior phenomenon for providing a new evidence that associated the managerial estimation with anti-sticky and sticky cost behavior in different positions.

V. Conclusions

This article examines the asymmetry co-integration between managerial expectations and cost response, as well as sales and inventory change, in Iraqi industry using nonlinear function modeling developed by Anderson et al. [5] and Chen et al. [14]. Once non-linear modeling and co-integration were introduced, the definition of the cost asymmetry was modified to mean short-run expectations combined with long-run improvement. Now that asymmetry co-integration has been advanced, the definition has also been modified further to mean short-run expectations or insignificant effects combined with long-run improvement only due to only expectations or short-run insignificant effects and long-run expectations only due to adjustment costs. The last approach is which requires separating currency expectations from appreciations and using a non-linear cost asymmetry model. This approach also allows us to determine if cost level changes have symmetric or asymmetric effects via managerial expectations. The results revealed that the change in the expectation basic coefficient impact on the wholesale cost response. Second, evidence of short-run asymmetric effects of sales and assets changes in cost response, significant short-run and long-run asymmetric effects were established in Iraqi industry. Third, asymmetric cost behavior was found for managerial expectations by non-linear function in Iraqi industry. Finally, asymmetry analysis revealed that while managerial expectations against the competitive environment have favorable effects on the asymmetric cost behavior of the industry.

One limitation of this article is that we only consider one determinant of the cost asymmetry phenomenon. Therefore, one possible extension work is to study the cost asymmetry with multiple determinants in non-linear function modeling. In fact, the cost function of the asymmetric model can be non-linear. One can consider the case the sales and assets are asymmetric random variables. This study contributes to our knowledge of how and when managerial expectations can be influenced into costs. Our study also empirically validates asymmetry co-integration as a mechanism that accounts for the relationship between managerial expectations and costs response. In addition, this research emphasizes the importance of managerial economics, which determines whether managerial expectations have a positive or negative effect on the cost structure. We hope that this study will stimulate future endeavors to advance our understanding of the relationship between managerial expectations and cost asymmetry.

ACKNOWLEDGEMENT

The authors would like to thank Iraqi Cultural Attaché in China and national company for supporting a research about data collecting and their corresponding for our academic goal.

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