Determinants of Employment of Non-Production Workers in Indian Manufacturing Industry: A Regression Analysis

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Abstract. The owners of capital have an inherent tendency and interest to exercise effective control over the production process. This is considered necessary to maximize their profit in a given situation. The process of economic reforms as initiated since July 1991 on a firm and bold footing in India have facilitated the this process of increased control of owners of capital over the production processes through their representatives, the managers, professionals and technocrats. This behavior of the firms has changed the demand for non-production and production workers in a firm or industry. Using the ASI data at 2-digit level an attempt has been made in this paper to identify some important determinants which might have influenced the demand for nonproduction workers or skilled workers in Indian manufacturing industries. For this purpose the stepwise regression coefficients was estimated which have explained changes in the ratio of non-production to production workers (NP/P). It was observed that the variables identified as important determinants of changes in the relative demand for the non-production workers (skilled workers) in Indian manufacturing industries exert their influence in different directions and in varying degrees on a particular industry and across industries also. Hence the policies formulated and implemented to augment the level of productivity and employment should be industry specific under the broad industrial policy framework

Key Words*:* Production workers, Non-production workers, Relative demand, NP/P, Capital Intensity, Total emoluments, GVA, Size of organization, Relative wages, Dummy variable, Regression Coefficient.

1 Introduction

The process of economic reforms as initiated since July 1991 in India has facilitated the increased control of capital over the production process. The firms or owners of capital exercise such control through their agents; the managers, professionals and technocrats. This behavior of the firms goes a long way in achieving an important objective i.e. to maximise profit. This situation creates a fundamental conflict of interest between labour and the owners of capital (Singh, 2015). In order to achieve such control over the labour process, the owners of capital adopt the use of machinery, automation of production process and employ scientific management methods to reorganise the work process to achieve their objective. The economic reforms popularly known as the new policy regim was marked by reduction/abolition of domestic and external barriers to entry and the consequent emergence of competition and a shift from low

volume-high margin scenario of the pre-reform years to high volume-low margin regime in the post-reform period (Tendulkar, 2003; Sen and Dasgupta, 2008).

The various measures initiated under the new policy regime, have intensified the process of industrial restructuring because the new policies have exposed the Indian enterprises to the environment of increased competitiveness both domestically as well as globally (Singh, 2015). The process of privatisation of PSUs has an inherent objective of reducing the role of state or public sector in nation's economic activities and increasing that of the private sector either by ownership transfer or management transfer or marketisation (Kaur, 2003). It is argued that privatisation may increase competition in actual sense and even if it does not, the very threat of entry by new firms can have a major influence on industry conduct. In order to increase efficiency of an organisation, competition rather than ownership (private or public), plays an important role (Kaur, 2003). Further, due to policy of openness, there has been a growing involvement of transnational corporations (TNCs) in formal manufacturing sectors of several developing countries including India. These TNCs have geared their investments towards production of more skill intensive goods (Ghose, 2000; Posthuma and Nathan, 2010). It is often stated that Indian firms are less dynamic in terms of the technological development efforts. However, after liberalisation, not only the multinational corporations (MNCs) or TNCs investment in skill intensive or capital intensive industries would increase but the Indian firms could also now easily import capital and intermediate goods as well as technology. These factors may lead to increase in the demand for skilled workers in Indian industries (Panda and Ryou, 2007). These changes are expected to alter the industrial composition of the workforce because some old firms in each industry would be closed down and new units would emerge in response to new economic reality created by the new policy regime (Seth and Aggarwal, 2003).

In the light of the above observations, the main objective of this paper is to discuss some important variables which are likely to influence the demand for skilled workers[1] in Indian manufacturing industry particularly after the period of economic reforms. Section – 2 of the paper deals with data sources and methodology. In order to achieve the above objective, section – 3 of the paper discusses important hypotheses. Section – 4 deals with the regression results followed by summary and conclusion in section – 5.

[1] In the present paper non-production workers have been treated as skilled workers.

2. Data Sources and Methodology

In order to analyse some of the important determinants of increase in demand for the non-production workers in Indian manufacturing industry the data for twenty two industries at the 2-digit level as well as the aggregate manufacturing industry for the year 1973-74 to 2005-06 have been collected from *Economic and Political Weekly Research Foundation* (EPWRF) data series II (2007) and the CSO publications on *Annual Survey of Industries* for various years. Since the data from the year 1973-74 to 2005-06 is based on NIC 1970, 1987, 1998 and 2004, necessary concordance has been made to make the data comparable over the period. *Annual Survey of Industries (ASI)* is the most comprehensive and reliable source of statistics on different variables of manufacturing, water supply, gas and electricity in India. ASI covers the entire factory sector. All industrial units (called factories) registered under section 2 (m) (i) and 2 (m) (ii) of the Factories Act, 1948 are included. ASI covers units employing 10 or more workers and using power or those employing 20 or more workers and not using power on any working day of the preceding 12 months. In ASI framework, data on production and non-production workers has been reported under the nomenclature of "workers" and "other than workers" consisting of managers, supervisors and other employees.

Some important variables that were expected to influence the changes in the composition of workforce in terms of non-production workers and production workers have been identified on the basis of literature survey. These are: capital intensity (K/L), relative wages of production workers and non-production workers (Wp/Wnp), ratio of total emoluments to gross value added (TE/GVA) and size of factory (L/F). These variables have been treated as explanatory variables; NP/P being the dependent variable in this paper. The regression coefficients for different independent variables have also been estimated to observe the degree to which changes in NP/P ratio are explained by these variables using *stepwise linear regression method*. The stepwise regression method has been preferred over simple linear regression method for the obvious reason that the choice of predictive variables is carried out by an automatic procedure using SPSS. This method is designed to find the most parsimonious set of predictors that are most effective in predicting the dependent variable. In this procedure, all predictive variables are entered simultaneously testing at each stage for variables to be included or excluded and also testing them one by one for statistical significance. SPSS provides a table of variables included

in the analysis and a table of variables excluded from the analysis. It is possible that none of the variables may be included and it is also possible that all of the variables may be included. The order of entry of the variables can be used as a measure of relative importance. Once a variable is included, its interpretation of the outcome in stepwise regression is the same as it would be using other methods. The β coefficients for different explanatory variables have been estimated in different steps and while interpreting the results the values of the last step have been discussed.

For estimating the regression coefficients of different explanatory variables of NP/P, following model has been. The outcome variable in this model is relative employment of the non-production workers (NP/P) in 22 manufacturing industries at the 2-digit level as well the aggregate manufacturing industry. The model is as follows:

$$(NP/P)_t = \alpha_1 + \beta_1 (K/L)_t + \beta_2 (Wp/Wnp)_t + \beta_3 (TE/GVA)_t + \beta_4 (L/F)_t + \alpha_2 D + U_t.$$

Where,

$(NP/P)_t$	=	Ratio of non-production to production workers (Skill intensity).
$(K/L)_t$	=	Ratio of capital to labor (Capital intensity)
$(Wp/Wnp)_t$	=	Ratio of wages of production workers to wages of non-production workers (Relative wages).
$(TE/GVA)_t$	=	Ratio of total emoluments to gross value added
$(L/F)_t$	=	Ratio of total employees to total factories (Size of organisation)
D	=	0 for pre-reform period (1973-74 to 1990-1991) and 1 for post-reform period (1991-92 to 2005-06)

The above Model is a simple linear regression model in which the β coefficient of a particular explanatory variable explains the magnitude of variation in NP/P as a result of a unit change in that explanatory variable.

3. The Hypotheses

The important hypotheses formulated regarding the relationship between the dependent variable (NP/P) and different independent or explanatory variables mentioned above are discussed as follows:

i) Capital Intensity (K/L): Different alternative measures of capital intensity to capture its role in determining the NP/P ratio may be (a) electric energy (k.w.h) per production

worker, (b) outlay on plant and equipment per production worker and (c) capital employed per worker. Here capital employed per employee (K/L) has been used as a measure of capital intensity[2]. A positive relationship between capital intensity and the NP/P ratio has been noticed by Florence (1953), Bendix (1956), Delehanty (1968), Seth and Bhasin (1978) and Bhasin and Seth (1980) who conclusively demonstrated that greater physical capital intensity is related with greater human capital intensity (non-production workers).

Florence (1972) has stated that more intense physical investment and increased productivity per direct labour (production workers) usually entails an increased ratio of indirect labour (non-production workers). Increased use of machines displaces direct labour but additional staff is required to cope with the increased complexity of machines and the greater quantity of output. Additional planning logically connected with intense investment because of the need to get the most out of fixed equipment also entails additional staff in form of salaried managers, foremen and office staff.

Ghose (2000) has also suggested that workers working with more and better machines produce more, but they also need to be more skilled if they are to work with more and better machines. This is why skill-intensity and capital-intensity are expected to move in the same direction while labour-intensity and skill-intensity are expected to move in opposite directions.

In the present study, K/L has also been used as a proxy for technological progress. It is expected that different measures adopted to liberalize and globalize Indian economy since 1991, particularly the measures related to import liberalization would encourage inflow of foreign direct investment (FDI), technology, and capital and intermediary goods which would further lead to the use of more advanced and sophisticated technology by the Indian firms. In the process of technological advancement in an industry or organisation, the intensity of capital generally increases. In this context Delehanty (1968) has aptly written that continuing technical revolution and deeper investment means increase in capital - labour ratio and substitution of indirect labour (non-production workers) for direct labour (production workers) following the replacement of some workers by machines.

[2] Guha has used number of workers as denominator to find the K/L ratio.

Seth and Bhasin (1978) have also supported the arguments of Florence and Delehanty through their case study of Indian manufacturing industries regarding existence of complementary relationship between physical capital and human capital. *Thus, it is hypothesised here that K/L and NP/P are positively related or there exists a complementary relationship between physical capital intensity and human capital intensity in an industry.*

ii) **Relative Wages of Production and Non-production Workers (Wp/Wnp):** Regarding the importance of relative wages as one of the important explanatory variables determining the composition of non-production and production workers in industries, Gujarati and Dars (1972) have rightly pointed out that this variable is obviously a candidate in any relative employment equation and can be justified in terms of the neoclassical theory of production. The relative wages of production and non-production workers indicate the relationship between factors price and factor proportions and also reveals the elasticity of substitution between production and non-production workers (Seth and Bhasin, 1978).

The hypothesis which has been tested here is that the ratio of wages of production workers to the wages of non-production workers is positively related to the NP/P ratio. In other words, any increase in the relative wage of the production workers is likely to increase the relative demand for the non-production workers and vice-versa. Earlier, some scholars (Gujarati and Dars, 1972; Seth and Bhasin, 1978 and Bhasin and Seth, 1980) have also found a positive relationship between the two ratios in large number of U.S. and Indian industries respectively.

However, some recent studies (Berman, Somanathan and Tan, 2005 and Ramaswamy, 2008) have found that during the 1990s the proportion of non-manual workers in aggregate registered manufacturing increased despite the increase in their relative wages. This increase in relative quantities of non-manual workers notwithstanding, the increase in their relative wages represents an aggregate demand shift towards this category of workers.

The testing of the above hypothesis that the ratio of wages of production workers to the wages of non-production workers (Wp/Wnp) is positively related to the NP/P ratio is likely to give a more clear direction to the issue at stake.

iii) **Ratio of Payrolls to Gross Value Added (TE/GVA):** The ratio of payrolls to gross value added, measures two different characteristics of an industry: (i) It is an estimate of

elasticity of labour demand with respect to changes in the level of output and (ii) It is an indirect measure of labour intensity of industry (Seth and Aggarwal, 2004).

Further, Mitra (1974) has observed that the number of production workers relative to the number of non-production workers is higher wherever the non-wages per employee (physical capital) is smaller and *vice versa*. In other words, as the labour intensity in an industry increases, the NP/P ratio decreases and as the capital intensity increases in an industry, the NP/P ratio also has a tendency to increase.

Considering characteristic (ii) of an industry as mentioned above, it may be stated that TE/GVA would be higher in labour intensive industries and lower in capital intensive industries. Earlier studies (Goldar and Seth, 1975 and Seth and Bhasin, 1978) have found negative relationship between payrolls to value added and NP/P ratio in many Indian manufacturing industries. *Therefore, it may be hypothesised here that the ratio of payrolls to gross value added (TE/GVA) and NP/P ratio are inversely related in labour intensive industries and positively related in capital intensive industries.*

iv) **Average Size of Organisation (L/F):** Goldar and Seth (1975) have stated three alternative measures of the size of an organisation viz. Capital employed per factory, Labour employed per factory and Value added per factory.

Earlier studies have not found any conclusive relationship between the size of an organisation and the NP/P ratio. Terrien and Mills (1955) have obtained a positive relationship between the size of an organisation and its administrative component of the total staff. He has concluded in his study that the percentage of administrative staff increases, as the size the organisation increases but only up to a limited extent. His hypothesis and conclusion has found support in the empirical works of Delehanty (1968). The scholar has considered asset size of companies and employment size of establishments for eighteen manufacturing industries for determining the size of an industry. He has argued that the larger establishments use relatively more people in technical occupations, and that large firms do more research and development (R&D) activities.

Further, larger firms can support permanent R&D and technical employees, while small firms cannot, and these firms find it more appropriate to purchase such services from other specialized firms. Empirically the scholar has largely found a positive relationship between the size of an organisation and the NP/P ratio. However, he has found relatively a weaker though

still positive relationship between the two variables for industries viewed at a more disaggregated level.

Florence (1972), while observing rank correlation of the twenty American industry groups for the period 1947-1967, has found a low positive and a low negative coefficient for staff ratios (proportion of salaried staff to production workers), when correlated respectively with plant and with firm size. On the contrary, Haire (1959) has noticed an inverse relationship between the size of an organisation and NP/P ratio. In his study of four companies conducted at the Institute of Industrial Relations at the University of California, Berkeley in the year 1958, Haire (1959) has observed that the ratio of supervisors to the supervised does not go up as the company grows. The ratio of top and middle management shows an even greater decline with increasing size of the firm. However, as the company increases the size of clerical workers, it showed some increase because they are part of the general function of control, coordination and communication which increases rapidly as the size increases.

In Indian manufacturing industries, Seth and Bhasin (1978) have found a positive relationship between the above two variables in only two industries, i.e. Starch *and* Aluminium, copper and brass. They have found negative relationship between the two variables in case of the following industries: Rice milling, Biscuit making, fruits and vegetables, Distilleries and breweries and Tanning.

In the present study the size of an organisation has been measured by the average employees per factory (L/F). This is because when organisation size is measured by capital employed per factory it may reflect, apart from size effect, the effect of mechanization also. *Thus, it is intended to test the hypothesis in this chapter that there exists a positive relationship between the size of an organisation (L/F) and the relative employment of the non-production workers (NP/P) in that organisation.*

v) **Dummy Variable:** In order to capture the effect of economic reforms after 1991 on the composition of non-production and production workers in Indian manufacturing industries the dummy variable has been used in the present analysis. The dummy variable takes the value of zero for the period 1973-74 to 1990-91 (pre-reform period) and one for the period 1991-92 to 2005-06 (post-reform period). *It is expected that the process of*

economic reforms has positively and significantly influenced the relative employment of non-production workers in the Indian organised manufacturing sector.

4. Analysis of Regression Results

The simple correlation analysis merely tells us the degree of association between NP/P ratio on the one hand and K/L, Wp/Wnp, TE/GVA and L/F on the other. It does not reveal as to what extent changes in K/L, Wp/Wnp, TE/GVA and L/F (explanatory variables) explain the variation in the NP/P in different industries over time. This objective is fulfilled by undertaking regression analysis.

Table – 1 shows regression coefficients, along with standard errors (S.E.), t values and P values with respect to the specified model. The β coefficients for different industries have been estimated in different steps. However, the results of only the last step have been discussed.

Table – 1: Stepwise Regression Results

S. No.	Industry	Dependent Variable: NP/P	Explanatory Variables					
1.	**All Manufacturing Industries**	***Step1***	Intercept	(K/L)all	(Wp/Wnp)all	(TE/GVA)all	(L/F)all	Dummy
		Coef. S.E. t P > [t]	0.264 (0.004) 74.483 0.000***					0.025 (0.005) 4.822 0.000***
		R-Square-r^2 = 0.429 **F-Value =** 23.253 **(*p-value .000****)** **Excluded variables:** (K/L)all, (Wp/Wnp)all, TE/GVA)all, (L/F)all						
		Step 2	Intercept	(K/L)all	(Wp/Wnp)all	(TE/GVA)all	(L/F)all	Dummy
		Coef. S.E. t P > [t]	0.214 (0.018) 12.125 0.000***		0.106 0.36 2.913 0.007***			0.033 (0.005) 6.12 0.000***
		R-Square-r^2 = 0.555 **F-Value =** 18.678 **(*p-value .000****)** **Excluded variables:** (K/L)all, TE/GVA)all, (L/F)all						
		Step 3	Intercept	(K/L)all	(Wp/Wnp)all	(TE/GVA)all	(L/F)all	Dummy
		Coef. S.E. t P > [t]	0.161 (0.022) 7.147 0.000***	0.011 0.003 3.232 0.003***	0.196 0.042 4.643 0.000***			0.012 (0.008) 1.433 0.163
		R-Square-r^2 = 0.673 **F-Value =** 19.853 **(*p-value .000****)** **Excluded variables:** TE/GVA)all, (L/F)all						
		Step 4	Intercept	(K/L)all	(Wp/Wnp)all	(TE/GVA)all	(L/F)all	Dummy

		Coef. S.E. t P > [t]	0.149 (0.021) 6.990 0.000***	0.015 (0.002) 7.453 0.000***	0.216 (0.041) 5.325 0.000***			
		R-Square-r^2 = 0.649 **F-Value =** 27.778 **(*p-value .000****)** **Excluded variables:** TE/GVA)all, (L/F)all						
2.	Food Products and Beverages (15)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.213 (0.024) 9.018 0.000***				0.001 (0.000) 2.821 0.008***	
		R-Square-r^2 = 0.204 **F-Value =** 7.955 **(*p-value .008****)** **Excluded variables:** (K/L), (Wp/Wnp), (TE/GVA), Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.169 (0.027) 6.373 0.000***				0.002 (0.000) 4.081 0.000***	0.017 (0.006) 2.750 0.010**
		R-Square-r^2 = 0.364 **F-Value =** 8.602 **(*p-value .001****)** **Excluded variables:** (K/L), (Wp/Wnp), (TE/GVA)						
3.	Tobacco and Tobacco Products (16)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.021 (0.015) 1.397 0.172		0.169 (0.049) 3.450 0.002***			
		R-Square-r^2 = 0.277 **F-Value =** 11.906 **(*p-value .002****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy						
		Step2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.040 (0.017) 2.424 0.022**		0.137 (0.048) 2.841 0.008***			-0.022 (0.010) -2.209 0.035**
		R-Square-r^2 = 0.379 **F-Value =** 9.139 **(*p-value .001****)** **Excluded variables:** K/L, TE/GVA, L/F						
		Step3	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.0931 (0.020) 0.458 0.658		0.183 (0.049) 3.750 0.001***			-0.040 (0.012) -3.334 0.002***
		R-Square-r^2 = 0.480 **F-Value =** 8.937 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA						

		Step4	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.012 (0.020) 0.612 0.545	-0.216 (0.120) -1.805 0.082*	0.173 (0.047) 3.646 0.001***		0.0005 (0.000) 3.015 0.005***	-0.029 (0.013) -2.283 0.033**
		R-Square-r^2 = 0.535 **F-Value =** 8.039 **(*p-value .000****)** **Excluded variables:** TE/GVA						
4.	Textiles (17)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.218 (0.005) 45.401 0.000***				-0.0005 (0.000) -13.529 0.000***	
		R-Square-r^2 = 0.855 **F-Value =** 183.024 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA, Dummy						
		Step2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.192 (0.011) 18.187 0.000***				-0.0003 (0.000) -4.816 0.000***	0.012 (0.004) 2.779 0.009***
		R-Square-r^2 = 0.885 **F-Value =** 115.213 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA						
5.	Wearing Apparel; Dressing and Dyeing of Fur (18)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.230 (0.005) 44.250 0.000***				-0.0006 (0.000) -8.720 0.000***	
		R-Square-r^2 = 0.710 **F-Value =** 76.034 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.196 (0.019) 10.155 0.000***		0.062 (0.04) 1.844 0.075*		-0.0005 (0.000) -4.669 0.000***	
		R-Square-r^2 = 0.740 **F-Value =** 42.661 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA, Dummy						
6.	Leather and Leather Products (19)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t	0.123 (0.018) 6.891		0.197 (0.038) 5.141			

		P > [t]	0.000***		0.000***			
		R-Square-r^2 = 0.460		**F-Value =** 26.428		(***p-value .000****)		
		Excluded variables: K/L, TE/GVA, L/F, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	0.094		0.238			0.021
		S.E.	(0.019)		(0.038)			(0.008)
		t	4.879		6.233			2.681
		P > [t]	0.000***		0.000***			0.012**
		R-Square-r^2 = 0.565		**F-Value =** 19.445		(***p-value .000****)		
		Excluded variables: K/L, TE/GVA, L/F						
7.	Wood and Wood Products (20)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	0.180		0.133			
		S.E.	(0.037)		(0.072)			
		t	4.856		1.834			
		P > [t]	0.000***		0.076*			
		R-Square-r^2 = 0.098		**F-Value =** 3.363		(***p-value .076**)		
		Excluded variables: K/L, TE/GVA, L/F, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	0.081	0.043	0.272			
		S.E.	(0.048)	(0.015)	(0.082)			
		t	3.320	2.819	3.320			
		P > [t]	0.101	0.008***	0.002***			
		R-Square-r^2 = 0.287		**F-Value =** 6.030		(***p-value .006****)		
		Excluded variables: TE/GVA, L/F, Dummy						
		Step3	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	-0.110	0.072	0.331	0.374		
		S.E.	(0.084)	(0.018)	(0.078)	(0.139)		
		t	-1.315	4.095	4.253	2.690		
		P > [t]	0.199	0.000***	0.000***	0.012**		
		R-Square-r^2 = 0.429		**F-Value =** 7.268		(***p-value .001****)		
		Excluded variables: L/F, Dummy						
8.	Paper and Paper Products (21)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	0.220		0.134			
		S.E.	(0.011)		(0.023)			
		t	19.483		5.704			
		P > [t]	0.000***		0.000***			
		R-Square-r^2 = 0.512		**F-Value =** 32.538		(***p-value .000****)		
		Excluded variables: K/L, TE/GVA, L/F, Dummy						
9.	Publishing, Printing and Reproduction of Recorded Media (22)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef.	0.300	0.100				

		S.E. t P > [t]	0.011 27.513 0.000***	(0.007) 13.542 0.000***				
		R-Square-r^2 = 0.0.855		**F-Value =** 183.395		**(*p-value .000****)**		
		Excluded variables: Wp/Wnp, TE/GVA, L/F, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.298 (0.010) 29.314 0.000***	0.081 (0.011) 7.693 0.000***				0.050 (0.021) 2.428 0.021**
		R-Square-r^2 = 0.879		**F-Value =** 109.126		**(*p-value .000****)**		
		Excluded variables: Wp/Wnp, TE/GVA, L/F						
10.	Coke, Refined Petroleum Products and Nuclear Fuel (23)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.246 (0.063) 3.936 0.000***		0.280 (0.118) 2.368 0.024**			
		R-Square-r^2 = 0.153		**F-Value =** 5.609		**(*p-value .024***)**		
		Excluded variables: K/L, TE/GVA, L/F, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.273 (0.062) 4.401 0.000***		0.266 0.114 2.330 0.027**			-0.043 0.024 -1.831 0.077*
		R-Square-r^2 = 0.238		**F-Value =** 4.693		**(*p-value .017***)**		
		Excluded variables: K/L, TE/GVA, L/F						
11.	Chemical and Chemical Products (24)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.658 (0.032) 20.650 0.000***				-0.003 (0.000) -6.937 0.000***	
		R-Square-r^2 = 0.608		**F-Value =** 48.119		**(*p-value .000****)**		
		Excluded variables: K/L, Wp/Wnp, TE/GVA, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.563 (0.050) 11.146 0.000***	0.004 (0.002) 2.350 0.026**			-0.002 (0.001) -3.189 0.003***	
		R-Square-r^2 = 0.669		**F-Value =** 30.330		**(*p-value .000****)**		
		Excluded variables: Wp/Wnp, TE/GVA, Dummy						

12.	Rubber and Plastics Products (25)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.232 (0.034) 6.914 0.000***		0.222 (0.073) 3.047 0.005**			
		R-Square-r^2 = 0.230 **F-Value =** 9.282 **(*p-value .005****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy					
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.197 (0.031) 6.340 0.000***		0.262 (0.064) 4.066 0.000***			0.037 (0.011) 3.312 0.002***
		R-Square-r^2 = 0.437 **F-Value =** 11.620 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA, L/F					
13.	Other non-Metallic Mineral Products (26)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.153 (0.022) 6.978 0.000***		0.178 (0.053) 3.337 0.002***			
		R-Square-r^2 = 0.264 **F-Value =** 11.38 **(*p-value .002****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy					
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.069 (0.017) 4.190 0.000***	0.011 (0.110) 7.818 0.000***	0.320 (0.036) 8.873 0.000***			
		R-Square-r^2 = 0.758 **F-Value =** 46.926 **(*p-value .000****)** **Excluded variables:** TE/GVA, L/F, Dummy					
14.	Basic Metal (27)	Dependent Variable: NP/P	**Explanatory Variables**				
		No Result	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
15.	Fabricated Metal Products, except Machinery and Equipments (28)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.206 (0.027) 7.630 0.000***		0.374 (0.077) 4.878 0.000***			
		R-Square-r^2 = 0.434 **F-Value =** 23.799 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy					

16.	Machinery and Equipment n.e.c. (29)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.410 (0.024) 17.086 0.000***					0.118 (0.036) 3.313 0.002***
		R-Square-r^2 = 0.261 **F-Value =** 10.974 ***(p-value .002*****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA, L/F						
		Step2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.129 (0.067) 1.932 0.063*		0.454 (0.104) 4.368 0.000***			0.141 (0.029) 4.912 0.000***
		R-Square-r^2 = 0.549 **F-Value =** 18.228 ***(p-value .000*****)** **Excluded variables:** K/L, TE/GVA, L/F						
		Step3	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	-0.118 (0.124) -0.950 0.350		0.310 (0.115) 2.691 0.012**		0.006 (0.003) 2.307) 0.028**	0.161 (0.028) 5.701 0.000***
		R-Square-r^2 = 0.619 **F-Value =** 15.677 ***(p-value .000*****)** **Excluded variables:** K/L, TE/GVA						
		Step4	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	-0.280 (0.127) -2.216 0.035**	0.071 (0.026) 2.764 0.010**	0.343 (0.105) 3.271 0.003***		0.008 (0.002) 3.179 0.004***	0.087 (0.037) 2.369 0.025**
		R-Square-r^2 = 0.700 **F-Value =** 16.357 ***(p-value .000*****)** **Excluded variables:** TE/GVA						
17.	Office Accounting and Computing Machinery (30)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.921 (0.090) 10.200 0.000***			-0.658 (0.255) -2.578 0.015**		
		R-Square-r^2 = 0.177 **F-Value =** 6.646 ***(p-value .015*****)** **Excluded variables:** K/L, Wp/Wnp, L/F, Dummy						
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.653 (0.109) 5.962 0.000***		0.953 (0.274) 3.475 0.002***	-1.050 (0.246) -4.260 0.000***		
		R-Square-r^2 = 0.413 **F-Value =** 10.549 ***(p-value .000*****)** **Excluded variables:** K/L, L/F, Dummy						

18.	Electrical Machinery and Apparatus n.e.c. (31)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.296 (0.016) 18.171 0.000***		0.375 (0.031) 12.192 0.000***			
		R-Square-r^2 = 0.827 **F-Value =** 148.633 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy					
19.	Radio, Television and Communication Equipment Apparatus (32)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.714 (0.029) 24.278 0.000***			-0.590 (0.075) -7.880 0.000***		
		R-Square-r^2 = 0.667 **F-Value =** 62.088 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, L/F, Dummy					
		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.644 (0.038) 16.737 0.000***		0.212 (0.083) 2.555 0.016**	-0.675 (0.077) -8.817 0.000***		
		R-Square-r^2 = 0.727 **F-Value =** 39.847 **(*p-value .000****)** **Excluded variables:** K/L, L/F, Dummy					
20.	Medical Precision and Optical Instruments, Watches and Clocks (33)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.417 (0.013) 33.217 0.000***					0.078 (0.019) 4.222 0.000***
		R-Square-r^2 = 0.365 **F-Value =** 17.827 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA, L/F					
21.	Motor Vehicles, Trailers and Semi-trailers (34)	Dependent Variable: NP/P	**Explanatory Variables**				
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.270 (0.017) 15.633 0.000***		0.224 (0.032) 7.061 0.000***			
		R-Square-r^2 = 0.617 **F-Value =** 49.860 **(*p-value .000****)** **Excluded variables:** K/L, TE/GVA, L/F, Dummy					

		Step 2	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.245 (0.019) 12.565 0.000***		0.204 (0.031) 6.578 0.000***	0.097 (0.043) 2.289 0.029**		
		R-Square-r^2 = 0.674 **F-Value =** 30.960 **(*p-value .000****)** **Excluded variables:** K/L, L/F, Dummy						
22.	Other Transport Equipment (35)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.348 (0.013) 27.003 0.000***				-0.0003 (0.000) -4.989 0.000***	
		R-Square-r^2 = 0.445 **F-Value =** 24.890 **(*p-value .000****)** **Excluded variables:** K/L, Wp/Wnp, TE/GVA, Dummy						
23.	Furniture; Manufacturing n.e.c. (36)	Dependent Variable: NP/P	**Explanatory Variables**					
		Step 1	Intercept	(K/L)	(Wp/Wnp)	(TE/GVA)	(L/F)	Dummy
		Coef. S.E. t P > [t]	0.261 (0.005) 51.748 0.000***	0.015 (0.006) 2.801 0.009***				
		R-Square-r^2 = 0.202 **F-Value =** 7.847 **(*p-value .009****)** **Excluded variables:** Wp/Wnp, TE/GVA, L/F, Dummy						

**** indicates significance at 1% level*
*** indicates significance at 5% level*
** indicates significance at 10% level*

It is evident from table – 1 that for the *aggregate manufacturing industry*, K/L and Wp/Wnp have significantly explained the change in NP/P ratio and rest of the explanatory variables are excluded from the model treating them as non-explanatory. The value of coefficient of K/L and Wp/Wnp is 0.015 and 0.216 and both are significant at 1% level. The value of R^2 being 0.649 shows goodness of fit of the model. Thus, the results of regression coefficients in case of β_1 and β_2 for *aggregate manufacturing industry* have significantly supported our hypotheses. The dummy variable has failed to explain the changes in NP/P.

The relative employment of non-production workers (NP/P) in industry 15 (*food products and beverages*) is influenced only by the size of organisation (L/F) and the dummy variable. Their respective coefficients are 0.002 and 0.017; both are significant at 1% and 5% levels

respectively. In industry 16 (*tobacco and tobacco products*), the outcome variable (NP/P) is significantly influenced by K/L, Wp/Wnp, L/F and dummy variable. The respective coefficients of the above explanatory variables are -0.216 (10% level), 0.173 (1% level), 0.0005 (1% level) and -0.029 (5% level). TE/GVA does not explain the variation in dependent variable. Here, K/L and dummy have contradicted the hypotheses but Wp/Wnp and L/F have supported the hypotheses. In industry 17 (*textiles*), the relative employment of the non-production workers is significantly influenced by L/F and the dummy. The value of β_4 and α_2 are -0.0003 and 0.012 respectively and both are significant at 1% level. β_4 contradicts while α_2 supports the hypothesis of the study.

In industry 18 (*wearing apparel, dressing and dyeing of fur*), the outcome variable is influenced by Wp/Wnp and L/F whose β coefficients are 0.062 and -0.0005. They are significant at 10% and 1% level respectively. The regression result of Wp/Wnp supports while that of L/F is contrary to our expectation in the hypothesis. The changes in NP/P in industry 19 (*leather industry*) are explained positively and significantly by two variables namely: Wp/Wnp and dummy. The coefficients of Wp/Wnp and dummy are 0.238 and 0.021 and both the coefficients are significant 1% and 5% level respectively. Both the coefficients have significantly supported the hypothesis. It may be noted with regard to industry 20 (*wood*) that changes in NP/P are significantly explained by three of the explanatory variables namely: K/L, Wp/Wnp and TE/GVA. The value of β_1, β_2 and β_3 are 0.072, 0.331 and 0.374 respectively. β_1, and β_2 are significant at 1% level, while β_3 is significant at 5% level. In this industry β_1, and β_2 have supported while β_3 has contradicted the hypothesis.

The β coefficient of Wp/Wnp in industry 21 (*paper and paper products*) is 0.134 at 1% level of significance which has supported our hypothesis. In industry 22 related to *publishing and printing etc.* the change in NP/P is explained only by K/L and dummy. β_1 coefficient is 0.081 which is significant at 1% level and the α_2 coefficient is 0.05 which is significant at 5% level. Both the coefficients have yielded the results favourable to the hypothesis. In industry 23 (*coke, refined petroleum products and nuclear fuel*), the changes in outcome variable NP/P are explained by Wp/Wnp and dummy. The β coefficient for Wp/Wnp is 0.266 which is significant

at 5% level and it supports the hypothesis while for dummy it is -0.043 which is significant at 10% level and it is contrary to the expectation.

The NP/P in industry 24 (*chemical and chemical products*) is influenced by K/L and L/F whose coefficients are 0.004 and -0.002 at 5% and 1% level of significance respectively. The K/L coefficient has supported while L/F coefficient has contradicted the hypothesis of the present study. For industry 25 (*rubber and plastic products*), the NP/P is depicted to be influenced by Wp/Wnp and dummy variable whose β coefficients are 0.262 and 0.037; both are significant at 1% level. The results of both the β coefficients have supported our hypotheses. For industry 26 (*other non-metallic mineral products*), the NP/P has been influenced by K/L and Wp/Wnp whose coefficients are 0.011 and 0.320. Both are significant at 1% level and support our hypotheses.

The outcome variable NP/P in industry 27 *(basic metal, alloys and metal products)* has not been explained by any of the explanatory variables and in industry 28 (*fabricated metal products*) the changes in outcome variable is explained only by relative wages (Wp/Wnp) whose coefficient is 0.374 at 1% level of significance. NP/P in industry 29 (*machinery and equipments n.e.c.*) is influenced by four explanatory variables viz K/L, Wp/Wnp, L/F and dummy. The β coefficient of K/L is 0.071 which is significant at 5% level; Wp/Wnp is 0.343 which is significant at 1% level; L/F is 0.008 which is also significant at 1% level and that of dummy is 0.087 which is significant at 5% level. The β coefficients of all the explanatory variables have supported the hypotheses of the present study.

The NP/P in industry 30 (*office accounting and computing machinery*) has been explained by two explanatory variables viz. Wp/Wnp and TE/GVA. The values of their β coefficients are 0.953 and -1.050; both are significant at 1% level and support our hypotheses. In industry 31 (*electrical machinery and apparatus n.e.c.*) the NP/P is explained only by Wp/Wnp whose coefficient is 0.375 which is significant at 1% level and it also supports our hypothesis. In industry 32 (*radio, television and communication equipment apparatus*) the NP/P is explained by two explanatory variables viz. Wp/Wnp and TE/GVA. Their β coefficients are 0.212 (significant

at 5% level) and -0.675 (significant at 1% level) respectively. Both the coefficients have supported the hypotheses of the present study.

For industry 33 (*medical precision and optical instruments, watches and clocks*), the NP/P is explained only by the dummy variable whose coefficient is 0.078 which is significant at 1% level. The NP/P in industry 34 (*motor vehicles, trailers and semi trailers*) has been explained by two explanatory variables viz. Wp/Wnp and TE/GVA. Their β coefficients are 0.204 and 0.097 which are significant at 1% and 5% respectively. The β coefficient of Wp/Wnp supports, while that of TE/GVA contradicts the hypothesis of the study. In industry 35 (*other transport equipment and parts*), the NP/P is influenced only by the average size of the organisation (L/F). It's β coefficient is -0.0003 which highly significant (1% level) and contrary to our expectation in the hypothesis. In industry 36 (*furniture; manufacturing n.e.c.*), the NP/P is explained only by the capital intensity (K/L). The value of its β coefficient is 0.015 which is highly significant (1% level) and it has also supported the hypothesis of the present study.

Table – 2: Summary Results of the Regression Model

S. No.	Dependent Variable $(NP/P)_t$	Explanatory Variables				
		$(K/L)_t$	$(Wp/Wnp)_t$	$(TE/GVA)_t$	$(L/F)_t$	Dummy
1.	**All Manufacturing Industry**	(+)***	(+)***	--	--	--
2.	Food Products and Beverages (15)	--	--	--	(+)***	(+)**
3.	Tobacco and Tobacco Products (16)	(-)*	(+)***		(+)***	(-)**
4.	Textiles (17)	--	--	--	(-)***	(+)***
5.	Wearing Apparel; Dressing and Dyeing of Fur (18)	--	(+)*	--	(-)***	--
6.	Leather and Leather Products (19)	--	(+)***	--	--	(+)**
7.	Wood and Wood Products (20)	(+)***	(+)***	(+)**	--	--
8.	Paper and Paper Products (21)	--	(+)***	--	--	--
9.	Publishing, Printing and Reproduction of Recorded Media (22)	(+)***	--	--	--	(+)**
10.	Coke, Refined Petroleum Products and Nuclear Fuel (23)	--	(+)**	--	--	(-)*
11.	Chemical and Chemical Products (24)	(+)**	--	--	(-)***	--
12.	Rubber and Plastics Products (25)	--	(+)***	--	--	(+)***
13.	Other Non-metallic Mineral Products (26)	(+)***	(+)***	--	--	--
14.	Basic Metal (27)	--	--	--	--	--
15.	Fabricated Metal Products, except Machinery and Equipments (28)	--	(+)***	--	--	--
16.	Machinery and Equipment n.e.c. (29)	(+)**	(+)***	--	(+)***	(+)**
17.	Office Accounting and Computing Machinery (30)	--	(+)***	(-)***	--	--
18.	Electrical Machinery and Apparatus n.e.c.	--	(+)***	--	--	--

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2394-3130 electronic ISSN

	(31)					
19.	Radio, Television and Communication equipment apparatus (32)	--	(+)**	(-)***	--	--
20.	Medical Precision and Optical Instruments, Watches and Clocks (33)	--	**--**	--	--	(+)***
21.	Motor Vehicles, Trailers and Semi-trailers (34)	--	(+)***	(+)**	--	--
22.	Other Transport Equipment (35)	**--**	**--**	--	(-)***	--
23.	Furniture; Manufacturing n.e.c. (36)	(+)***	**--**	--	--	--
	Total (+) **(-)**	**6/22** **1/22**	**14/22** **Nil**	**2/22** **2/22**	**3/22** **4/22**	**7/22** **2/22**

**** indicates significance at 1% level*
*** indicates significance at 5% level*
** indicates significance at 10% level*

5. Summary and Conclusion

The analysis of the results of the above model may be summarised as follows:

- In case of *aggregate manufacturing industry* the NP/P is positively and significantly (1% level) influenced by K/L and Wp/Wnp which has supported hypotheses i) and ii). The dummy variable has failed to explain the changes in NP/P.
- The explanatory variable K/L has positively influenced the NP/P at 1% level of significance in case of four industries. These are industries related to NIC code 20, 22, 26 and 36. It is positive and significant at 5% level in case of industry 24 and 29. The results of six out of twenty two industries have supported hypothesis i) of the study.
- Contrary to our expectation the regression coefficient of K/L in case of industry 16 has negatively influenced the NP/P, but only at the 10% level of significance.
- Wp/Wnp being the second determinant in the model has positively determined the NP/P in case of eleven industries at 1% level of significance which have strongly supported our hypothesis ii). These industries are related to NIC code 16, 19, 20, 21, 25, 26, 28, 29, 30, 31 and 34. Two industries viz. code 23 and 32 have supported the hypothesis at 5% level and one industry viz. code 18 at 10% level of significance. The results of fourteen out of twenty two industries have supported hypothesis ii) of the study.
- TE/GVA has impacted the changes in NP/P in an inverse manner only in case of two industries viz. code 30 and 32 at 1% level of significance supporting hypothesis iii) of the study. Two industries viz. code 20 and 34 have been influenced positively at 5% level of significance contradicting hypothesis iii).
- The regression coefficients of L/F have supported our hypothesis iv) in case of three industries viz. NIC code 15, 16 and 29, while the same has been contradicted in case of four industries viz. code 17, 18, 24 and 35. All coefficients are significant at 1% level.

- The dummy variable has explained changes in NP/P in positive manner in case of three industries viz. code 17, 25 and 33 at 1% level of significance and four industries viz. code 15, 19, 22 and 29 at 5% level of significance, thus supporting hypothesis v) of the study. The dummy has negatively influenced NP/P in case of two industries viz. code 16 at 5% level and code 23 at 10% level of significance. Thus the behaviour of dummy variable has supported hypothesis v) in case of seven out of twenty two industries.

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