Changes in Skill Intensity in Indian Manufacturing Industry: Some Important Determinants

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Abstract. The formulation and adoption of a new economic policy during the year 1991 which mainly focused on privatisation of Public Sector Undertakings (PSUs), liberalisation of regulations relating to trade, industries and globalisation of the Indian economy can be said to have facilitated the increased control of owners of capital over the production processes through their representatives, the managers, professionals and technocrats. This process has necessitated the change in 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 factors which might have acted as important determinants of changes in the demand for non-production workers or skilled workers in Indian manufacturing industries. For this purpose the multiple correlation coefficients was computed between NP/P (dependent variable) on the one hand and various explanatory variables on the other. 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, Correlation coefficient

1 Introduction

The main objective of the firm is to maximise profit, which creates a fundamental conflict of interest between labour and the owners of capital. In order to maximise the potential of labour and maximise profit, the owners of capital have to exercise effective control over the process of production because of this inherent conflict of interest. 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 (Seth, 2002). The formulation and adoption of a new economic policy during the year 1991 which mainly focused on privatisation of Public Sector Undertakings

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(PSUs), liberalisation of regulations relating to trade, industries and globalisation of the Indian economy can be said to have facilitated the increased control of owners of capital over the production processes through their representatives, the managers, professionals and technocrats. This new regime 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. 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. The scholar in her study has also found that 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 chapter 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, some important hypotheses have been formulated and discussed in section – 3. Section – 4 of the paper discusses important statistical results followed by summary and conclusion in section – 5.

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.[2]

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. The workers in ASI framework consist both of *directly employed workers* including men, women and children as well as the *workers employed through contractors*. The workers in ASI framework (Factories Act, 1948) are defined as the persons employed directly or through any agency whether for wages or not and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process or in any other kind of work incidental to or connected with the manufacturing process or the subject of the manufacturing process. Labour engaged in the repair and maintenance or production of fixed assets for factory's own use or

[1] In the present paper non-production workers have been treated as skilled workers.
[2] The concordance up to NIC-1998 has already been done by the EPWRF data series and in NIC-2004 the change is not very significant at the 2- digit level so concordance is not that complicated.

labour employed for generating electricity or producing coal, gas etc. are included. Number of workers represents the average daily employment.[3] This category of workers is known as production workers (P) in the U.S. system of manufacturers. Thus, the non-production category of workers (NP) in the U.S. system of manufacturers or the category of 'other than workers' in ASI framework is a residual category which by implication includes those workers which have not been included in the category of workers in strict sense of the term. The other than workers in the ASI framework consists of supervisors, managers and other employees which may refer to technocrats and other support staff related to sale, purchase, credit, finance, store, security, cafeteria, legal, medical and R&D facilities. In order to capture changes in relative demand for non-production workers (skilled workers) in the Indian manufacturing industries the present paper has used ratio of non-production to production workers (NP/P) as computed by the author as an indicator of skill intensity (Singh, 2010; 2015).

In order to study the important determinants of variation in the structure of manpower in Indian manufacturing industries; the industries at the *two digit level* belonging to NIC code 15 to 36 and the *aggregate manufacturing industry* have been considered as sample.[4] These industries are listed in Table – 1.

Table – 1: Sample of Industries

S. No.	**Industries (NIC-Code)**
1.	Food Products & Beverages (15)
2.	Tobacco Products (16)
3.	Textiles (17)
4.	Wearing Apparel; Dressing & Dyeing of Fur (18)
5.	Tanning & Dressing of Leather, Footwear etc. (19)
6.	Wood and Wood Products (20)
7.	Paper and Paper Products (21)
8.	Publishing, Printing & Recorded Media (22)
9.	Coke, Refined Petroleum & Nuclear Fuel (23)
10.	Chemical and Chemical Products (24)
11.	Rubber and Plastic Products (25)
12.	Non-Metallic Mineral Products (26)

[3] Average daily employment is computed by dividing total man-days worked during a year by the total number of working days during the year. Man-days are obtained by summing-up the number of workers attending in each shift over all the shifts worked on all days. Thus, the number of workers is based on actual attendance and not on physical number of persons on roll (Uchikawa, 2003).

[4] NIC 37= Recycling has been added to the ASI from the year 1998-99 only, so it has been left out in order to maintain consistency.

13	Basic Metals (27)
14.	Fabricated Metals except Machinery (28)
15.	Machinery and Equipment n.e.c. (29)
16.	Office, Accounting & Computing Machinery (30)
17.	Electrical Machinery & Apparatus n.e.c**.** (31)
18	Radio, Television & Communication Equipments (32)
19.	Medical, Precision & Optical Instruments, Watches & Clocks (33)
20.	Motor Vehicles & Trailers etc**.** (34)
21	Other Transport Equipment (35)
22.	Furniture & Manufacturing n.e.c. (36)
23.	**Aggregate Manufacturing Industry**

Note: The figures in parentheses indicate the NIC code 2004.

The different explanatory variables which are expected to explain inter-temporal and inter-industry variations in the NP/P ratio[5] and which have been used in this study are capital intensity (K/L), ratio of the prices of two labour inputs i.e. ratio of wages production and non-production workers (Wp/Wnp), ratio of pay rolls to value added (TE/GVA) and average size of the organisation (L/F). These factors have earlier been identified as important determinants of the NP/P ratio and have been discussed by scholars like Rostas (1948), Delehanty (1968), Gujarati and Dars (1972), Goldar and Seth (1975), Seth and Bhasin (1978) and Bhasin and Seth (1980). Besides the above explanatory variables, a dummy variable has also been incorporated in the regression equation in order to capture the effect of economic reforms on the variation in NP/P ratio.

The K/L has been computed as a ratio of fixed capital to total employees. Wp/Wnp shows the ratio of the wages of production workers and non-production workers[6]. After computing total wages for production and non-production workers (in Rs. Lakh) separately, for each two categories of employees in each of two-digit industries, the same has been divided by the respective total number of production and non-production workers. This exercise gives average annual wage rate for each category of workers i.e. Wp and Wnp (in Rs). Finally, Wp/Wnp is obtained by simply dividing the former by the latter. TE/GVA is the ratio of total emoluments to gross value added and L/F is the ratio of total employees to total number of factories in the ASI manufacturing at 2- digit level.

[5] In the present paper NP/P has been treated as dependant variable.

[6] In ASI data the wages of non-production workers are not separately reported so it has been computed as the difference between total emoluments to employees and wages to production workers. Although this computation has a minor limitation but the same is neutralized when the variables are taken in form of ratio i.e. Wp/Wnp= Wp/TE – Wp. The same methodology has been used by Mitra and Ural (2007); Mathur and Mishra (2007); Ramaswami (2008).

The adoption of structural adjustment programme during the year 1991 and thereafter polarised the scholars into protagonists and antagonists of the various reform measures and their likely impact on the generation of employment. Very few scholars have discussed the impact of these reform measures on the demand for and other possible determinants of these two groups of workers viz. *non-production (NP) and production workers (P)* in different industries in the organised manufacturing sector. It should be recognised that the demand for various categories of workers is a derived demand, so there may be several factors other than policy regime that influence employment potential of a particular category of worker in an industry or sector. The various measures adopted for economic reforms affect the pattern of such demand via affecting these various fundamental factors determining the pattern in the short and long run.

Seth and Aggarwal (2004) have suggested that from the formal theories of the firm and industrial organisation, one can identify several variables which can be used to explain inter-temporal and inter-industry variations in the demand for non-production and production workers which in turn influence the NP/P ratio. These variables may be differences in production function between the industries, the organisational differences, differences in the scale and size of typical firms, and market structure of the industry.

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[7]. 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).

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

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. 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 can not, 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. Statistical Analysis

In the present paper it has been considered necessary to observe the nature and degree of correlation between NP/P (dependent variable) on the one hand and its different explanatory variable on the other. The said correlation coefficients have been computed and presented in table – 2.

Table – 2: Correlation between NP/P (Dependent Variable) and Different Independent Variables (1973-74 to 2005-06)

S. No.	Dependent Variable (NP/P)	Explanatory Variables			
		K/L	Wp/Wnp	TE/GVA	L/F
	All Manufacturing Industry	0.564***	-0.008	-0.616***	-0.576***

1.	Food Products and Beverages (15)	-0.004	0.201	0.046	0.452***
2.	Tobacco and Tobacco Products (16)	-0.399**	0.527***	0.176	-0.200
3.	Textiles (17)	0.870***	-0.152	-0.845***	-0.925***
4.	Wearing Apparel; Dressing and Dyeing of Fur (18)	-0.768***	0.742***	0.194	-0.843***
5.	Leather and Leather Products (19)	-0.197	0.678***	0.003	0.001
6.	Wood and Wood Products (20)	0.157	0.313*	0.088	-0.014
7.	Paper and Paper Products (21)	0.017	0.716***	0.186	-0.135
8.	Publishing, Printing and Reproduction of Recorded Media (22)	0.925***	-0.671***	-0.878***	-0.478***
9.	Coke, Refined Petroleum Products and Nuclear Fuel (23)	-0.307*	0.391**	0.215	0.045
10.	Chemical and Chemical Products (24)	0.746***	-0.098	-0.661***	-0.780***
11.	Rubber and Plastics Products (25)	0.255	0.480***	-0.322*	-0.049
12.	Other Non-metallic Mineral Products (26)	0.349**	0.514***	-0.359**	-0.439**
13.	Basic Metal (27)	0.018	-0.111	0.094	-0.039
14.	Fabricated Metal Products, Except Machinery and Equipments (28)	0.136	0.659***	-0.262	-0.130
15.	Machinery and Equipment n.e.c. (29)	0.421**	0.431**	-0.304*	0.304*
16.	Office Accounting and Computing Machinery (30)	0.063	0.240	-0.420**	-0.242
17.	Electrical Machinery and Apparatus n.e.c. (31)	-0.535***	0.910***	0.326*	0.383**
18.	Radio, Television and Communication Equipment Apparatus (32)	0.446***	-0.134	-0.817***	-0.575***
19.	Medical Precision and Optical Instruments, Watches and Clocks (33)	0.582***	-0.017	0.079	0.560***
20.	Motor Vehicles, Trailers and Semi-trailers (34)	-0.509***	0.785***	0.450***	-0.028
21.	Other Transport Equipment (35)	0.513***	-0.377**	-0.531***	-0.667***
22.	Furniture; Manufacturing n.e.c. (36)	0.449***	-0.070	-0.120	0.266

Note: (1) Figures in parentheses are the NIC code of the respective industries

*(2) *** indicates significance at 1% level*

*** indicates significance at 5% level*

** indicates significance at 10% level*

According to hypothesis i) of the present study, there exists a positive relationship between K/L and the NP/P ratio. In other words, the sign of correlation coefficients between the above two variables is expected to be positive. It may be observed from table 5.1 that in case of *aggregate manufacturing industry* the correlation coefficient between the two variables is not only positive (0.564) but it is also significant at 1% level.

As far as individual industries at the 2-digit level are concerned, the sign of correlation coefficient is positive as expected, in industries 17, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 32, 33, 35 and 36 (15 out of 22). The correlation coefficient is significant at 1% level (highly significant)

in case of industries 17 (*textiles*), 22 (*publishing, printing and reproduction of recorded media*), 24 (*chemical and chemical products*), 32 (*radio, television and communication equipment and apparatus*), 33 (*medical, precision and optical instruments, watches and clocks*), 35 (*other transport equipments*) and 36 (*furniture; manufacturing n.e.c.*). The correlation coefficient is significant at 5% level (moderately significant) in case of industries 26 (*other non-metallic mineral products*) and 29 (*machinery and equipment n.e.c.*). There are six industries which have exhibited non-significant positive correlation coefficient between the two variables. These are industries 20 (wood and wood products), 21 (*paper and paper products*), 25 (*rubber and plastic products*), 27 (*basic metal*), 28 (*fabricated metal products, except machinery and equipments*) and 30 (*office accounting and computing machinery*).

The highest and lowest positive correlation coefficients are found to be 0.925 and 0.017, in case of industries 22 (*publishing, printing and reproduction of recorded media*) and 21 (*paper and paper products*) respectively. The former was significant at 1% level, while the latter was non-significant.

A negative correlation is found in case of industries 15, 16, 18, 19, 23, 31, and 34 (07 out of 22) which is against our hypothesis. Out of these industries, correlation in industries 18 (*wearing apparel; dressing and dying of fur*), 31 (*electrical machinery and apparatus n.e.c*.) and 34 (*motor vehicles, trailers and semi-trailers*) are highly significant (1% level). For industry 16 (*tobacco and tobacco products*), it is moderately significant (5% level) and in industry 23 (*coke, refined petroleum and nuclear fuels*), it is significant at 10% level. Industries 15 (*food products and beverages*) and 19 (*leather and leather products*) have depicted negative but non-significant value of correlation coefficient.

The highest and the lowest negative correlation coefficient between NP/P and K/L are -0.768 and -0.004 in case of industries 18 (*wearing apparel; dressing and dying of fur*) and 15 (*food products and beverages*) respectively. The former was significant at 1% level while the latter was non-significant.

According to hypothesis ii), Wp/Wnp and NP/P ratio is also expected to be positively related. It may be observed from table 5.1, that in case of aggregate manufacturing industry the

correlation coefficient between the two variables is negative but non-significant (-0.008).[8] As far as individual industries are concerned, the positive association between the two variables is noticed in fourteen industries viz.15, 16, 18, 19, 20, 21, 23, 25, 26, 28, 29, 30, 31 and 34 out of which correlation coefficient in nine industries viz.16, 18, 19, 21, 25, 26, 28, 31 and 34 are significant at 1% level where as correlation in industries 23 and 29 are found to be significant at 5% level. There is only one industry related to *wood* (20) where the correlation coefficient is significant at 10% level. Two industries viz. 15 and 30 have depicted non-significant positive correlation coefficient.

The highest and the lowest positive correlation coefficient are observed in case of industries 31 (*electrical machinery and apparatus n.e.c.*) and 15 (*food products and beverages*) for which the value of coefficients are 0.910 and 0.201 respectively. The former is significant at 1% level while the later shows insignificant value of coefficient. Negative correlation coefficient has been found in eight industry groups viz. 17, 22, 24, 27, 32, 33, 35, and 36. Among these industries, significant correlation has been found only in industry 22 (1% level) and 35 (5% level). The highest and the lowest value of negative correlation coefficients are -0.671 and -0.017 for industry 22 (*publishing, printing and reproduction of recorded media*) and 33 (*medical, precision and optical instruments, watches and clocks*) respectively. The former is significant at 1% level, while the latter shows a non-significant correlation coefficient.

Hypothesis iii) states that TE/GVA and NP/P ratio are negatively related in case of labour-intensive and positively related in case of capital-intensive industries. The correlation coefficient between TE/GVA and NP/P ratio in case of *aggregate manufacturing industry* is found to be negative (-0.616) and highly significant (1%). For individual industries the correlation coefficients are negative in case of eleven industries viz. industry 17, 22, 24, 25, 26, 28, 29, 30, 32, 35 and 36. Industry 17, 22, 24, 32 and 35 have shown significant correlation at 1% level, while in industry 26 and 30, it is significant at 5% level. In industry 25 and 29, it is significant at 10% level. In industry 28 and 36, the coefficient of correlation is non-significant.

Out of the above nine industries in which correlation coefficients are negative and significant; industry 24 (manufacture of chemicals and chemical products), 25 (rubber and

[8] Convincingly it can not be said that the outcome has contradicted our expectation. The picture will become clear if such correlations for individual industries are also studied.

plastic products), 26 (other non-metallic mineral products), 30 (office, accounting and computing machinery) and 32 (radio, television and communication equipment and apparatus) are capital intensive. Here, the sign of correlation is contrary to general expectation, while the remaining four belong to labour intensive group of industries. Here, the sign of correlation coefficient is as per our expectation.

The highest and the lowest negative correlation coefficient is found in case of industries 22 (publishing, printing and reproduction of recorded media) and 36 (*furniture; manufacturing n.e.c.*); the value of coefficients being -0.878 and -0.120 respectively. The positive correlation coefficients between TE/GVA and NP/P are noticed in case of eleven industries viz. 15, 16, 18, 19, 20, 21, 23, 27, 31, 33 and 34. Only industry 34 and 31 have shown significant correlation coefficient at 1% and 10% level respectively; rest of them are statistically non-significant. The highest and lowest positive correlation between the two variables has been depicted in industry 34 and 19 respectively. The former is significant at 1% level, while latter is non-significant. In hypothesis iv) it has been assumed that L/F and NP/P are positively related. A perusal of column 6 of table 5.1 shows negative correlation coefficient for the *aggregate manufacturing industry*. Its value of coefficient is -0.576, which is significant at the 1% level. This result is contrary to our expectation in the present hypothesis.

The positive relationship between the two variables has been found in seven industries. These are industries 15, 19, 23, 29, 31, 33 and 36. The correlation is significant at 1% level only in industry 15 and 33, whereas correlation coefficients in industries 31 and 29 are significant at 5% and 10% levels respectively. The highest and the lowest positive correlation coefficients are found in industries 33 *(medical, precision and optical instruments, watches and clocks)* and 19 *(leather and leather products)* for which coefficient values are 0.560 and 0.001. The former is significant at the 1% level while the latter shows almost negligible and non-significant coefficient of correlation. The negative correlation coefficients are found in fifteen industries viz.16, 17, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, 32, 34 and 35. The correlation coefficient is significant at 1% level for the industries 17, 18, 22, 24, 32 and 35 and 5% level for industry 26. The remaining industries have depicted non-significant coefficients of correlation.

The highest and the lowest values of negative correlation coefficients are found in industries 17 *(textiles)* and 20 *(wood and products of wood)* for which correlation coefficients are -0.925 and -0.014 respectively. The former is significant at 1% level while latter is non-significant.

5. Summary and Conclusion

The formulation and adoption of a new economic policy during the year 1991 which mainly focused on privatisation of Public Sector Undertakings (PSUs), liberalisation of regulations relating to trade, industries and globalisation of the Indian economy can be said to have facilitated the increased control of owners of capital over the production processes through their representatives, the managers, professionals and technocrats. In the ASI framework these catgory of employees are known as non-production workers. An attempt was made in this paper to identify those factors which might have acted as important determinants of changes in the demand for non-production workers or skilled workers in Indian manufacturing industries at the 2-digit level. For this purpose the multiple correlation coefficients was computed between NP/P (dependent variable) on the one hand and various explanatory variables on the other.

The different explanatory variables which are expected to explain inter-temporal and inter-industry variations in the NP/P ratio[9] and which have been used in this study are capital intensity (K/L), ratio of the prices of two labour inputs i.e. ratio of wages production and non-production workers (Wp/Wnp), ratio of pay rolls to value added (TE/GVA) and average size of the organisation (L/F) 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 also 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 was observed in the above analysis of correlation results that:

- Hypothesis i) is supported by positive sign of correlation in fifteen industries. The correlation coefficients between variables are statistically significant for nine industries supporting the hypothesis of positive relationship between K/L and NP/P. The correlation result of *aggregate manufacturing industry* is also rightly signed and significant at 1% level.

[9] In the present paper NP/P has been treated as dependant variable.

- Hypothesis ii) is supported by positive sign of correlation in fourteen industries. The correlation coefficients between variables are statistically significant for twelve industries supporting the hypothesis of positive relationship between Wp/Wnp and NP/P. For *aggregate manufacturing industry* the correlation sign is contrary to our expectation, but its coefficient is non-significant.

- In hypothesis iii), eleven industries depict negative sign of correlation, out of which nine are statistically significant. Eleven industries yield positive sign of correlation coefficient. For two of them it is found to be statistically significant. Thus, on the whole it can be said that negative correlation sign yielded in case of nine industries has significantly supported our hypothesis. The correlation sign of *aggregate manufacturing* is also rightly signed and significant.

- As far as the size of organisation (L/F) and NP/P ratio are concerned (hypothesis iv) the correlation sign in seven industries supports our hypothesis that these two variables are positively related. Among these seven industries, coefficients of four are statistically significant. Rests of the industries depict the sign which is contrary to our expectation. Negative correlation coefficients have been significant in case of seven industries. Thus, four industries have significantly supported our hypothesis. The existence of negative sign in case of *aggregate manufacturing industry* has also significantly contradicted our hypothesis. Thus, the relationship between size of an organisation (L/F) and Skill intensity (NP/P) is found to be ambiguous.

To conclude, it may be stated 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. It should further be noted that the changing composition of workers in a particular industry or the whole industrial sector has an important bearing on the level of output, employment and industrial relations.

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