Study on the Behavior of Materials, Labor, and Overhead Costs in Manufacturing Companies listed in Tehran Stock Exchange

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***Abstract*—This research is the kind of practical research and with use of Analyzing information contained in income statements of companies listed in Tehran Stock Exchange for the period 2000 to 2003 is conducted. The aim of this research is determine the causal relationship of sales income and expenses and evaluation of costs stickiness. Costs stickiness means that with activity increase, Costs are increasing faster than when activity decrease and costs decreasing. For example, if sales increase 10% Expenses increased 9% But if sales revenue decreased 10 %(equal to increase level) costs decreased 8%, In such a situation the costs is sticky. In this study the stickiness of raw material costs, direct labor costs and overhead costs using the relationship between sales revenue and each of the costs by three-variable regression is investigated. With the results of this study Overhead costs are sticky but the cost of raw materials and direct labor costs are not sticky.**

***Index Terms*—Costs, sales revenue, stickiness, three-variable regression.**

I. Introduction

Productivity and giving services to customers in a given time and Earning Money, and sustain costs that have a reasonable profit for the company the long term, is the main purpose of entity. To determine an entity's objectives and use unit resources to achieve these objectives planning, that is one of the main tasks of the management, is used. In planning stage managers need information about predetermined costs to predict profit. Amount of Predetermined costs can be determined by treating the costs association with sales revenue. In fact, changes of costs can be explained by changes in sales revenue through costs relationship with the income. In this study, we sought to analyze the relationship of company's costs with sales revenue and to investigate stickiness behavior in costs. Costs stickiness means that by increasing sales revenue, costs increased faster compared with Time that decreased with the reduction of sales revenue (equivalent to an increase in sales revenue). For example, if sales revenue increase 10% costs increased 9% but if sales revenue decreased 10% (equivalent to the rate of increase) costs decreased with 8%, in such a situation the costs will be sticky. Costs investigated in this study include raw material cost, direct labor costs and overhead costs. At This study the relationship of any of these costs with sales revenue will be analyze.

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Thinking the relationship between costs and activities At late 1960 and early 1970 of some scientists, including Solomon and Astabus presented, After that many ideas at this field was presented. Such as Noreen theory which states that costs related to the activity level can be divided into fixed and variable, Fixed costs are assumed to be independent of the level of activity whereas variable costs are assumed to change linearly and proportionately to changes in the level of activity (Noreen 1991).Estimates behavior of costs in relation to level of activity regardless costs stickiness would be misleading. Fried, Sondhi and White stated that Estimated costs behavior according to activity regardless attributes such costs stickiness may be misleading (white, sondhi, fried1997).In fact managerial decision making regardless costs stickiness is the big wrong (Garrison and Noreen2001).

II. Reviwe and Hypoteses

The behavior of overload costs in relation to the level of activity has been studied At Washington State hospitals in the United States.In most cost accounting systems, marginal cost of a unit activity is considered equal to average cost of a unit activity, While based on the results of this research_in the desired community average cost of per unit activity is higher than the marginal cost of per unit activity approximately 40%. Even At some departments, this figure reaches 100%.Thus, applying average cost of per unit activity rather than the final cost of activity each unit must be carried out more carefully. The study concludes that most effect of changes on activity on overhead costs in the year of activity changes occurs (Noreen, Soderstrom1997).

Another research has examined stickiness of operation costs. This study shows that when activity level increased costs increase higher since activity level decreased. These costs those are sticky Are conflicting with traditional costing model which assumes that Costs act appropriate to activities. This study concludes that when sales revenue Increase 1% operating expenses increased. /97% But with a 1% decrease in sales revenue, operating costs Will be reduced. /91%. This study has been done in a sample of U.S. companies, French, Russian and German.

Results of this study are as follows:

1) Operating expenses of French and German companies are stickier than operating costs of U.S. and Russian companies.

2) Company and Industry Type are effective on the stickiness of cost.

3) One of the reasons for higher stickiness of costs at the French and German companies to Russian and American

companies is different tax systems in these countries.(Calleja, Thomas, Steliaros,2005)

In another study the effect of changing in volume of activity on cost stickiness was studied. In this study, it is expressed that this is management of a company that prefers to raise costs at the time of increasing activities level but at the time of reducing the level of activity management did not show much interest in reducing costs. In this study, influence of two factors on the behavior of management (that causes costs be sticky) has been studied:

1)The rate of change in activity level: management response to the high changes in activity level is increasing costs but at the time of small changes in activity level managerial response will be figure in to a member of assets.

2)The rate of using capacity :If the company be at the highest level of its productive capacity managerial behavior will be in such a way that will be Cause stickiness of costs, means In top activity levels management increases costs But at the time of reduce the level of activity does not effort to reduce costs.

This research that has been done in the U.S. health care institutes, Shows that In relation to the first factor management response to upper and lower changes in activity levels is the same. The percentage of changes in the costs for small changes in activity level of (3% ±) is not very different from the percentage of changes in costs for large changes in activity level (more than 3% ±). Thus the first research hypothesis will not be accepted.

But the second research hypothesis is accepted. Means If This Company in high levels of its capacity operates the costs will be sticky (Balkrishnan, Petersen, Soderstrom, 2001).

A. Hypotheses

In connection with the asymmetric cost behavior three hypotheses are tested in this study, as follows:

H1: the magnitude of a direct material costs increase as a function of an increase in net sales revenues is greater than the magnitude of a direct material costs reduction as a function of an equivalent reduction in net sales revenues.

H2: the magnitude of a direct labor costs increase as a function of an increase in net sales revenues is greater than the magnitude of a direct labor costs reduction as a function of an equivalent reduction in net sales revenues.

H3: the magnitude of a overhead costs increase as a function of an increase in net sales revenues is greater than the magnitude of a overhead costs reduction as a function of an equivalent reduction in net sales revenues.

A company's managers are often faced with issues such as planning and control in business. At planning Stage managers need the costs information for predict future costs. The changes in future costs associated with changes in sales revenue can be determined, so with determine this relationship the amount of costs associated with the sales revenue can be predicted.

Hypothesis H1, H2 and H3 considers how the managerial intervention affects the process of resource adjustment. Managers make discrete changes in committed resources because some corresponding costs cannot be added or reduced fast enough to combine changes in resources with small changes in demand.

Firms have to incur in adjustment costs to remove committed resources and to replenish these resources when demand is reestablished. Adjustment costs include, for example, expenses with dismissing employees and hiring new ones, as well as organizational costs deriving from reduction motivation of the remaining employees after the dismissing of many professionals. When demand rises, managers raise committed resources in order to match the additional demand. When demand declines, however, some committed resources will not be totally utilized, unless managers take the deliberate decision to cut them. In order to do this, it is necessary that managers assess the probability that this demand decline is temporary, when the time is come to decide upon the reduction of committed resources. Sticky cost behavior will occur if the manager decides to keep unnecessary resources instead of incurring in adjustment costs when volume declines. (Medeiros, Costa, 2001)

III. Sample Selections

Statistical population included all firms listed in Tehran Stock Exchange by the end of 2003.It is necessary to mentioned that select the companies listed in Tehran Stock Exchange as the statistical population in terms that, usable information about Iranian companies is located in this entity. All the companies with the following conditions are selected for the sample:

1. Sample companies are manufacturing companies.
2. At least the beginning of 2000 fiscal year is listed in Tehran Stock Exchange.
3. Annually Information on costs and revenues of the company since 2000 to 2003 is available.

At least A Sample of 82 companies in a 5-year period 2000 until 2003 was chosen to test the research hypotheses.

IV. Research Methodologies

In this section we outline the models used to test the hypotheses outlined in Section 2.We test for cost stickiness of firms using the following model:

$$\log\left[\frac{\textit{total costs}_{i,t}}{\textit{total costs}_{i,t-1}}\right] = \alpha + \beta 1 * \log\left[\frac{\textit{revenue}_{i,t}}{\textit{revenue}_{i,t-1}}\right] + \beta 2 * \textit{decrease}_{i,t} * \log\left[\frac{\textit{revenue}_{i,t}}{\textit{revenue}_{i,t-1}}\right] + \varepsilon_{i,t}$$

The variable *decrease* (*d*) is a dummy variable that takes the value of 1 when revenue decreases between two periods, and is otherwise 0.

The use of the log model is consistent with previous studies (Anderson *et al.* (2003), Subramaniam & Weidenmier (2003)). Since the value of the *decrease* variable (*d*) is 0 when revenue increases, β1 measures the increase in percentage terms in costs with a 1% increase in revenue. On the other hand, since the value of *decrease* is 1 when revenue decreases, the sum of β1 and β2 measures the decrease in percentage terms in costs following a 1% decrease in revenue. If the traditional cost behavior model is valid, β2 would be equal to 0 since upward and downward changes in costs will be equal, and β1 would be equal to 1, reflecting proportionality. If companies exhibit sticky cost behavior, β2 will be negative and statistically significant.

A. Empirical Procedures

Descriptive statistics only describe the tested sample and its objective is calculating parameters of the sample and testing data status can be transferred to the reader into the brief look. In Table 1 central and Dispersion indexes such as mean, standard deviation, minimum, maximum, Skeweness ratio and Kurtosis ratio to data and for dependent and independent variables during the period of research has been investigated.

TABLE I:DESCRIPTIVE STATISTICS OF DATA, DEPENDENT AND INDEPENDENT VARIABLES

variables	Unit of measure	Mean	minimum	maximum	standard deviation	Kurtosis ratio	Skewness ratio
Sales revenue	Money	242401	22304	2281986	207480	19.51	3.75
Material costs	Money	90313	573.4	567812	79183	5.31	2.22
Labor costs	Money	15595	1218	249408	13751	45.4	6.2
Overhead costs	Money	*45805*	*2682*	*640862*	*42832*	*31.04*	*5.05*
[revenue i,t / revenuei,t-1]	%	26	14	53	8	3.62	1.78
[material costs i,t / material costsi,t-1]	%	22	12	31	8	-3.81	-.28
[labor costs i,t / labor costsi,t-1]	%	27	14	38	9	-4.12	-.28
[overhead costs i,t / overhead costsi,t-1]	%	*18*	*-9*	*64*	*23*	*.649*	*1*

Using sample Values the statistic calculated And then using estimate and statistic tests, Statistics can be extended to the population parameters. At this stage after collecting statistical data and perform the necessary calculations, these data entered in Information files of SPSS statistical software to achieve the research objectives to be analyzed. Hypotheses of This study tested and analyzed with the following methods:

1. Pearson Correlation Coefficient
2. Coefficient of determination R2
3. Adjusted coefficient of determination R2
4. The probability value (p.value)
5. the residual Analysis include:
   - residual Histogram
   - p-p.Fig
   - Scatter. Fig

The data used in our study are arranged as a pooled (across firms) regression model for each year, and then we took the average of annually regression coefficients, because to measure cost stickiness we need decrease and increase of revenue in our sample, but in pool of Iranian firms we have alone increase of revenue ,and in each year maybe we have decrease of revenue too, in our sample firms .each model are used for each year, and then we took an average from regression coefficients .The regressions are carried out using SPSS Version 14.

V. EMPIRICAL FINDINGS

The empirical findings on each of the hypotheses are set out below.

A. Direct Material Costs Stickiness

TABLE II presents the results for the full sample of companies.

TABLE II: DIRECT MATERIAL COSTS STICKINESS

$\log [total\ costs_{i,t} / total\ costs_{i,t-1}] = \alpha + \beta 1 * \log [revenue_{i,t} / revenue_{i,t-1}] + \beta 2 * decrease_{i,t} * \log [revenue_{i,t} / revenue_{i,t-1}] + \varepsilon_{i,t}$

The variable *decrease* (*d*) is a dummy variable that takes the value of 1 when revenue decreases, and is otherwise 0.

year	p.value	α	β1	β2	R^2	Adj.R^2
2000	0	.039 (3.105)	.71 (9.872)	-.072 (-.355)	.6	.63
2001	0	.044 (2.717)	.11 (1.12)	1.222 (5.008)	.4	.41
2002	0	.015 (.712)	.777 (4.536)	-.95 (-4.441)	.2	.2
2003	.014	.097 (8.299)	.12 (2.362)	.074 (.506)	.1	.09

Adjusted coefficient of determination (R^2)for each regression is very close to R^2 coefficient of the regression And difference is partial, So adequacy of each regression model is confirmed. Residual histogram confirmed that this residual are normal (Fig. 1-4).to analysis Lack of Perth data the p-p Fig chart is used. Regarding the residual points is close to the line and is not out of range not to be Perth data has proven (Fig. 5- 8).To study Homogeneity of the residuals variances scatter Fig chart is used. Due to the symmetry of the shape, variances homogeneity will be accepted (Fig. 9-12).

Regression results using 328 firm-years for Iranian companies. Separate regressions are run for each year and 82 companies. T-stats are shown in parentheses below the estimated regression coefficients.

The estimated values of β1 range from 0.777 (for year 2002 listed companies) to 0.11 (for year 2001 listed companies), implying that total material costs increase, on average, by around 0.43% per 1% increase in revenue(average of β1 in each year) . Across all companies in the sample, β2 averages0.27; when revenue decreases by 1%, total material costs decrease by around 0.70% (0.43 + 0.27). This confirms that changes in total material costs are not sticky.

B. Direct Labor Cost Stickiness

TABLE III presents the results for the full sample of companies.

TABLE III: DIRECT LABOR COST STICKINESS

log [*total costs i,t / total costsi,t-1*] = α + β1 * log [*revenue i,t / revenuei,t-1*]+ β2 * *decrease i,t* * log [*revenue i,t / revenuei,t-1*]+ ε *i,t*
The variable *decrease* (*d*) is a dummy variable that takes the value of 1 when revenue decreases, and is otherwise 0.

Year	p.value	α	β1	β2	R^2	Adj.R^2
2000	0	.083 (8.556)	.23 (4.175)	-.015 (-1.004)	.6	.19
2001	0	.09 (7.551)	.03 (.447)	.536 (3.089)	.4	.18
2002	.002	.064 (5.748)	.355 (3.539)	-.35 (-2.919)	.2	.14
2003	.048	.049 (4.025)	.12 (2.423)	-.258 (-1.658)	.1	.05

As can be seen in TABLE III Adjusted coefficient of determination (R^2) for each regression is very close to R^2 coefficient of the regression And difference is partial, So adequacy of each regression model is confirmed. Residual histogram confirmed that this residual are normal (Fig. 13-16).to analysis Lack of Perth data the p-p Fig chart is used. Regarding the residual points is close to the line and is not out of range not to be Perth data has proven (Fig. 17-20).To study Homogeneity of the residuals variances scatter Fig chart is used. Due to the symmetry of the shape, variances homogeneity will be accepted (Fig. 21- 24).

Regression results using 328 firm-years for Iranian companies. Separate regressions are run for each year and 82 companies. T-stats are shown in parentheses below the estimated regression coefficients.

The estimated values of β1 range from 0.355 (for year 2002 listed companies) to 0.03 (for year 2001 listed companies), implying that total direct labor cost increase, on average, by around 0.183% per 1% increase in revenue(average of β1 in each year) . Across all companies in the sample, β2 averages-.093; when revenue decreases by 1%, total direct labor costs decrease by around 0.09% (0.183-0.093). This confirms that changes in total direct labor costs are sticky.

C. Overhead Costs Stickiness

TABLE IV presents the results for the full sample of companies.

TABLE IV: OVERHEAD COSTS STICKINESS

log [*total costs i,t / total costsi,t-1*] = α + β1 * log [*revenue i,t / revenuei,t-1*]+ β2 * *decrease i,t* * log [*revenue i,t / revenuei,t-1*]+ ε *i,t*
The variable *decrease* (*d*) is a dummy variable that takes the value of 1 when revenue decreases, and is otherwise 0.

Year	p.value	α	β1	β2	R^2	Adj.R^2
2000	0	.036 (3.568)	.46 (8.287)	-.55 (-3.458)	.5	.48
2001	0	.07 (7.456)	.038 (.6)	.66 (4.323)	.3	.33
2002	0	.024 (2.109)	.55 (3.368)	-.55 (-4.332)	.3	.29
2003	0	.038 (4.403)	.26 (6.705)	-.35 (-3.211)	.4	.38

As can be seen in TABLE IV Adjusted coefficient of determination (R^2) for each regression is very close to R^2 coefficient of the regression And difference is partial, So adequacy of each regression model is confirmed. Residual histogram confirmed that this residual are normal (Fig. 25-28).to analysis Lack of Perth data the p-p Fig chart is used. Regarding the residual points is close to the line and is not out of range not to be Perth data has proven (Fig. 29- 32).To study Homogeneity of the residuals variances scatter Fig chart is used. Due to the symmetry of the shape, variances homogeneity will be accepted (Fig. 33- 36).

Regression results using 328 firm-years for Iranian companies. Separate regressions are run for each year and 82 companies. T-stats are shown in parentheses below the estimated regression coefficients.

The estimated values of β1 range from 0.55 (for year 2002 listed companies) to 0.26 (for year 2003 listed companies), implying that total overhead costs increase, on average, by around 0.33% per 1% increase in revenue (average of β1 in each year). Across all companies in the sample, β2 averages-0.2; when revenue decreases by 1%, total overhead costs decrease by around 0.13% (0.33- 0.2). This confirms that changes in total overhead costs are sticky.

VI. CONCLUSIONS

Our findings suggest that total material costs are not sticky; averaged across all the firms in our sample, direct labor costs increase by 0.19% per 1% increase in revenue, but decrease by only 0.09% per 1% decrease in revenue, and overhead costs increase by 0.33% per 1% increase in revenue, but decrease by 0.13% per 1% decrease in revenue, then direct labor costs and overhead costs are sticky.

Our results are consistent with an alternative cost behavior model that takes into account the asymmetric friction created by managers when adjusting committed resources following changes in the level of activity of the firm.

The results have implications for managers and corporate decision makers. Decisions based on the traditional cost behavior model will overestimate or underestimate the responsiveness of costs to changes in the level of activity. The traditional approach to cost behavior recommends methods such as regression analysis to estimate the average cost change associated to a unit change in the activity driver. Performing such estimations with no consideration to cost stickiness, leads to underestimation of cost responses when activity rises and to overestimation of cost responses when activity falls.

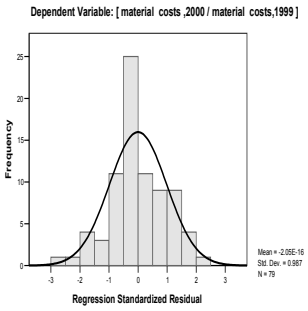
A managerial inference of the analysis is that cost stickiness can be verified and controlled. Managers can assess their exposition to sticky costs when observing the cost sensitivity to volume reductions. They can increase the costs sensitivity to volume fluctuations by taking contractual decisions which reduce the adjustment costs connected to change the levels of committed resources.

An understanding of sticky cost behavior will result in a better and more robust planning and control system. Careful planning can mitigate sticky cost behavior. To avoid or minimize the effects of sticky cost behavior, managers need to be able to identify and manage unused capacity and resources. This may not necessarily mean reducing the supply of resources, which may not be possible or feasible.

Alternative ways might include focusing on the marketing aspect to boost demand or shifting unutilized resources to alternative activities.

In terms of the control function, cost stickiness potentially distorts standard costing systems, variance analysis, and compensation schemes. Evaluating individual performance against a benchmark which, for perfectly rational reasons, does not flex as expected because of adjustment costs associated with prior commitments, is clearly inequitable.

Considering cost stickiness at the planning and control stages and making allowance for those factors that cause cost stickiness will yield better performance and results, and ultimately enhance shareholder wealth.



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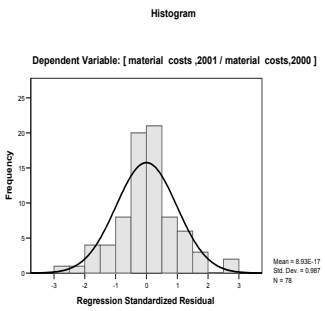

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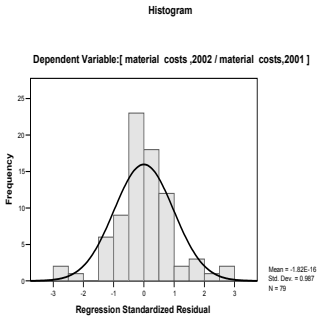

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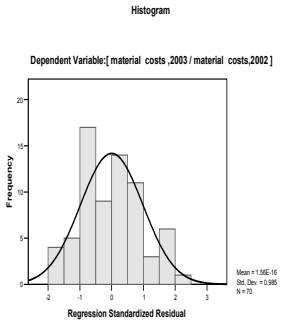

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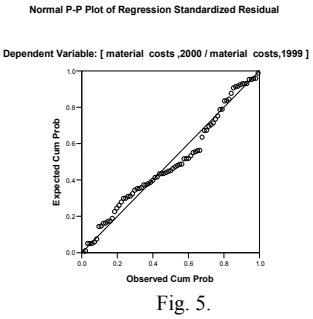

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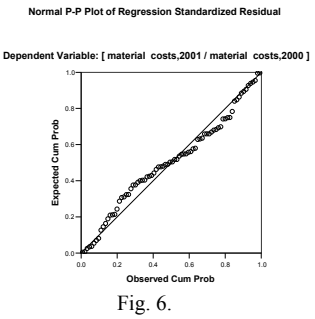

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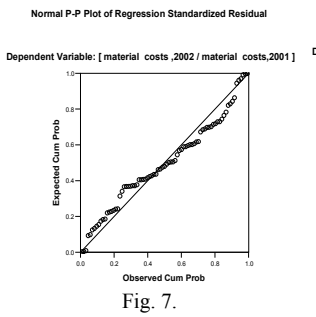

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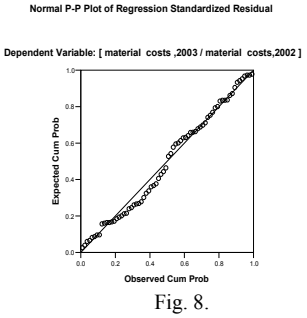

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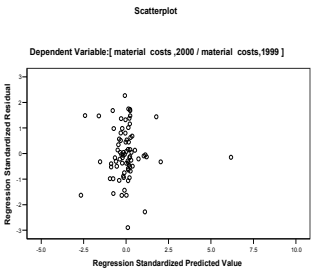

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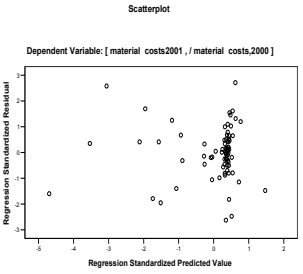

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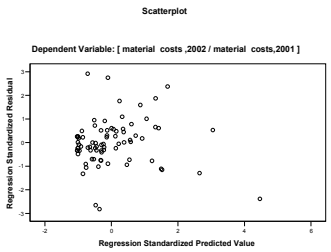

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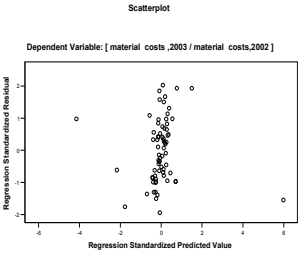

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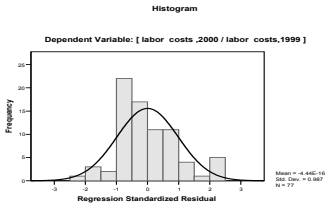

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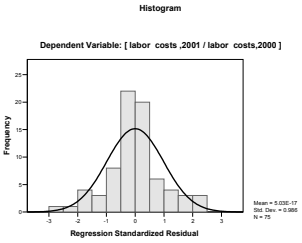

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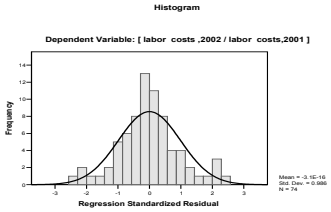

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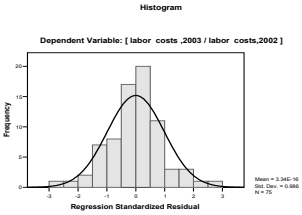

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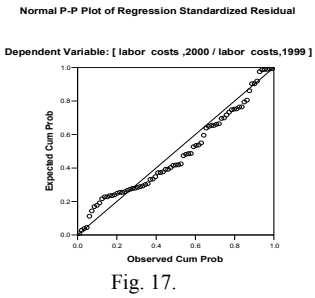

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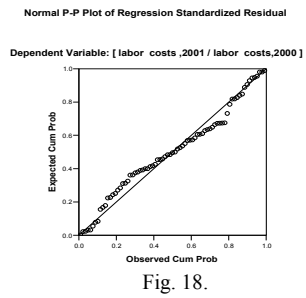

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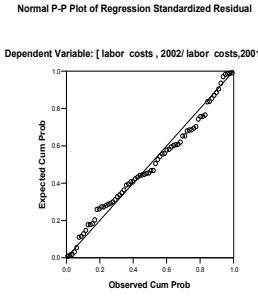

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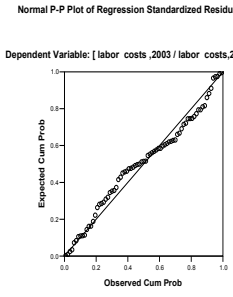
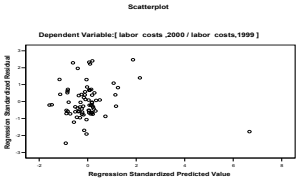


Fig. 20.



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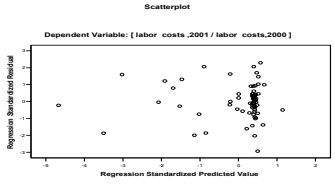

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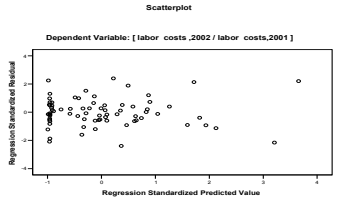

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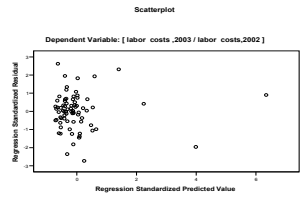

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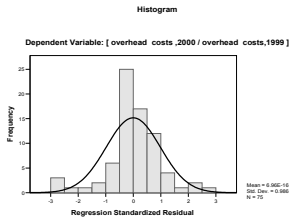

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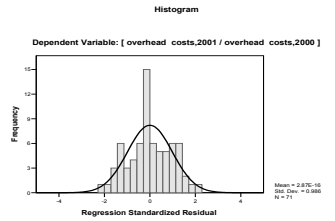

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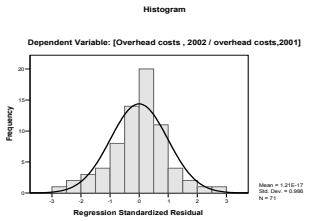

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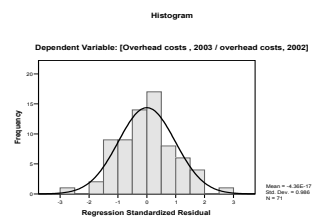

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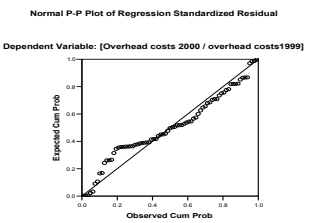

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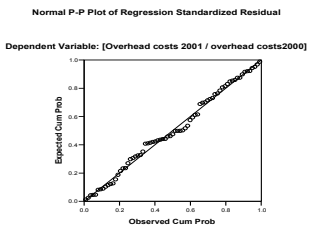

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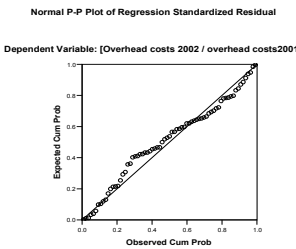

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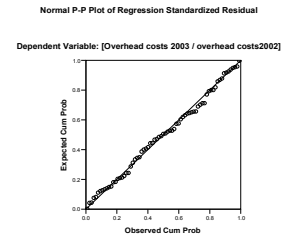

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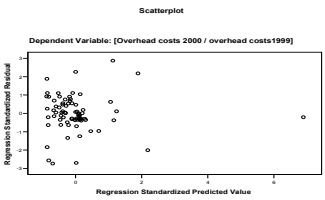

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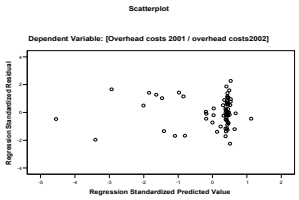

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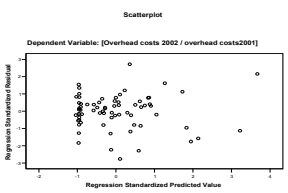

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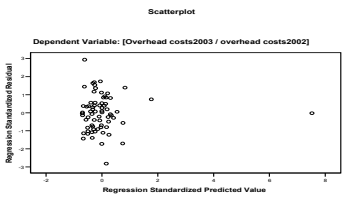

Fig. 36.

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