International Journal of Applied Research 2016; 2(1): 735-743

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(1): 735-743
www.allresearchjournal.com
Received: 24-11-2015
Accepted: 27-12-2015

Dr. Tanu Kathuria
Ph.D., Economics, Jawaharlal Nehru University, New Delhi, Economic Officer, NITI Aayog (erstwhile Planning Commission), Govt. Of India

Correspo ndence
Dr. Tanu Kathuria
Ph.D., Economics, Jawaharlal Nehru University, New Delhi, Economic Officer, NITI Aayog (erstwhile Planning Commission), Govt. Of India

Productivity and wages in Indian manufacturing sector: Spatial variation and determinants

Dr. Tanu Kathuria

Abstract
The objective of this paper is to examine changes in productivity in the Indian organized manufacturing sector at regional level and explore its linkage with wages. We use Annual Survey of Industries data since 1980/81 to 2009/10 to analyse the growth and changes in organised manufacturing at two-digit level.

Although being one of the most populous countries in the world, India only has 39.2 percent of total working population out of which 42 percent comes from rural India. Also, out of the total workers, male workers which constitute the major part i.e. around 52 percent (Census of India, 2001). Two digit level industry wise comparative growths have been sluggish in the post reform period for majority of unregistered sector and vice versa for the registered sector (Report on Small Scale Industries Sector, 2000, SIDBI).

During this period, large investments were made in building up capacity over a wide spectrum of industries with a view to achieve rapid industrialization. This rapid stride in industrialization was accompanied by a corresponding growth in technological and managerial skills not only for efficient operation for highly complex and sophisticated enterprises, but also for their planning, design and construction. In this era, industrial competitiveness has taken the center stage of policy discussions in India. Unit labour costs are used to measure the competitiveness because it is felt that wages form a major component of the fixed cost and hence directly impact the profitability. There observed considerable variations in the wage rate and labour productivity across the different sub-sectors of the Indian Industry. The analyses of labour productivity, total factor productivity and real wages show that growth of real wages is not uniform across industries and there are large disparities across states. Calculations of partial and total factor productivity for the sub-periods also reveal marked inter-temporal differences in the growth rate. Finally, I find that TFP and labour productivity have a stronger influence on wages along with factors like skill, size and capital-labour ratio.

Keywords: Productivity, Translog-Divisia index, Annual Survey of Industries, Coefficient of Variation, Organized Manufacturing.

Introduction
India is ranked among the ten most industrialized countries in the world[1] and at the same time is also home to one third of worlds poor[2]. The pattern of industrialization impacts on how the masses benefit from the growth via higher wage earnings from the industrial sector. Pro-poor economic and industrial policies focus on increasing the economic returns to the productive factors that the mass possesses, e.g. raising returns to unskilled labour, whereas policies promoting higher returns to capital and land tend to increase inequality.[3] Also the location of industrial facilities has an impact on poverty reduction and inequality. As enterprises tend to concentrate in the urban areas because of ready access to skilled labour force, better infrastructure, larger markets and technological spillovers (Lanjouw and Lanjouw, 2001), industrialization may increase inequality between urban and rural areas. But as industrialization proceeds on a large and diversified scale, inter-regional competition to attract investment among the regions would tend to increase. Therefore, Industrial growth

[1] Business Standard Reporter/ New Delhi March 30, 2011. And also, India is now one of the top 10 industrial nations of the world and has also withstood the financial recession with a growing trend of productivity in its manufacturing industries, according to a report by the United Nations Industrial Development Organisation (Unido).
[2] "India – New Global Poverty Estimates". World Bank.
[3] Use of capital intensive methods instead of labour intensive ones tends to increase income disparities, as does the employment of skill-biased technologies.

and structure at the regional level becomes important indicators of regional development. Significant degree of industrialization, thus, is important to transform social and economic conditions within the regions.

Like other large economies in the world, the federal structure in India is organised around clearly defined geographical areas into State and Union Territories (UTs). While the UTs are administered directly by the federal government, States enjoy a degree of autonomy in shaping development policies including fostering industrial development. But independent India inherited a backward and regionally imbalanced economy reflecting the distorted pattern of development imposed by the colonial power to sub-serve its own interest. Hence, there were marked disparities in economic and industrial development at the state level. Later the industrial development, in India, underwent fundamental changes from early 1980s with the first round of (mild) liberalization. The new economic policies initiated since 1991 provided further stimulus for industrial growth and many state governments have come out with proactive policies for promoting investment in the manufacturing sector. How far these policy changes have helped in raising standard of living at the state level, therefore, needs to be examined. The primary purpose of industrialization is to raise the standard of people of a given country or region : "reducing the real cost per unit of producing goods and services", as Hughes would have put it; or "increased real income per capita", as Moore would have defined it. Accordingly the per capita income is assumed as the output, or dependent variable, of industrialization, or operationally, of the growth of manufacturing industry. Technological progress accompanying industrialization, then leads to larger components of skills in the industrial work force that have a wider applicability while studying their wage patterns or share. Thus since industrialisation impacts return to labour, we need to identify the factors that affect wages of industrial workers. There are two lines of argument that has been advanced to explain the rise in wages of the industrial workers. There are several researchers who have argued that the changes in wages and salaries often have no relation with productivity and wages thus do not function as an instrument that induces efficiency. Rather relative strength or weakness of the collective bargaining agents, rise in consumer price index, the minimum wage legislation etc. are considered as possible determinants of wages [4].

Krueger and summers (1986) and Dickens and Katz (1986) suggest that there are strong regularities in the pattern of industrial wages. It seems that more profitable industries, those with more monopoly power, and smaller labour's share, pay higher wages. The regularities appear to be statistically significant and hold at different times and places, and account for a fairly large fraction of inter-industry wage variations. The role of Unions in wage determination has also been stressed by many researchers. William (1985) argues that varying costs of union avoidance across sectors will lead some firms to offer pay premiums to avoid unionization. Firms that find it costly to defeat a union will offer supers-competitive wages to prevent unionization. According to this theory, the ease with which an industry can defeat a union drive has a negative relationship with its wage differential. The testable implication of Dickens' model is that inter-industry wage variability should be low where the threat of unionization is low. Inter-industry wage differentials results from varying degrees of union bargaining power across industries. If the industry wage differentials are due to "strong" unions that can raise wages without suffering severe employment losses in certain industries, one would expect to find less variability in wages across industries for non-union workers. The other line of argument supports the fact that changes in wages and salaries often have a relationship with productivity and thus wages becomes an instrument that induces efficiency. There are several studies that have recognised that productivity plays an important role in determining the effective wage rate prevailing in the state i.e. whether the labour force is paid as per their contribution in value added. Madan (1971) found a gradual, though uneven, rise in real wages of organized industrial labour over the period (1951-70), the money earnings increased at the rate of 4.1% while the real earnings increased only at the rate of 1.6%. A study by the Central Statistical Organization (CSO) indicates that wages at current prices increased 2-3 folds in basic, capital and intermediate goods industries in the factory sector during 1960-77. Jose (1992) has looked at the trends in productivity and earnings of employees in 19 organized industry groups during 1970s and 1980s. He suggests that during the 1970s there has been relative stagnation or even decline in productivity levels in a number of industries whereas during 1980s there came about a sharp acceleration in productivity, which was quite conspicuous in the high wage industry. Thus various studies on determinants of wages in India finds that the growth in wages are influenced by number of factors like productivity, the collective bargaining agents, rise in consumer price index, the minimum wage legislation etc.. In this paper we investigate how the determinants of wages vary across states and how far wages are affected by productivity at state level. Rest of the paper is organised in the following fashion. In section 2, we discuss briefly the data and methodology used in the analyses in this paper. The growth and variation of the wages are discussed in section 3 and productivity in section 4. In section 5, the wage-productivity relationship is examined. Section 6 summarises the findings.

2. Data Sources and Methodology

As stated above, in this paper we investigate the relationship between productivity and wages in the organised manufacturing sector across Indian states. We use wages, and estimate labour productivity and total factor productivity for the period 1980-81 to 2009-10 and the interrelationship among these. The period is divided into two sub-periods, 1980-81 to 1990-91and 1991-92 to 2009-10 to see the impact of reforms that were initiated in 1991 as it resulted in several changes key changes for fostering manufacturing sector.

In this paper we use data on Indian organised manufacturing sector at two-digit level of Indian Industrial classification codes (called National Industrial Classification, NIC). The geographical coverage in this paper is for sixteen major states that have roughly over 95% of Indian population and geographical area.[5] These data are compiled in the Annual Survey of Industries (ASI) collected by the Central Statistical Organization of Indian Government. We use the unit record

[4] Fallon and Lucas (1991) in their study of manufacturing industries of India argue that industrial wages had grown significantly relative to consumer prices of industrial workers during 1960s and 1970s. Lucas (1988) has argued that real product wage in manufacturing steadily increased by about 86% between 1960-61 and 1979-80 and much of the wage increase could be attributed to the prevalence of trade union militancy, minimum wage legislation and job security laws.

[5] List of States included in the analyses is reported in Appendix 1.

data that has details on output, and inputs for each firm in the data base. We use data on gross value added (GVA) of the industries as a measure of output. GVA is deflated by industry specific wholesale price indices (WPI) to make it in real terms.[6] The deflator is obtained from Office of the Economic Adviser (OEA), Ministry of Commerce and Industry, Government of India (http://eaindustry.nic.in/). The raw materials series is deflated by all-commodities WPI. The capital data is deflated by a capital deflator, which is obtained from the "Handbook of statistics on the Indian economy" published by Reserve Bank of India (RBI). In addition to the GVA, other variables taken from the ASI data are, number of workers, total persons engaged, wages paid to workers, invested capital and gross fixed capital formation.

We use the following explanatory variables for the analysis in this paper. These are labour productivity (LP), defined as output per unit of labour input., Managerial Skill proxied by % share of employees to total persons engaged, Industry Size proxied by total capital K= [(1-0.07) * GFCF (t-1)+IC(t)], where, GFCF(t-1) is Gross Fixed Capital formation in previous year, IC is invested capital in current year and Depreciation rate is considered to be 7% annually (0.07).[7]

The total factor productivity (TFP) is estimated using Theil-Törnqvist Index or the Translog-Divisia index which is a discrete approximation to the Divisia index of technical change.

The index at two time periods, *s* and *t*, can be defined as:

$$ln\frac{TFP_t}{TFP_s} = lnTFP_t - \ln TFP_s$$
$$= \frac{1}{2}\sum_{i=1}^{N}(w_{is} + w_{it})(ln\, y_{it} + \ln\, y_{is}) - \frac{1}{2}\sum_{j=1}^{k}(\gamma_{js} + \gamma_{jt})(ln\, x_{jt} + \ln\, x_{js}) \quad (2.1)$$

Where the y's and x's are the values of output and input, and the w's and γ's are shares of outputs and inputs, respectively. For the labour input, γ is wages paid to workers, and for the capital input, it is the income earned by capital.

More specifically, for the two-input case, taking value added as output, and labor and capital as inputs, the Translog index of TFP growth can be given by the following equation:

$$\Delta \ln TFP(t) = \Delta \ln Y(t) - [\frac{SL(t)+SL(t-1)}{2} \times \Delta \ln L(t)] - [\frac{SK(t)+SK(t-1)}{2} \times \Delta \ln K(t)] \quad (2.2)$$

In the above equation, Y is taken as output; L denotes labour and K denotes capital. SL is income share of labour and SK denotes income share of capital. Δ ln Y(t) is defined as the difference between the output at two time periods i.e. Δ ln Y(t) = ln Y(t) – ln Y(t-1). In the same way income share of labour and capital i.e. Δ ln L(t), and Δ ln K(t) are defined. SK and SL add up to unity. Δ ln TFP is the rate of technological change or the rate of growth of TFP.

In addition, the indexes of labour and capital productivity growth have been generated using the annual growth rates (*g*) of these variables. A value of 100 has been assigned to initial year and for successive years, following formula has been used.

$Index_t = Index_{t-1} \times (1+g_t)$ (2.3)

Growth rate of wages for the sub period is calculated by fitting an exponential curve. The growth rates of partial and total factor productivity have been calculated using the following semi-log equation which takes the form

$$\log TFPI_t = \emptyset + \gamma t + \varepsilon \quad (2.4)$$

where, $TFPI_t$ represents total factor productivity index at time period *t* and ε is the white noise error term. The average annual growth rates for the period 1980-81 to 2005-06 have been obtained as $\lambda \times 100$.

3. Growth and Inter-state Variation in Wages

The Indian manufacturing sector is classified into two broad categories, organised and unorganised sectors. Firms in both the sectors can be identified at different level of disaggregation, by NIC codes at the level of industry and at the state level by location. We here provide a synoptic view of the manufacturing sector and its two components, viz. organized and unorganized manufacturing in India's real GDP. It can be seen from Table 1 that the average share of manufacturing sector in real GDP increased from about 13 per cent during 1970-75 to about 15.1 per cent during 2000-05, i.e., approximately by just about 2 percentage points over a period of more than three decades. During 1970-75, India's real GDP of manufacturing sector was more or less equally distributed between its organized and unorganized segments. Over the years, the growth of real income in the organized manufacturing has been higher than that of unorganized manufacturing sector, resulting in the average contribution of the unorganized sector shrinking to almost half of that of the organized sector during 2000-05. Kochhar *et al*. (2006) demonstrate that given the per capita GDP and size of India, the share of manufacturing sector in GDP was in conformity with the stylised growth pattern of other countries. RBI, DGR 2011 points out that the share of organised sector in total employment generation of manufacturing sector is just about one-fifth. This when put together with the data reported in table 1, indicates that only about 32 per cent of income of the total manufacturing sector was generated in the unorganised sector, which employs almost 80 per cent of labour of the manufacturing sector. In other words, we see the disproportion between income and employment generation within the manufacturing sector, i.e., between its organised and unorganised segments. But it is clear from the table that in the manufacturing sector as a whole, the organised sector has been growing faster than the unorganised sector.

Followed by an overview of growth of industrial structure of Indian economy, the analysis of regional wage differentials is of importance now. A good number of studies have been made on the trends in inter-area wage differentials during the past two decades or so[8]. Almost all of these studies relate to the economies at a relatively high stage of industrialization; and one virtually unanimous conclusion emerging out of them has been that the geographical differentials have registered a narrowing trend particularly during the past few decades.

[6] We use gross value added at as a measure of output, as it is widely used in the Indian manufacturing industrial literature (e.g., Goldar, 2004; Unel, 2003; Ahluwalia, 1991)

[7] Unel, 2003

[8] See, e.g., L. G. Reynolds and C. H. Taft, The Evolution of Wage Structure, Yale, 1956, and references cited in C. Kerr, "Wage Relationship? The Comparative Impact of Market and Power Forces", in J. T. Dunlop (ed.). The Theory of Wage Determination, London, Macmillan, 1966, p. 177.

Table 1: Contribution of Manufacturing Sector to India's Real GDP

Average GDP (in Rupees Crore at 1999-2000 Constant Prices)				
Period		**Average GDP of Manufacturing Sector**	**Average GDP of Organized Manufacturing Sector**	**Average GDP of Unorganized Manufacturing Sector**
1970-75	Value	64405	33545	30786
	Share	13.2	6.9	6.3
1975-80	Value	81744	42547	39108
	Share	13.9	7.2	6.6
1980-85	Value	101412	55571	45841
	Share	14.3	7.8	6.5
1985-90	Value	133812	79756	54056
	Share	14.7	8.7	6
1990-95	Value	171233	109247	61987
	Share	14.6	9.3	5.3
1995-2000	Value	248504	162847	85657
	Share	15.7	10.3	5.4
2000-05	Value	316307	212370	103938
	Share	15.1	10.1	5

Source: http://www.mospi.nic.in/mospi_cso_rept_pubn.htm, National Accounts Statistics – Back series 1950-51 to 1999-2000 and http://www.mospi.nic.in/mospi

Note: share is the % share of the respective sector in the Real GDP (1999-2000 prices).

Table 2: Average Variation in Wage per Worker across States

Year/States	1980-81 to 1990-91	1991-92 to 2009-10	1980-81 to 2009-10
AP	0.411	0.484	0.453
AS	0.666	0.793	0.739
BI	0.529	0.734	0.647
DEL	0.322	0.241	0.275
GU	0.379	0.311	0.34
HR	0.31	0.326	0.319
KR	0.369	0.3	0.329
KE	0.447	0.546	0.504
MP	0.54	0.374	0.444
MH	0.381	0.402	0.393
OR	0.671	0.52	0.584
PU	0.278	0.335	0.311
RJ	0.371	0.293	0.326
TN	0.376	0.375	0.375
UP	0.333	0.258	0.29
WB	0.313	0.376	0.349

Source: Author's own calculations using Annual Survey of industries data (Unit Level)

Table 2 reports the coefficient of variation in wage per worker across states in the pre and post reform period. In the pre reform period, the average CoV moved from 0.310 in Haryana to maximum upto 0.666 in Assam and 0.671 in Orissa. Whereas in the post reform period the average CoV showed a declining trend in few states and narrated a different story for few other states. For example for Delhi it declined from 0.322 in pre reform period to 0.241 in the post reform period. Similarly for Gujrat, Karnataka, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh, disparities are observed to be decreasing. There does not seem to have evolved as yet anybody of propositions which would state the relationship between the level and structure of industrial activity on the one hand and the geographical wage differentials on the other. Theoretically, however, there appears to be a logical basis to expect a newly industrializing country to exhibit a narrowing tendency in its inter-area wage structure. The logic may be advanced on the following lines. Before a country embarks upon a programme of large-scale industrialization, there may exist industries located in various regional pockets, many of which may be catering for the regional and local markets; and the labour markets may also be of localized and enclave character devoid of any high degree of inter area competitiveness across the regions. Consequently, each re gion may have its own wage structure independent of the structures of other regions. But, as industrialization proceeds on a large and diversified scale, inter-area competition on the demand side of the labour market would tend to increase. Technological progress accompanying industrialization, on the other hand, leads to a larger component of such skills in the industrial work force that have a wider applicability than the local market. In other words, higher technology requires a larger percentage of skilled, educated, and trained workers, who are more often willing to sell their labour in areas other than their own localities than the illiterate unskilled workers. Thus, both the demand and the supply forces tend to so act as to make the labour market spatially competitive. Whereas for rest of states CoV seems to be increasing stating that disparities in the states in the pattern of distribution of wages is increasing. The maximum was observed for Assam at 0.793 followed by Bihar at 0.734 and Kerala at 0546. One of the reasons for this widening disparity in post reform period is the growth in skill-incentive industries and the rising demand for skilled workers. Using Annual Survey of Industries data, Nagaraj (2004) also finds that between 1995-96 and 2000-01, 15% of the workers in the organized manufacturing sector lost their jobs. In contrast, the employment of supervisors increased steadily during this period. This suggests that deregulation of labour law, skill upgrading in the urban labour market realized via adoption of new technology induced by foreign direct investment and increasing competition are some of the possible reasons for increasing demand for skilled labour, thereby increasing wage inequality. Whereas for the state like Assam, Bihar, Kerala, supply was not matching the demand, bringing in different wage patterns over time and thus increasing wage disparities. But, on the contrary, the overall trend (for the whole period under study), except for few states, reported decreasing disparities in earnings of labour indicating somewhat equal distribution of wages among labour in the states. Further, we have examined the movement of CoV across different two-digit industry groups for sub-periods (pre and post reforms) and also for the entire period under review and the same are reported in table 3.

Table 3: Average Variation in Wage per Worker across Industry Groups

Year/Industries	1980-81 to 1990-91	1991-92 to 2009-10	1980-81 to 2009-10
20	0.437	0.403	0.417
22	0.43	0.387	0.405
23	0.244	0.211	0.225
27	0.261	0.338	0.305
28	0.224	0.242	0.235
30	0.426	0.375	0.396
31	0.454	0.524	0.494
32	0.29	0.335	0.316

33	0.446	0.479	0.465
34	0.347	0.321	0.332
35	0.281	0.307	0.296
37	0.384	0.442	0.418
38	0.447	0.333	0.381
97	0.246	0.259	0.252

Source: Author's own calculations using Annual Survey of industries data (Unit Level)

In many industries, disparities are observed to be increased in the post reform period. For industries like Manufacture of food Products (20), Tobacco and Tobacco product (22), Manufacture of cotton textile (23), Manufacture of Organic and Inorganic Chemical industry (30), industry of Metal Products and Parts (34) and Other Manufacturing Industry (38), disparities seemed to be declining as the CoV showed a declining trend. Whereas for rest of the industries under study, disparities reported to be rising in the post reform period as compared to pre reform period. Industry of Nuclear Fuel (31) is the one showed the maximum variation in the distribution of wages among labours. It reported the highest CoV in the pre reform period at 0.454 as well as the increased number of 0.524 in the post reform period. Also for the whole period the maximum variation is observed in this industry group only.

It can be inferred that the growth rate of real wages in different states is not uniform and there exists a wide range of diversity. The possible explanation of wage differential could be the short run immobility of labour or transitory labour demand shocks. Also the differences in unmeasured aspects of labour quality causes wage differentials.

4. Productivity Trends

In this section we analyse the productivity trends during the pre-reform and post-reform periods. Productivity estimates discussed in this section have been calculated using ASI data and the industrial coverage of these estimates is uniform for the entire period. The TFPG for the period 1980-81 to 1990-91 has been either stagnant across a large number of industries and states (table 4). Only corresponding to manufacture of paper and paper products industries (28), TFPG has been positive and reasonable in terms of magnitude, in most of the states. Manufacture of Cotton Textiles (23) and Manufacture of Industrial Organic and inorganic chemicals (30) are the industries in which TFP grew in almost all the states over a period of time. Manufacture of machinery and equipments, other than transport equipments (35), Manufacture of wood and wood products (27), Manufacture of Metal products and parts (34) and Manufacture of beverages, tobacco and tobacco products (22) registered a negative TFPG during the post reform period in some states. In Gujrat, Haryana, Madhya Pradesh and Tamil Nadu are the states which experienced positive TFPG in all the industries.

A comparison of TFPG over time shows that it improved in post reform period over the pre-reform period in a large number of industries across various states (table 4). However, corresponding to some states like Assam, Bihar, Orissa, in majority of industries, experienced a decline in TFPG during the post reform period relative to pre reform. Manufacture of machinery and equipments, other than transport equipments (35) in Bihar is peculiar example where a negative TFPG is registered in both the sub-periods, although there seems to be some improvements in the post reform period. For the entire period, in some states like Assam, Bihar, some industries showed a negative growth in TFP. Whereas, for rest other states, the growth in TFP is moderately positive when taken together for the entire period under study.

As indicated and reported above, most of the industries registered growth in TFP across several states over a period of time. The improvement in TFPG across various industries and states in the second sub-period over the first can be attributed to rising contribution of change in technical efficiency. With deregulation, acquisition of technological capabilities leading to better utilization of resources may be said to have enhanced productivity growth in the second sub-period. It is important to note here that there was an appreciable improvement in the level of capacity utilization during the post reform period. During this period the rate of industrial investment was modest and the emphasis was on fuller utilization of the installed capacity already in existence. Thus, our findings of (comparative) rising trend in total factor productivity during the post reform period may be attributed to a large extent to these gains in capacity utilization. Besides, the impact social, financial and physical infrastructure growth on TFPG in various industries is quite significant in explaining its growth in the post reform period (Mitra, 1999).

Table 4: Growth in Total Factor Productivity for Entire and Two Sub Periods

State	Period/Industry	20	22	23	27	28	30	31	32	33	34	35	37	38	97
AP	1980-81 to 1990-91	0.1	0.08	0.06	0.18	0.05	0.04	0.02	0.02	0.05	0.09	-0.01	0.03	0.05	0.05
	1991-92 to 2009-10	0.11	0.09	0.13	0.19	0.11	0.07	0.14	0.05	0.19	0.12	0.17	0.12	0.11	-
	1980-81 to 2009-10	0.08	0.07	0.08	0.09	0.08	0.08	0.06	0.06	0.09	0.1	0.08	0.08	0.03	-
AS	1980-81 to 1990-91	0.1	-	0.02	0.05	-	-0.14	0.19	0.05	0.23	0.02	0.06	0.06	-	0.04
	1991-92 to 2009-10	0.04	-	0.2	-0.14	-	0.33	0.1	0.06	-0.07	0.03	0.21	-	-	-
	1980-81 to 2009-10	0.03	-	0.06	-0.04	-	0.08	0.07	0.08	0.03	-0.01	0.1	-	-	-
BI	1980-81 to 1990-91	0.09	0.05	0.1	0.09	0.05	0.1	0.07	0.08	0.06	0.14	-0.02	0.01	-	-0.03
	1991-92 to 2009-10	0.12	0.14	0.09	-	0.16	-	-	-0.04	-	-0.13	-0.01	-0.23	-	-
	1980-81 to 2009-10	0.09	0.11	0.01	-	0.08	-	-	-0.04	-	-0.02	-0.06	-0.09	-	-
DL	1980-81 to 1990-91	0.01	-0.04	0.11	0.17	0.08	0.02	0.14	0.13	0.03	0.08	0.05	0.07	0.08	0.12
	1991-92 to 2009-10	0.19	0.07	0.2	0.07	0.12	0.12	0.08	-0.01	0.05	0.12	0.13	0.11	0.12	-
	1980-81 to 2009-10	0.09	0.05	0.06	0.09	0.1	0.07	0.07	0.06	0.05	0.09	0.08	0.08	0.1	-
GU	1980-81 to 1990-91	0.08	0.1	0.01	0.04	0.07	0.04	0	0.07	0.05	0.08	0.05	0.06	0.07	0.08
	1991-92 to 2009-10	0.12	0.24	0.14	0.16	0.11	0.09	-	0.13	0.12	0.11	0.11	-	0.11	-
	1980-81 to 2009-10	0.08	0.15	0.07	0.1	0.08	0.06	-	0.1	0.1	0.08	0.07	-	0.08	-
HR	1980-81 to 1990-91	0.1	0.1	0.06	0.06	0.08	0.02	0	-0.01	0.05	-0.01	0.04	0.1	0.11	0.17
	1991-92 to 2009-10	0.13	0.14	0.16	0.11	0.1	0.1	0.14	0.09	0.15	0.14	0.09	0.09	0.1	-
	1980-81 to 2009-10	0.09	0.1	0.09	0.08	0.07	0.05	0.05	0.06	0.09	0.06	0.06	0.08	0.08	-
KR	1980-81 to 1990-91	0.1	0.07	0.04	0.02	0.12	0.04	0.09	0.1	0.12	0.05	0.03	0.02	-0.05	0.01
	1991-92 to 2009-10	0.12	0.18	0.14	0.23	0.08	0.12	0.16	0.08	0.17	0.1	0.09	0.11	0.13	-
	1980-81 to 2009-10	0.09	0.1	0.08	0.09	0.08	0.07	0.09	0.07	0.12	0.07	0.07	0.08	0.04	-

KE	1980-81 to 1990-91	0.1	0.12	0.06	-0.09	0.12	0	0.1	0.03	0.07	0.02	0.07	-0.06	0.01	-0.01
	1991-92 to 2009-10	0.07	0.06	0.09	0.15	0.05	0.07	0.05	0.06	0.05	0.11	0.1	0.09	0.06	-
	1980-81 to 2009-10	0.06	0.07	0.06	0.05	0.07	0.04	0.02	0.05	0.05	0.05	0.08	0.08	0.04	-
MH	1980-81 to 1990-91	0.15	0.11	-0.01	0.02	0.09	0.07	0.19	0.07	0.01	0.09	0.02	0.11	0.07	0.23
	1991-92 to 2009-10	0.09	0.05	0.21	0.18	0.1	0.1	-	0.12	0.03	0.04	0.18	0.1	0.19	-
	1980-81 to 2009-10	0.1	0.07	0.11	0.07	0.05	0.09	-	0.07	0.01	0.05	0.09	0.09	0.15	-
MP	1980-81 to 1990-91	0.07	0.06	0.03	0.04	0.05	0.04	0.11	0.07	0.06	0.05	0.05	0.06	0.05	0.03
	1991-92 to 2009-10	0.08	0.1	0.14	0.13	0.12	0.08	0.16	0.12	0.11	0.09	0.09	0.1	0.1	-
	1980-81 to 2009-10	0.06	0.06	0.05	0.08	0.08	0.06	0.09	0.08	0.05	0.05	0.07	0.08	0.07	-
OR	1980-81 to 1990-91	0.04	0.15	0.06	0.06	0.07	-	0.12	0.06	0.14	0.11	0.04	-	-0.17	-
	1991-92 to 2009-10	0.03	0.09	0.1	-	0.13	-	0.07	0.1	0.1	0.06	0.07	-	-	-
	1980-81 to 2009-10	0.04	0.05	0.01	-	0.07	-	0.12	0.06	0.08	0.06	0.05	-	-	-
PU	1980-81 to 1990-91	0.04	0.09	0.08	0.1	0.25	-0.01	0.05	0.14	0.06	0.1	0.01	0.05	0.08	0.14
	1991-92 to 2009-10	0.1	0.02	0.09	0.17	0.09	0.08	0.12	-	0.07	0.06	0.11	0.1	0.06	-
	1980-81 to 2009-10	0.08	0.06	0.08	0.12	0.12	0.06	0.06	-	0.06	0.07	0.08	0.06	0.08	-
RJ	1980-81 to 1990-91	0.03	-	0.04	-0.01	0.13	0.08	-	0.07	0.01	0.1	0.06	0.08	0.16	0.06
	1991-92 to 2009-10	0.1	-	0.11	0.28	0.08	0.09	-	0.12	0.13	0.07	0.09	0.14	0.1	-
	1980-81 to 2009-10	0.1	-	0.06	0.19	0.1	0.09	-	0.07	0.01	0.08	0.06	0.11	0.11	-
TN	1980-81 to 1990-91	0.08	0.11	0.06	0.02	0.05	0.01	0.11	0.06	0.07	0.03	0.04	0.04	0.08	0.03
	1991-92 to 2009-10	0.08	0.12	0.07	0.23	0.1	0.09	0.06	0.07	0.1	0.12	0.08	0.13	0.06	-
	1980-81 to 2009-10	0.06	0.1	0.05	0.09	0.06	0.04	0.06	0.06	0.07	0.08	0.06	0.08	0.06	-
UP	1980-81 to 1990-91	0.09	0.2	-0.02	0.12	0.09	0.06	-	0.09	0.08	0.12	0.1	0.11	0.15	0.04
	1991-92 to 2009-10	0.11	0.1	0.17	0.16	0.14	0.09	-	0.15	0.12	0.09	0.11	0.15	0.09	-
	1980-81 to 2009-10	0.08	0.11	0.07	0.13	0.09	0.08	-	0.1	0.09	0.07	0.08	0.13	0.1	-
WB	1980-81 to 1990-91	0.21	0.15	-0.01	0.05	0.05	0.03	0.04	0	-0.03	0.04	0.01	0.03	-0.03	0.04
	1991-92 to 2009-10	0.07	0.14	0.14	0.19	0.15	0.16	0.13	0.15	0.12	0.11	0.12	0.1	0.09	-
	1980-81 to 2009-10	0.15	0.08	0.07	0.09	0.09	0.09	0.06	0.09	0.06	0.07	0.06	0.04	0.04	-

Source: As in Table 1

Table 5: Results for Model 1 Dependent variable: industrial wages

Model	**Fixed Effect Model**						**Random Effect Model**						Hausman p-value
States/ Variables	Labour Productivity	Capital (Size)	Skill	Capital Labour Ratio	Constant	R^2	Labour Productivity	Capital (Size)	Skill	Capital Labour Ratio	Constant	R^2	
AP	1.672* (0.117)	1.149*(0.049)	-0.094* (0.049)	-3.827* (0.216)	0.976* (0.186)	0.907	1.695* (0.118)	1.144* (0.048)	-0.112* (0.048)	-3.854* (0.209)	1.073* (0.186)	0.907	0.004
AS	0.815* (0.088)	0.989* (0.051)	-0.02** (0.059)	-2.257* (0.150)	0.565* (0.152)	0.897	0.824* (0.087)	0.994* (0.051)	-0.042** (0.057)	-2.298* (0.148)	0.644* (0.151)	0.897	0.333
BI	0.772* (0.102)	0.845* (0.060)	0.035** (0.057)	-2.14* (0.193)	0.932*(0.178)	0.846	0.773* (0.101)	0.861*(0.058)	0.027** (0.056)	-2.178* (0.187)	0.936* (0.179)	0.846	0.833
DL	0.642* (0.103)	1.022* (0.038)	-0.149* (0.044)	-2.199* (0.103)	1.024* (0.137)	0.859	0.645* (0.103)	1.022* (0.037)	-0.146* (0.042)	-2.205* (0.103)	1.018* (0.130)	0.859	0.928
GU	1.948* (0.145)	1.035* (0.048)	-0.001** (0.067)	-3.907* (0.214)	0.87* (0.237)	0.882	1.931* (0.147)	1.042* (0.048)	-0.048** (0.063)	-3.94* (0.216)	1.071* (0.224)	0.882	0.824
HR	1.436* (0.124)	1.072* (0.036)	0.005** (0.052)	-3.24* (0.136)	0.558* (0.159)	0.925	1.473* (0.125)	1.083* (0.036)	-0.051** (0.049)	-3.307* (0.136)	0.748* (0.151)	0.925	0.92
KR	1.646* (0.116)	0.782* (0.052)	0.252* (0.066)	-2.476* (0.201)	-0.092** (0.231)	0.878	1.654* (0.115)	0.788* (0.052)	0.227* (0.064)	-2.517* (0.198)	0.01** (0.226)	0.878	0.802
KE	2.104* (0.137)	1.255* (0.553)	-0.131* (0.062)	-4.204*(0.224)	0.845* (0.223)	0.844	2.125* (0.139)	1.206* (0.051)	-0.174* (0.060)	-4.071* (0.210)	1.023* (0.210)	0.843	0.001
MP	1.664* (0.152)	0.908* (0.066)	0.024** (0.066)	-2.738* (0.259)	0.41* (0.198)	0.863	1.696* (0.152)	0.908* (0.065)	0.013** (0.065)	-2.786* (0.256)	0.468* (0.199)	0.863	0.022
MH	1.439* (0.137)	1.06* (0.044)	-0.164* (0.056)	-3.694* (0.186)	1.799* (0.229)	0.882	1.454* (0.137)	1.045* (0.042)	-0.128* (0.051)	-3.64* (0.181)	1.656* (0.208)	0.882	0.001
OR	0.95* (0.105)	0.955* (0.043)	-0.024** (0.055)	-2.262* (0.137)	0.563* (0.159)	0.834	0.953* (0.104)	0.958* (0.042)	-0.032**	-2.283*	0.596* (0.152)	0.834	0.831

									(0.052)	(0.136)			
PU	1.088* (0.110)	1.213* (0.043)	-0.269* (0.051)	-3.305* (0.158)	1.316* (0.152)	0.927	1.099* (0.111)	1.19* (0.042)	-0.25* (0.047)	-3.256* (0.157)	1.288* (0.143)	0.927	0.001
RJ	0.975* (0.088)	1.213* (0.043)	-0.172* (0.053)	-3.457* (0.151)	1.273* (0.166)	0.918	1.007* (0.089)	1.207* (0.043)	-0.188* (0.053)	-3.482* (0.152)	1.347* (0.168)	0.918	0.434
TN	1.926* (0.155)	1.101* (0.061)	-0.169* (0.069)	-3.845* (0.289)	1.206* (0.274)	0.895	1.951* (0.154)	1.09* (0.059)	-0.158* (0.066)	-3.824* (0.283)	1.175* (0.266)	0.895	0.014
UP	1.582* (0.123)	0.948* (0.045)	-0.044** (0.059)	-3.261* (0.203)	1.14* (0.221)	0.873	1.577* (0.122)	0.959* (0.044)	-0.048** (0.056)	-3.315* (0.202)	1.167* (0.208)	0.873	0.02
WB	0.154** (0.190)	1.212* (0.054)	-0.336*(0.063)	-3.141* (0.274)	2.638* (0.249)	0.83	0.118** (0.191)	1.205* (0.053)	-0.282* (0.060)	-3.032* (0.269)	2.395* (0.237)	0.829	0.003

Note (i) Hausman Test Ho: difference in coefficients not systematic.
For accepting null hypothesis Hausman p value > 0.05 and thus Random Effect estimates are used.
(ii) Standard Errors are in parenthesis.
(iii) *and ** denote significant at 5% and 10% level, respectively.
Source: As in Table 2.

Table 6: Results for Model 2 Dependent variable: industrial wages

Model	Fixed Effect Model					Random Effect Model					Hausman p-value
States/ Variables	Total Factor Productivity	Capital (Size)	Skill	Constant	R^2	Total Factor Productivity	Capital (Size)	Skill	Constant	R^2	
AP	5.795*	0.493*	0.355*	-11.93*	0.855	0.606*	0.476*	0.384*	-12.48*	0.854	0.001
	(0.719)	(0.026)	(0.045)	(1.423)		(0.72)	(0.026)	(0.044)	(1.429)		
AS	2.371*	0.469*	0.508*	-5.461*	0.847	2.365*	0.459*	0.507*	-5.401*	0.847	0.001
	(0.73)	(0.029)	(0.04)	(1.423)		(0.722)	(0.029)	(0.04)	(1.414)		
BI	3.582*	0.281*	0.481*	-7.018*	0.721	3.157*	0.304*	0.478*	-6.242*	0.721	0.001
	(0.642)	(0.033)	(0.031)	(1.251)		(0.633)	(0.031)	(0.031)	(1.239)		
DL	2.851*	0.402*	0.546*	-6.361*	0.694	2.82*	0.401*	0.541*	-6.277*	0.694	0.901
	(0.732)	(0.035)	(0.041)	(1.453)		(0.719)	(0.034)	(0.04)	(1.432)		
GU	6.653*	0.26*	0.773*	-14.23*	0.794	6.539*	0.266*	0.78*	-14.063*	0.794	0.976
	(0.913)	(0.031)	(0.059)	(1.848)		(0.927)	(0.031)	(0.064)	(1.87)		
HR	2.916*	0.401*	0.745*	-7.18*	0.812	3.232*	0.39*	0.695*	-7.594*	0.811	0.388
	(0.936)	(0.034)	(0.061)	(1.853)		(0.914)	(0.033)	(0.057)	(1.825)		
KR	7.188*	0.301*	0.785*	-15.478*	0.853	7.248*	0.296*	0.769*	-15.511*	0.853	0.329
	(0.657)	(0.022)	(0.044)	(1.313)		(0.655)	(0.022)	(0.043)	(1.311)		
KE	7.446*	0.428*	0.582*	-15.598*	0.685	7.627*	0.411*	0.547*	-15.772*	0.685	0.803
	(0.953)	(0.035)	(0.07)	(1.882)		(0.937)	(0.034)	(0.066)	(1.858)		
MP	4.474*	0.371*	0.478*	-9.293*	0.803	4.085*	0.381*	0.496*	-8.62*	0.802	0.044
	(0.801)	(0.032)	(0.041)	(1.557)		(0.771)	(0.031)	(0.041)	(1.512)		
MH	4.248*	0.361*	0.475*	-8.534*	0.791	4.126*	0.364*	0.496*	-8.389*	0.79	0.002
	(0.948)	(0.027)	(0.052)	(1.896)		(0.936)	(0.027)	(0.048)	(1.877)		
OR	4.593*	0.445*	0.537*	-10.035*	0.766	4.465*	0.442*	0.532*	-9.728*	0.766	0.094
	(0.728)	(0.027)	(0.052)	(1.44)		(0.719)	(0.026)	(0.048)	(1.428)		
PU	2.504*	0.521*	0.325*	-5.364*	0.84	1.978*	0.516*	0.436*	-4.653*	0.837	0.761
	(0.749)	(0.029)	(0.056)	(1.468)		(0.67)	(0.028)	(0.045)	(1.349)		
RJ	2.019*	0.453*	0.581*	-4.987*	0.827	2.157*	0.445*	0.587*	-5.288*	0.827	0.044
	(0.608)	(0.027)	(0.052)	(1.192)		(0.601)	(0.026)	(0.05)	(1.182)		
TN	6.209*	0.433*	0.416*	-12.689*	0.858	5.916*	0.439*	0.455*	-12.26*	0.857	0.004
	(0.878)	(0.026)	(0.046)	(1.737)		(0.863)	(0.025)	(0.044)	(1.72)		
UP	3.667*	0.385*	0.553*	-7.937*	0.807	3.577*	0.385*	0.572*	-7.833*	0.807	0.462
	(0.752)	(0.027)	(0.051)	(1.495)		(0.729)	(0.026)	(0.048)	(1.461)		
WB	2.576*	0.622*	0.283*	-5.038*	0.747	2.64*	0.628*	0.297*	-5.094*	0.747	0.148
	(0.89)	(0.036)	(0.047)	(1.785)		(0.863)	(0.035)	(0.045)	(1.734)		

Notes: As in table 5.
Source: As in table 2.

5. Wage Productivity Relationship

In this section, we examine the impact of productivity (total and partial) along with other variables on wage determination of industries in different states of India. For this, two models, as specified below, have been estimated.

Model 1: we hypothesize that

$$wages = f(LP, SZ, SK, {}^{K}/_{L})$$

which can be written as

$$wages_{it} = \beta_{0i} + \beta_1 LP_{it} + \beta_2 SZ_{it} + \beta_3 SK_{it} + \beta_4 {}^{K}/_{L_{it}} + \mu_{it}$$

for purposes of estimation.

Model 2: Unlike the model 1 where K/L enters as explanatory variable, we hypothesize that

$$wages = f(TFP, SZ, SK)$$

For the purposes of estimation, the model may be re-written

$$wages_{it} = \beta_{0i} + \beta_1 TFP_{it} + \beta_2 SZ_{it} + \beta_3 SK_{it} + \mu_{it}$$

Where SK, SZ, K/L, LP and TFP are, for each industry 'i', wage rate, % share of employees to total persons engaged, Industry Size proxied by calculated total capital, Capital Labour Ratio, Labour Productivity and total factor productivity respectively. β_1, β_2, β_3, β_4 are the parameters to be estimated.

A powerful and flexible procedure for analyzing associative relationships between a dependent variable and one or more independent variables is Regression Analysis. It helps in determining whether there exists any significant relationship between independent and dependent variables.

By putting all the data together and without any distinction between cross section and time series, Pooled Ordinary Least Square (OLS) can be run. But if in particular we can assume that constant term for each industry differs. This can be specified as:

$$Y_{it} = \alpha + X_{it}\beta + \mu_{it} \qquad (5.1)$$

Where, i represents the i^{th} cross-sectional unit for each industry considered in study and t for the t^{th} time period for each year considered in the study, y_{it} is the vector of the explained variables, X_{it} is the vector of the explanatory variables of each industry at any time, β is the vector of estimated parameters and μ_{it} is the error vector. In literature the above model is known as the Fixed Effect Regression Model (FEM). This states that although the intercept may differ across individuals but each individual's intercept does not vary over time. This method use dummies to estimate fixed effect in model and is also known as Least Square Dummy Variable (LSDV) Model.

Sometimes Random Effect Model (REM) or Error Components Model (ECM) is preferred over FEM as the latter is expensive in terms of degree of freedom.

The model may be written as:

$$Y_{it} = \alpha + X_{it}\beta + \mu_{it} \qquad (5.2)$$

where,

$$\mu_{it} = \gamma_{it} + \varepsilon_{it} \qquad (5.2(A))$$

in which $\gamma_i$is the cross section or individual specific, error component and ε_{it} is the combined time series and cross section error component. Hence in the equations above, explanation of error term varies with the model.

Mundlak (1978) argues that the decision on the nature of the effects, whether it is random or fixed, is both arbitrary and unnecessary. He says that it is up to the user to decide whether he wants inference with respect to the population of all effects (random effects) or only with respect to the effects that are in the sample (fixed effects).

We estimate model 1's equation, which tests the direct impact of labour productivity, with other selected variables on the industrial wages and present the results in table 5. Labour productivity is one of the various dimensions of productivity; increase in which is important but not necessarily with a decrease of employment especially in a labour surplus economy such as India. Creation of new employment opportunities at a rising level of productivity is the most cherished objective. Following this, Model 1 is estimated using fixed effect and random effect model. But after running the post estimation Hausman Test, to choose the results from the two estimations, we have to resort to fixed effect model for these states namely: Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal. From table 5, it is observed that in industries chosen for the study, increase in wages has been mainly on account of rise in labour productivity and size of industry whereas capital labour ratio has negative impact on the rise in wage rate. On the other hand, the percentage share of employees to total persons engaged, did not contribute significantly to the growth of wage rate in these industries. In other words, wages have been revised time to time taking into account mainly the rise in labour productivity giving less weight to other factors in industries.

While estimating the other model which tests the direct impact of total factor productivity, with other selected variables on industrial wages, we resorted to fixed effect estimates, as supported by the Hausman test, only in case of Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu. The results of the same are presented in table 6. It is observed that the rise in wages is much influenced by total factor productivity followed by skill and then size of the industry. Although the growth in wages due to labour productivity is observed to be less than the growth accounted from rise in total factor productivity. The elasticity of wages to TFP is found to be highly elastic as compared to that of labour productivity. Nonetheless, the effect of other factors on wage rate movement is statistically small but enough to reveal the net effect on it. Therefore we can summarise that other factors which can affect the wage rate are also important and can influence wage movement, but TFP and labour productivity are the significant among all.

Overall our results support the earlier findings of Sidhu (2008), Abraham (2007), Banga (2005), which argue that labour productivity is an important determinant of wage rate along with the other factors. However, our results do not support the findings of Banerjee (2007), where he argues that the distribution of manufacturing income disfavours workers and they are not compensated for the productivity gains. Consequently, the wage-productivity gap appears to have been growing. Conclusively, this section suggests that the impact of labour productivity on wages is relatively less to that of impact of total factor productivity on wages. Although, we can say that increase in any of the two will lead to growth in wages.

6. Summary and Conclusion

In retrospect our review of the trend in earnings clearly brings out that there were considerable inter-temporal differences in their movement. And also the growth rate of real wages in different industries are not uniform, there exist a wide range of diversity. Estimates for the sub-periods also revealed marked differences in the growth rate for labour productivity which was markedly higher and there were sharper differences observed for capital productivity and TFP. They grew faster in the pre reform period as compared to in the post reform. The importance of total factor productivity (TFP), labour productivity, capital labour ratio, Skill and size of the industry in determining the wage rate has been widely acknowledged by the policy makers in the Indian Economy in the recent years and the same is witnessed by our study. However, the related empirical literature also includes the impact of many other economic variables in determining the impact on wage rate. The results

reveal that along with other factors labour productivity and TFP have a stronger positive relation with wages and so has a significant impact on its determination.

For policy purposes, our results are interesting and relevant. This study has identified the relationship of wages with different indicators. Results point out that for increasing the wage rate, TFP can be enhanced easily as it is positively and significantly related with the wage rate. Another fact which has emerged from this study, and is contrary to a general belief, that improvement in labour productivity is not a solution to the problem of low wage rate. Our results indicated that labour productivity in industries will have a positive impact on the growth of wage rate. Further, the Skill growth is not being significantly transformed to enhanced wage rate and hence better industrial performance. Therefore, improvement in TFP and labour productivity along with variables such as Size, Skill, and Capital-labour ratio should be increased only after a careful evaluation of its crowding effects.

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