Investigating the Relationship of Disparity in Income, Private investment and wage rate in Indian states: A Panel Cointegration Approach

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Abstract:

In this paper, we use enterprise level data from the Annual Survey of Industries (ASI) to examine the inter-relationships between per capita income, wage rate and private investment of the registered manufacturing sector across the Indian states in the years of trade and investment liberalization. The study uses cointegration and fully modified OLS estimators for a panel of 20 major states spanning the period 1993-2007. There is evidence of two long-run bidirectional relationships of per capita income with wage rate and private investment and a short-run bidirectional relationship between the per capita income and per capita private investment. The wage rate does not cause the per capita income in the short-run, and it does not cause the private investment in both the short and long run.

Key words: income, wage disparity, private investment, regional level, manufacturing industries, India, panel cointegration

JEL Codes: E2, J3, R1, R3

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1. Introduction

Regional imbalance is one of the major hindrances for sustainability of economic growth and development of India. The persistence of imbalanced regional growth poses a serious threat to economic growth and development and creates economic, social and political tension (Chowdhury, 2003; Persson and Tabellin, 1994). India is a mixed, liberalised, federal and developing economy. The country is widely diversified socially, politically, economically and in terms of availability of natural resources. Private investment is considered as the main driver for the rapid growth of the Indian economy, on the one hand. Private investment, on the other hand, is also responsible for the increasing disparities in India's economic development at the sub-national level in the economic reform years (Mallick, 2014; Mallick, 2013a; Purfield, 2006; Rao *et al,*1999). Private investment contributes to an economy directly by raising national income. It also indirectly contributes to the economy by increasing demand for labour, which generates employment opportunities and pushes the price of labour and, consequently, increases income and standard of living. It is believed that the introduction of various economic reform measures since 1991 has aggravated the competition for attracting private investment across the Indian states in a variety of ways. Even, the attraction of private investment to generate employment opportunities, scaling up wages and growth have become an important part of the political agenda in the recent elections at the national and sub-national levels in India.

The inter-regional growth literature predicts that the inflow of private investment within an economy depends on the cost of factor inputs and the rate of return on the investment (Calberg, 1981). This means that the inflow of private investment varies inversely with factor costs. In this context, the inflow of private investment will be higher in a region with the lower cost of labour or wage rate. The inflow of private investment, including foreign direct investment (FDI), adopts modern technologies and uses developed managerial skills that pushes productivity and wage rate in the developing economies (Mallick, 2017; Mallick, 2015a; Mallick, 2015b; Arnal and Hijzen, 2008; Mallick, 2014; Aigbokhan, 2011). The 'marginal productivity theory of wages' indicates that increase in private investment leads to increase in productivity and the wage rate. Hence, the theories predict that there could be a simultaneous relationship between the wage rate and the inflow of private investment within an economy. The wage rate affects private investment, on one hand and it is affected by private investment on the other hand. Similarly, income is expected to have a positive impact on the inflow of private investment (Mallick, 2013b), because the states with high income may have bigger consumption market, which may lead to increase in prices of products and hence profit of the entrepreneurs. The other possible reason is that the high-income states are expected to have good quality infrastructure and human capital, which pushes productivity and the rate of return on investment. Finally, the wage rate of labour is partly determined by the level of income. High income leads to improvement of the standard of leaving, which makes the wage rate higher than that of the states with lower income. On the other hand, wage inequality is one of the main causes of rising income disparity as well (Herr and Ruoff, 2014). The wage differential is a vital source of divergence in India and has a very relevant role in Indian economic policy to reduce income disparity (Marjit and Mitra, 1996; Das, 2002).

The existing studies on the disparity in economic development during the economic reform years in the context of the Indian economy have concentrated on identifying the factors of disparity in wages, income and private investment (Mallick, 2014; Mallick, 2013b, Mallick, 2012a; Mallick, 2011; Das, 2002; Ramaswamy, 2008; Purfield, 2006; Dholkia, 1976; Papola, 1972; Rao *et al,*1999; Amiri, 2011). The study by Mallick (2014) examines the impact of the disparity in private investment on the disparity in income across the Indian states during the economic reform years. Mallick (2013b) establishes income as one of the crucial factors for the disparity in private investment across the Indian states. Some of the studies have limitations in the measurement of private investment. For instance, Baddeley *et al*., (2006), Rao *et al.* (1999) and Purfield (2006) examined the impact of investment on state level economic growth. However, due to the unavailability of data on investment, they used proxies, which are poor reflections of the extent of private investment and public investment at the state level because they exclude loans extended by various non-financial institutions to private enterprises, foreign investors in the states and public investment as a part of public expenditure. Some other studies dealt with the disparity in wage rates across various sub-sectors of manufacturing industries (Amiri, 2011; Ramaswamy, 2008; Purfield, 2006; Dholkia, 1976; Papola, 1972) and across the Indian states as well (Das, 2002). Amiri (2011) and Ramaswamy (2008) noted that wage disparity increased during the economic reform years. The liberalization measures in the 1990s widened the disparity between skilled and less-skilled workers due to higher international trade, import of skill-based technologies, changes (SBTC) and increase in investment including FDI. The growth of wage rate for skilled labour was considerably higher than that of the unskilled category during the reform years, which created substantial wage disparities between them across various occupations[1]. Further, a large number of studies have also established that wage differentials are due to the differences in technical skills and level of education (Dickens and Katz, 1986; Holzer, *et al.*, 1988; Katz and Summers, 1988; Katz and Murphy, 1991; Krueger and Summers, 1986; Krugman, 1994; Lowe, 1995; Murphy, *et al.*, 1998; and Virén, 2005) and the higher returns to high-skilled workers (Borjas *et al.,* 1992; Glaeser and Mare, 2001; Wheaton and Lewis, 2002), along with the globalisation and polarisation of the labour market. Autor *et al.*, (1998, 2003, 2006), Goldin and Katz (2008), Card (2002) and Acemo-Glu (1998) emphasised on SBTC as the cause of wage disparity and, thus, income inequality.

However, there is no empirical evidence, which establishes the above simultaneous relationship between income, private investment and wages in the context of Indian states. Private investment and wage rate were crucial for the rising income disparity across the Indian states during the economic reforms period. It is policy imperative to understand how they are inter-related to each other in both the short and long run. Hence, a detailed study on the causal relationship of disparity in private investment, income and wage is required to design policies to achieve balanced regional growth and sustain high national economic growth in India. Against this background, the purpose of this paper is to investigate empirically the relationship between income, private investment and wage rate in the major Indian states during the period of economic reforms. The study considers the manufacturing sector (registered) as the major contributor to private investment and national income in India's industrial sector. The study considers 20 major states, viz., Andhra Pradesh, Assam, Bihar, Chhatisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttaranchal and West Bengal during the period from 1993-94 to 2007-08 for the empirical verification. The rest of the paper is organized as follows. In Section 2, the regional disparity in private investment, wage rate and income is discussed. Section 3 comprises data sources and outlines the technique of estimation. Section 4 presents the main findings. Finally, Section 5 summarises and discusses policy implications of the findings.

[1]Administrative and professional workers are generally considered as skilled labour as they have school and college education. They are the highest paid workers. In contrast, the unskilled workers include the labourers and production workers as they have no higher education, and are lowest paid (Amiri, 2011).

2. Data

The variables included in the empirical analysis are per capita income, wage rate and per capita private investment of the registered manufacturing sector across 20 major states from 1993-94 to 2007-08. The Central Statistical Organization (CSO) of India is the basic database of this study. The per capita income is measured as the per capita Gross State Domestic Product (GSDP). The GSDP of the registered manufacturing sector is used at the constant prices (1999-2000) from the CSO database. The wage rate or labour cost (LC) is measured as the as the average wage (= total emoluments/ total number of employees), which is used in the empirical studies (Sidhu, 2008). The nominal series on wage rate is taken from the plant level record of the Annual Survey of Industries (ASI). The series is converted into real prices at 1999-00 base by using the GSDP deflator of the registered manufacturing sector of CSO data.

Private investment is represented by the gross fixed capital formation (GFCF). The measurement of state level private investment is a challenging task in developing countries like India[2]. The study utilises the enterprise records of the ASI and the aggregate data of National Accounts Statistics (NAS) to generate a series on the state level private investment of the registered manufacturing sector. The NAS provides data on GFCF at the both current and constant prices with base year 1999-00 by industry of use. The NAS gives data on GFCF for the entire economy and the public sector by industry of use, including the 1-digit industry code of the National Industrial Code (NIC). The entire manufacturing industry includes the un-registered and registered sectors. Private investment in the registered manufacturing industry is what is remaining after deducting public GFCF from the total GFCF in this sector. The enterprise level data of ASI provides annual data on GFCF in the registered manufacturing industries by the types of institutions at the current prices. Hence, the national private GFCF in the registered manufacturing sector is distributed among the states on the basis of plant level data for private enterprises to estimate the private investment in this sector in 20 major states from 1993–94 to 2007–08 (for the detailed methodology, see Appendix A1). These estimates are used to measure the state level per capita private investment (PRI).

[2]The measurement of private investment at the state level in India is thoroughly discussed in Mallick (2014), Mallick (2013a), Mallick (2013b), Mallick (2012a), Mallick (2012b) and Mallick (2008).

3. Empirical Strategy

The variables are converted into their natural logarithms to achieve stationarity in variance. The panel data method is used to investigate the cointegrating relations and short-run causality among ln. per capita income (LGSDP), ln. wage rate (LLC) and ln. per capita private investment (LPRI). In brief, the empirical investigation involves three steps, viz. (1) panel unit root testing to determine the order of integration of the variables, (2) employing panel cointegration tests to examine the long-run relationships among the variables, and (3) applying dynamic panel causality tests to evaluate the short-run cointegration and the direction of causality among variables. In addition, the study uses panel fully modified OLS procedures (FMOLS) model to examine the long-run impact.

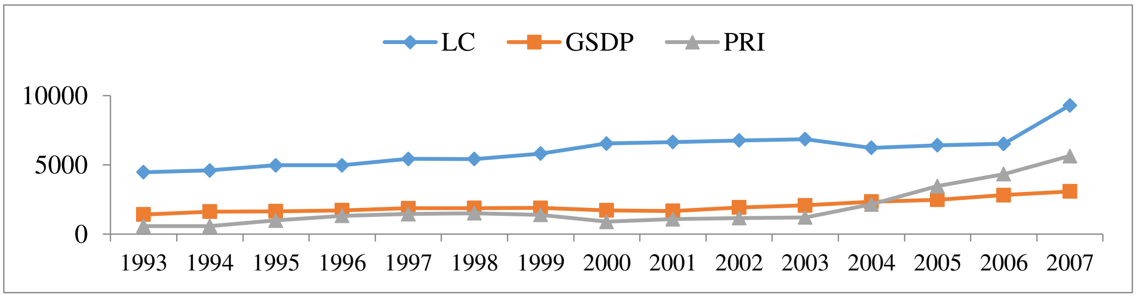
Panel data provide a larger number of point data, increasing the degrees of freedom and reducing the collinearity between regressors. Hence, panel data allows powerful statistical tests, which test statistics follow normal distribution. Further, the literature suggest that panel based unit root tests have higher power than unit root tests on individual time series. The recently developed panel unit root tests, which are commonly used in economic analyses are Levin, Lil and Chu (2002), Breitung (2000), and IPS or Im, Pesaran and Shin (2003), Maddala and Wu (1999), Choi (2001) and Hadri (2000).

After identifying the integrated order of the variables in the analysis, the cointegartion test is conducted. The most popular panel cointegration tests applied in recent literature are Pedroni (1999), Pedroni (2004), Kao (1999) and a Fisher-type test using an underlying Johansen methodology (Maddala and Wu, 1999). The Pedroni and Kao Tests are based on Engle-Granger (1987) two-step (residual-based) cointegration tests. In our analysis, we employ three kinds of panel cointegration tests: Pedroni's (2004), Kao's (1999), and Johansen's (1988) Fisher panel cointegration tests. These cointegration tests only indicate whether or not the variables are cointegrated or whether a long-run relationship exists between them. Since they do not indicate the direction of causality, we estimate the long and short-run relationships by using panel FMOLS and Vector Error Correction Model (VECM) proposed by Engle and Granger (1987), respectively. The VECM is used to conduct the granger causality tests for short run relationships. The long-run impact of each variable is estimated using panel FMOLS developed by Pedroni (2000).

4. Empirical Analysis

The above data have been used to describe the trends of per capita income, wage rate and private investment of the manufacturing sector across 20 major states in Figure 1. The figure shows a rising trend in wage rate along with per capita income and per capita private investment across the Indian states during the period of economic reforms. This means that there is a positive relationship between per capita income, wage rate and per capita private investment across the Indian states. Further, the regional disparity in per capita income, wage rate and per capita private investment is measured by the standard deviation across the states. The trends in the regional disparity are presented in Figure 2, which shows that the rising trends in regional disparity in income is associated with the rising trend in disparity in wage rate and per capita private investment from 1993 to 2007. Therefore, there is positive relationship between regional disparities in per capita income, wage rate and per capita private investment across the Indian states.

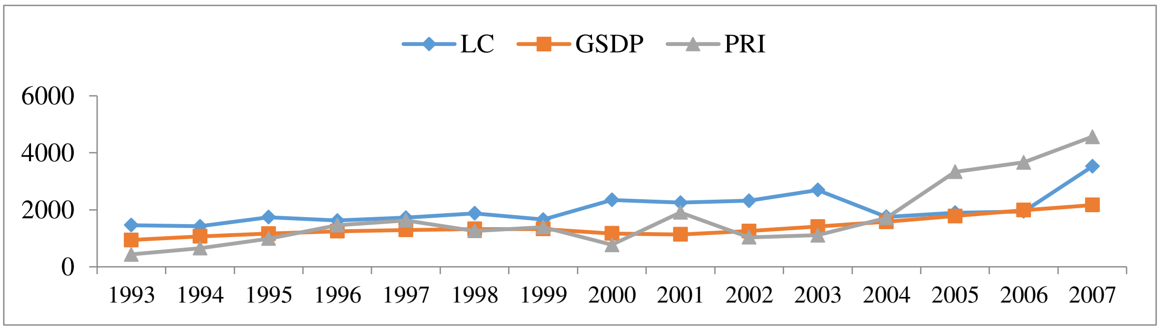
Figure1: per capita income, wage rate and per capita private investment



Note: LC (10): annual wage rate in 10 units; GSDP and PRI are per capita income and private investment. It is in terms of average of 20 states (for detailed data, see Table A2 in appendices).

Sources: Unit levels data of Annual Survey of Industries, Government of India

Figure 2: Inequality in income, wage rate and private investment



Sources: As in figure 1.

In the line with the above patterns in the manufacturing sector, the studies dealing with the entire economy at the state level in India also find rising disparities in income and private investment. This rising disparity in aggregate income is explained by a large number of studies (Ahluwalia, 2002; Dasgupta *et al.,* 2000; Kurian, 2000; Mallick, 2014; Marjit and

Mitra, 1996; Purfield, 2006; Rao *et al.,* 1999). The main reasons for such rising disparity are the rich and faster-growing states have had higher success in generating jobs in the private sector and attracting capital, the economic growth of the richer and faster growing states is more stable than that of the poor states and the differences in economic policies across the regions (Purfield, 2006).

Rao *et al.,* (1999) lay emphasis on the differences in infrastructure and human resources for causing such regional divergence in the post-reform era because they have an edge in attracting investment. Specifically, private investment is more important than public investment in spurring economic growth and development in developing countries. Private investment is more productive than the public investment (Khan and Kumar, 1997; Khan and Reinhart, 1990; Mallick, 2013a; Mallick, 2014). Hence, the disparity in private investment contributed to the rising disparity in economic growth and development in Indian states in the reform years (Kurian, 2000; Ahluwalia, 2002; Mallick, 2014). However, Mallick (2013b) provided evidence to show that income disparity is one of the reasons for the high disparity in private investment because the high-income states are expected to have good quality infrastructure and human capital, which pushes productivity and, hence, the rate of returns on investment. The high-income states have better social and demographic characters and higher per capita resources along with infrastructure, which are vital to attract private investment (Kurian, 2000).

The differential wage rates are identified as the vital sources of divergence in India, which is against of validity of Samuelson's factor price equalization theorem (Marjit and Mitra, 1996). In general, labour heterogeneity, with respect to skill, heterogeneous nature of industrial structure and administration rules across the states, widens the wage gap in India. The rising wage gap in the manufacturing sector is due to skilled labour (Ramaswamy, 2008; Amiri, 2011). The skilled workers' share in total employment has been increasing in India during the period of liberalization and globalization, which is accompanied by an increase in relative wages of skilled labour. It indicates a shift in the aggregate demand in favor of skilled workers, which could be due to the rise of multinational investment and domestic private investment. The economic liberalization of the 1990s gave Indian industries greater access to the international markets, capital goods and technology[3]. It provided incentives for increasing production, upgrading technologies and modernizing industries. In turn, the

[3]India liberalized trade and foreign investment policies as measures of economic reform in 1991, which focused on the reduction of tariffs, the elimination of the licensing regime, the abolition of non-tariff barriers on imports, the removal of trade monopolies and the simplification of the trading regime and administration procedures.

demand for highly skilled labour increased and led to an increase in economic activities and skill-wages. On the other hand, less-skilled workers were adversely affected. Low demand weakened their bargaining power and led to growing wage inequality.

The globalization and the polarization of the labour market into high and low-skill jobs also enhanced wage disparity. Due to globalization, manufacturing activities were shifted to the countries with lower wages, like India and China. The employment of new technologies increased productivity and efficiency on the one hand and on the other hand, it eliminated millions of formerly low-skill but high-paying jobs. The developed cities had distinct advantages in terms of attracting high-skilled labour, high-technology jobs and other economic assets in the era of globalization and that led to the locational divergence of high skilled workers (Florida, 2002; Berry and Glaeser, 2005). Further, the distribution of skills varies across the types of regions, with higher wage analytical skills being concentrated in the developed regions, and lower-wage physical skills concentrated in less developed regions (Bacold*et al.,* 2009; Florida *et al.,* 2011). Glaeser *et al,.* (2009) noted that, even the inequality could be explained by the clustering of more and less skilled people in particular locations (Glaeser *et al.,* 2009)[4].

From the above discussion, it is not possible to establish the cause and effect relationship between private investment, income and wage rate. Hence, this section presents the estimated results of the causality relations between LGSDP, LLC and LPRI. The descriptive statistics of these variables are presented in Table A3 of appendices. To test the nature of their association, the empirical investigation in this paper begins by testing stationarity property of the variables and then tests for panel cointegration by using methods developed by Pedroni (1995, 1999). Given the long-run equilibrium relationships, we explore the causal link between the different pairs of variables by testing for Granger causality through Vector Error Correction (VEC) regressions. In addition, we estimate Panel FMOLS regressions in order to highlight the effect of wage disparity on the disparity in income and private investment at the state level. The detailed results are explained below.

4.1. Panel Unit Root Tests

The analysis of the dataset is started by testing the statistical properties of the time series by using panel unit root tests. The determining of the time-series properties of the variables is an

[4]For instance, there is increase in wage inequality in urban India over the period 1983-99 due to the increase in the returns on skills, which is itself a consequence of increases in the demand for skilled labour (Kijima, 2005). Similarly, Rubiana (2006) argues that relative demand shifts contributed to relative wage shifts across gender and skill upgrading within industries increases the demand for skilled labor.

important step, as the presence of non-stationary regressors invalidates many standard hypotheses tests (Granger and Newbold, 1974). The stationarity of variables is investigated by the Breitung test, Levin, Lil and Chu test, IPS test, Fisher-type tests using Augmented Dickey-Fuller (ADF) and Philips-Perron (PP), and Hadri tests. The tests have been computed under three different specifications, represented by the inclusion of individual effects, individual effects and linear trends and none as reported in Table 1. The Levin, Lil and Chu, Breitung and Hadri tests assume that there is a common unit root process (Levin *et. al.* 2002; Breitung, 2000). The Levin, Lil and Chu, and Breitung tests employ the null hypothesis of common unit root while the Hadri test uses a null of no common unit root. The null hypothesis of the individual unit root process is verified by IPS and Fisher tests of ADF and PP (Im *et al.*, 2003; Maddala and Wu, 1999). The first four columns report the panel unit-root statistics for the variables at the level. The majority of the tests with various combinations of three types of specification do not reject the hypothesis of unit roots for all the four variables. For instance, only five out of 14 combinations of tests and specifications reject the unit-root hypothesis for LGSDP, whereas the remaining shows the presence of unit root. Hence, the decision is the presence of unit root for LGSDP at the level. The panel unit roots results suggest that the variables at level are not stationary and thus any causal inferences from the series at level give spurious results.

Table 1: Panel Unit Root Test

Variables	LGSDP	LLC	LPRI	D(LGDP)	D(LLC)	D(LPRI)
Exogenous variables: Individual effects and individual linear trends						
Levin, Lin & Chu	-4.04*	1.14	-2.53*	-10.86*	-0.90	-14.88*
Breitung	-0.98	-0.19	-3.16*	-5.71*	5.84	-9.47*
Im, Pesaran and Shin	-2.2**	-2.96*	-1.44	-7.43*	-2.90*	-10.58*
ADF - Fisher	64.93**	62.66**	50.15	121.92*	77.29*	163.03*
PP - Fisher	57.62**	41.36	44.90	160.66*	90.93*	206.73*
Hadri z-stat	6.90*	4.54*	5.53*	6.9*	4.99*	4.22*
Exogenous variables: Individual effects only						
Levin, Lin & Chu	0.82	3.05	1.19	-11.65*	-4.52*	-18.10*
Im, Pesaran and Shin	2.82	3.79	1.69	-9.73*	-7.70*	-14.51*
ADF - Fisher	32.71	24.48	26.72	158.89*	133.25*	227.051*
PP - Fisher	36.60	21.36	23.49	178.96*	139.74*	264.57*
Hadri z-stat	10.12*	11.33*	8.73*	10.12*	-0.19	0.29
Exogenous variables: None						
Levin, Lin & Chu	8.73	8.09	4.85	-8.55*	-11.40*	-16.70*
ADF - Fisher	4.15	2.24	4.00	212.07*	166.24*	263.51*
PP - Fisher	6.16	1.52	3.32	225.12*	180.90*	304.96*

Note: * significant at 1% level, ** significant at 5% level at 10% level. Automatic selection of lags based on SIC. Newey-West bandwidth selection using Bartlett kernel. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. Probabilities for Hadri test is computed using Z distribution.
Source: Author's calculation using EViews 8.

The last three columns report the panel unit-root statistics for the first differences of each variable. Similarly, the table shows that the majority of the test statistics indicate rejection of the null of non-stationarity for all variables. It may, therefore, be concluded that all the variables are unit-root variables of order 1 or integrated of order 1.

4.2. Panel Cointegration Analysis

Having found that all variables under consideration are of I (1) process, we then proceed to test whether a long-run relationship exists between them. Pedroni's within and between dimension results of the panel cointegration tests and Kao's panel cointegration test results under the three different specifications are presented in Table 2. Two of the four panel test statistics and two of the three group test statistics along with Kao's (1999) test statistics suggest that there is a panel cointegration. Hence, the majority of the test statistics indicates the existence of panel cointegration in all the three specifications among the set of variables. The group Phillips and Perron (1988) statistic, and the group Dickey and Fuller (1979) ADF type t-statistic are statistically significant at 1 per cent. According to Pedroni (2004), the Phillips and Perron (1988) type rho and t-statistics tend to under-reject the null in the case of small samples. Thus, given that two of the three tests suggest panel cointegration in most cases, it is reasonable to conclude that all variable sets are cointegrated. In sum, there is strong statistical evidence in favour of panel cointegration; hence, there may be long-run relationships between the variables under consideration.

Table 2: *Pedroni and Kao Panel cointegration tests results*

	Trend assumption: No deterministic trend		Trend assumption: Deterministic intercept and trend		Trend assumption: No deterministic intercept and or trend	
Tests	Statistics	Weighted statistics	Statistics	Weighted statistics	Statistics	Weighted statistics
Pedroni Residual Cointegration Test:						
Panel v-Statistic	0.42	0.11	-0.55	0.42	0.86	0.49
Panel rho-Statistic	-0.73	-0.66	1.04	0.80	-0.35	-0.45
Panel pp-Statistic	-3.61*	-3.89*	-3.56*	-4.83*	-2.35*	-2.31*
Panel ADF-Statistic	-4.23*	-4.47*	-3.58*	-4.85*	-2.76*	-2.69*
Group rho-Statistic	0.56		2.67		0.28	
Group pp-Statistic	-4.89*		-5.06*		-4.25*	
Group ADF-Statistic	-5.28*		-4.07*		-5.19*	
Kao Residual Cointegration Test:						
ADF-t Statistic	-4.99*					

Note: * significant at 1% level. Automatic selection of lags based on SIC. Newey-West automatic bandwidth selection using Bartlett kernel.

Source: Author's calculation using EViews 8.

In addition, Kao's (1999) residual panel cointegration tests reject the null of no cointegration at 1 per cent significance level. Further, in order to confirm the test results of these two tests, we then use Johansen's approach, which enables us to determine the number of cointegrating vectors as well. The optimal lag length is chosen based on Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC) in Johansen's

(1988) Fisher panel Cointegration test. The results suggest that there are two conintegrating vectors, which are statically significant at 1 per cent (see Table A4 in appendix).

4.3. Long-run Impact and Causality

The cointegrating relationships between the variables allow estimatiion of the long-run impact on each other. However, the presence of panel cointegrations makes the OLS estimators biased and inconsistent. Hence, this study utilises the panel FMOLS estimator[5], which not only takes into account the problem of endogeneity of the regressors but also the serial correlation in the error term (Fayissa and Nsiah, 2013). Recently, several studies have used panel FMOLS, such as Ouedraogo (2013) and Liddle (2012). The three models are estimated for the three variables and their results are presented in Table 3.

Model 1 estimates the effect of disparity in wage rate and private investment on per capita income. The estimated regression coefficients are strongly significant at 1 per cent level with the expected signs. The estimated coefficients of LLC and LPRI are 0.61 and 0.13, respectively. These results submit that the labour market is crucial for the increasing regional disparity in the long run income as argued by Marjit and Mitra (1996). The differential in wage rate could be due to the heterogeneous element of industrial structure and administration rules, which causes regional divergence across the Indian states (Marjit and Mitra, 1996). Specifically for the manufacturing sector, the labour market is crucial for the regional disparity in Indian states following the liberalisation measures, including de-licensing, in India (Aghion *et al.,* 2005). Similarly, Model 2 provides the result that LGSDP and LPRI are significant for the regional disparity in wage rate. As expected income and private investment affect wage rate positively. Finally, Model 3 shows that the coefficient of LGSDP is only strongly and positively significant in explaining the disparity in LPRI. Therefore, in the long-run, the bidirectional causality run between income and wage rate and between income and private investment. However, the inflow of private investment positively affects wage rate across the Indian states. The finding is in line with the two famous hypothesis, i.e, ‘ability to pay’ and ‘technology’ as evidenced by Dholkia (1976) and Papola (1972) in the case of the manufacturing sector in India. According to the ‘ability to pay’ hypothesis, the wage rate is determined by labour productivity. In a competitive market condition, the wage rate is equal to the marginal product of labour. The inflow of private investment raises labour productivity, which pushes the wage rate. Similarly, as per the

[5]Panel FMOLS is used because of a small sample of the study. The FMOLS has relatively lower small sample distortions (Pedroni, 2001; Ouedraogo, 2013) and more flexibility in terms of hypothesis testing (Basher and Mohsin 2004).

technology hypothesis, the adoption of improved technology or upgradation of the existing machinery demands more skilled workers and supervisors. This necessitates provision of training to the existing workers and the recruitment of more skilled workers and supervisors. Experienced and skilled labour is available at higher payment rates in the competitive labour markets. The adoption of advanced technology raises labour productivity. Consequently, wage rates would go up. In this context, FDI is more technology intensive than that of domestic counterparts in developing countries. Hence, foreign owners pay higher wages than local firms do in the emerging economies (Arnal and Hijzen, 2008; Viren, 2005). However, labour cost is not significant in determining the inflow of private investment across the Indian states in the long-run. The inflow of private investment is driven by labour productivity, as noted by Mallick (2013b). The findings suggest that the labour market is responsible for the disparity in economic development and significantly beneficial to the inflow of private investment in the long-run.

Table3: *Panel Fully Modified Least Squares (FMOLS) Estimates*

Independent Variables	Model 1	Model 2	Model 3
	LGSDP	LLC	LPRI
LGSDP		0.65*	2.67*
LLC	0.61*		0.29
LPRI	0.13*	0.08**	

Note: * and ** denote significant at 1 % and 5 % level of significance, respectively.

The causal relationship is now examined more thoroughly with the use of panel VECM estimators. Defining the lagged residuals from the estimated long-run cointegration equations, the dynamic error correction models are estimated[6]. The optimal two-year lag structure is chosen, using SIC and AIC criteria. By focusing on the purpose of the study, the short-run causality is examined using the Granger causality test based on the specified VECM. This test takes into account the joint effect or the significance of both the one-year and two-year lagged variables. The result is presented in Table 4, which indicates that in the short-run there are two unidirectional causalities and one bidirectional causality in this system of equations. The change in the per capita income immediately affects wage rate significantly. However, the change in wage rate does not cause income disparity in the short-run. The inflow of private investment causes income disparity in the short-run, and hence the wage rate. The inflow of private investment raises the demand for labour, which pushes the wage rate. Finally, private investment is caused by the income in the short-run. As mentioned earlier, the states with higher income are expected have a sound consumer market, better

[6] Details of the results on the PVEC estimation are available from author.

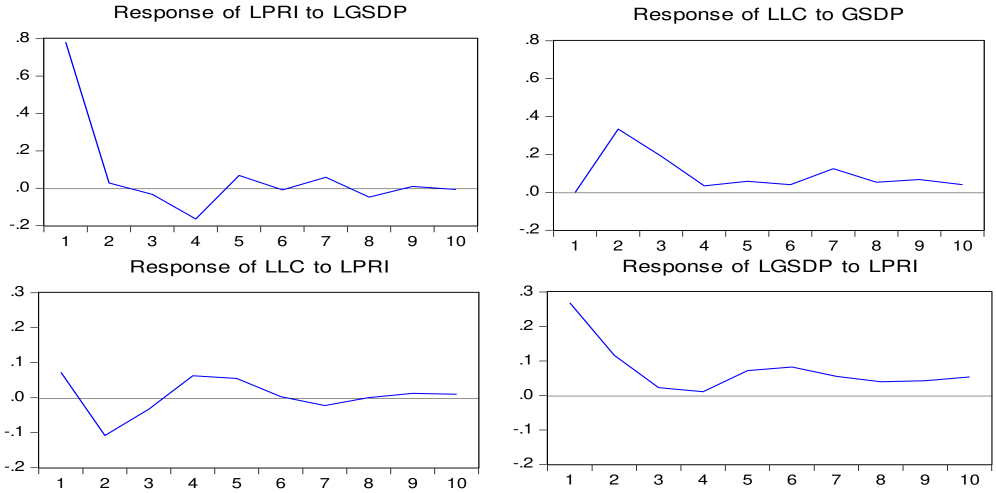
human capital and better quality of infrastructure, which maximises profit and rate of return on investment. Nevertheless, wage does not cause inflow of private investment. It could be due to the significance of labour efficiency or productivity raising the rate of return of firms as evidenced in the context of Indian states (Mallick, 2013b). Further, Noorbakhsh *et al.,* (1999) noted that skilled labour is significant in determining the inflow of FDI into developing countries, because FDI is shifting towards the knowledge and skill-intensive manufacturing sector. This shift is also taking place across the broad groups and again within the same group of manufacturing industries. Given the locational factors along with minimum levels of skills, the comparative advantage of low labour costs may still matter, but only in a handful of low technology activities. In this context, it can be stated that the significance of skilled labour or productivity depends on the structure of the industries. This finding confirms that the labour market is crucial and significantly beneficial to the inflow of private investment in the short-run as well. In turn, it affects the per capita income across the Indian states.

***Table 4**: PVEC Granger Causality/Block Exogeneity Wald Tests*

Excluded Variables	D(LGSDP)	D(LLC)	D(PRI)
D(LGSDP)		37.74*	8.20**
D(LLC)	1.63		3.15
D(PRI)	39.21*	18.66 *	
All	44.73*	65.84 *	9.30**

Note: The values in the table are the chi-square values. The values *, ** and *** represent the statistical significance at 1%, 5% and 10%.

Fig 3. Response to Cholesky One S.D. Innovations



The above mentioned short-run relations have been estimated through the impulse-response functions (IRF) based on the panel VECM specification. The system is perturbed by a one-time unit shock on each of the variables to analyse how the shock changes the time path of the variables. Point estimates of the impulse responses and their corresponding

90 per cent confidence intervals are calculated for a time horizon of 10 years. The results of the impulse response analysis for the above four significant relationships are presented in Figure 3. The figure indicates that one standard deviation change in income positively affects the inflow of private investment for the initial two years. The positive shock to private investment has sudden positive impact on income and wage rate. Further, the positive shock to income is associated with the increase in private investment.

Variance decompositions (VDC)

In this section, we use the Forecast Error Variance Decomposition (FEVD) as an analytical tool to assess the relative importance of the shocks of variable in explaining fluctuations of other variables in the system. While impulse-response functions provide information on the size and speed of target variable due to shocks on other variables in the system, they do not give information on the importance of shocks on the variance of target variable on the other variables. We have analysed the variance decomposition, which indicates how much of forecast error variance of each variable can be explained by exogenous shocks (changes) to the variables in the panel VECM model[7]. The FEVD results are presented in Table 5 over forecast horizons of six years.

Table 5. Variance Decompositions analysis

Period	S.E.	LGSDP	LPRI	LLC
Proportions of forecast error in LGSDP accounted for by				
1	0.67	100.00	0.00	0.00
2	0.81	66.13	18.88	14.99
3	0.84	61.52	19.47	19.01
4	0.88	58.33	25.65	17.02
5	0.89	55.69	25.30	17.00
6	0.91	52.24	28.15	16.21
Proportions of forecast error in LPRI accounted for by				
1	1.08	7.43	92.56	0.00
2	1.28	17.01	72.07	03.92
3	1.34	20.22	67.60	12.18
4	1.48	24.97	59.13	15.89
5	1.52	27.66	55.66	16.67
6	1.63	30.28	53.49	16.22
Proportions of forecast error in LLC accounted for by				
1	0.28	6.59	3.33	90.08
2	0.33	15.04	9.02	75.95
3	0.35	16.03	13.16	70.80
4	0.36	18.02	17.20	64.78
5	0.38	18.19	20.93	60.87
6	0.39	19.82	22.10	58.08

[7]The FEVD measures the fraction of the *s*-step ahead of forecast error variance (FEV) of an endogenous variable due to the innovations or structural shocks to itself or to another endogenous variable in the system (Lutkepohl, 2005; Ewing *et al.,* 2007). That means it decomposes the FEV into the components accounted due to shocks in the different endogenous variables (Lutkepohl, 2005; Ewing *et al.,* 2007).

Table 5 shows the contribution of the FEV explained by a LGSDP shock on the relevant variables in the system. It is evident in the first year that LGSDP itself explains 100 per cent of forecast error in its own value and it explains the largest proportion of forecast error throughout the period of six years. However, the explanatory power of LLC and LPRI has increased in this duration. By the end of six years, wage rate and private investment are emerged to explain the variance of LGSDP by 16 and 28 per cent, respectively. The analysis finds that the larger proportion of forecast error variance in LPRI is explained by its own value whereas LGSDP explains around 7 per cent of the forecast error variance in the first year. As the time horizon moves on, the explanatory power of LGSDP increases and they explain 30 per cent by the end of six years. Similarly, in the first year the forecast error variance of LLC is explained mainly by its own shock. However, as the time progresses until six years, variance due to its own shock goes down to 62 per cent, and variance due to LGSDP and LPRI increases to 20 per cent and 22 per cent, respectively.

In brief, in the long-run, the regional wage disparity has bidirectional causality with the disparity in income across the Indian states during the period of liberalisation. In addition, private investment is crucial in this rising disparity in wage rate and income across the states in the long-run. Pertaining to short-run causality, there is bidirectional causality between private investment and income. Wage disparity is caused by disparity in income and private investment because the inflow of private investment demands skilled labour and it raises wage rate. Similarly, as income increases, consumption demand increases and that requires increase in production. In turn, it demands for skilled labour by increasing wage rate. However, the wage rate in the short-run does not cause the private investment and income, either.

5. Conclusions and Policy Implications

This study investigates causal relationships between per capita income, per capita private investment and wage rate in the registered manufacturing sector across the Indian states during the period of liberalization. The preliminary analysis suggests that there is an increasing trend in the regional disparity of per capita income, per capita private investment and wage rate across the 20 major states. The study uses the panel data method for the empirical analysis to establish the cause and effect relationships during the period in 1993-94 to 2007-08. The unit root test shows that all the variables are integrated of Order 1, which allowed the test for cointegration. The residual cointegration test of Pedroni and Kao suggests the existence of long-run equilibrium relations, which is again confirmed through the Johansen Fisher panel test by identifying two cointegrating vectors. Then, the long-run effects of each variable are examined by panel FMOLS method. The results show that the long-run disparity in income is explained by wage rate and private investment while the long-run disparity in wage rate is explained by income and private investment and the long-run disparity in private investment is explained by the per capita income only. Finally, the results on short-run causality through Block Exogeneity Wald test evidenced that the short-run disparity in wage rate is caused by private investment and per capita income. In the short-run, there is a bidirectional causality between private investment and income and two unidirectional relationships run from private investment to wage rate and income to wage rate. These short-run relationships are also revealed in the impulse response functions and VDC analysis.

The main findings of this analysis suggest that private investment plays an important role in shaping the disparity in wage rate and income. The reduction in regional imbalances is crucial for the sustainability of high economic growth in India, which requires even allocation of private investment and lowering of wage gap. Mallick (2013a; 2013b; 2014; 2015) laid emphasis on human capital, productivity and infrastructure as the crucial locational factors for the inter-state allocation of private investment. Furthermore, better human capital and infrastructure can drive up economic growth directly by serving as inputs in production and, indirectly, by promoting innovations and attracting private investment. Further, they help in reducing income inequalities across different sections of people within a state as well (Besley *et al.,* 2013). Labour productivity also determines the wage rate in the Indian manufacturing sector (Sidhu, 2008). Skilled labour is the cause of the disparity in productivity and hence the wage rate in the manufacturing sector in India (Ramaswamy, 2008; Amiri, 2011). The shift in aggregate demand in favour of skilled-labour leads to an increase in wage disparity in this sector. The literatures established that variation in wage inequality is also associated with human capital, skill levels, occupational structure, skill-biased technical change and job polarization.

Hence, central and state governments are required to take the practical measures such as development of infrastructure and human capital in the poor states to ensure fair allocation of private investment (Mallick, 2015c), and to provide training to improve the skills of the low-wage labourers to catch up with skilled labourers. Hence, the augmentation of health and education levels to increase labour productivity in low performing states is essential. To ensure this, well-directed social programmes focused on enhancing the health and education of the labour force, especially in rural areas of the backward states, are required. Various initiatives, such as the recent "Skill Development Programme"[8], are being taken by the Indian government but it matters more to implement them effectively. In these programmes, special considerations should be given to the rural labour force in the backward states, which will reduce the wage gap across the states. However, the central government distributes public resources among states through standard formulae, which is intermediated by the Finance Commission to maintain equity. In addition, the central government distributes various discretionary schemes, which are mainly determined by the political equations of the central government with the individual states.

The current Finance Commission has recommended a new approach of 'cooperative federalism' in consultation with the states to reduce regional disparities and foster economic growth[9]. However, its success relies on the design and implementation of policies by state and local administrations, which should emphasise the above aspects. In particular, a higher share of resources should be allocated to states that have low quality of human capital, high proportion of unskilled labour and poor infrastructure.

The findings provide scope for important policy initiatives to reduce wage and income inequalities across the Indian states. The present paper contributes to the existing studies at the state level in a number of ways. Primarily, the present paper is the first in kind to study the issue in the context of the manufacturing sector in the Indian states. This study adds to our understanding of the relationship between private investment, income and wage rate from a regional perspective. Secondly, this study suggests necessary policy recommendations that could stem the increasing disparity in economic development across regions. Furthermore, the detailed analysis by considering one important sub-sector of the manufacturing industries would probably give more insight into the relationship between private investment, wage rate and income.

[8]For the detail of skill India Programme, see http://pib.nic.in/newsite/erelease.aspx?relid=123296 .
[9]The recommended approach involves a significant increase in the fiscal devolution to states from 31.54% to 42%, reduction in fragmentation of fiscal transfers, and providing states with larger fiscal space to plan and spend based on their needs and priorities.

Appendices

A1. Estimation of private investment in Indian States

The study uses the methodology of CSO in defining investment. Investment is measured as the GFCF, which comprises construction, machinery equipment and computer software equipment (CSO, 2007). The study uses both the plant level data of ASI and the aggregate data of the NAS. Plant level data of ASI provides information on various blocks. A block provides PSL No., industry code, description of industry, state code, district code, sector code (i.e. rural and urban) code and the number of units. The PSL No., and industry code are used for the identification of the sample. Block B provides information on the ownership, which categorises all the units by the ownership. There are 6 types of ownerships, i.e. (1) wholly Central Government, (2) wholly State and/or Local Govt, (3) Central Government and State and/or Local Government jointly, (4) joint sector public, (5) joint sector private, (6) wholly private ownership. The joint sector private and wholly private ownership are considered as private ownership, while the other four are in the category of public sector ownership, as defined by the NAS.

The indicators related to GFCF are provided in the Block C of unit level data. Block C provides data on net value of fixed asset (closing as on), net value of fixed asset (opening as on), additions during the year due to revaluation and depreciation provided during the year by types of assets, i.e., land, building, plant and machinery, transport equipment, computer equipment including software, pollution control equipment and others. As per CSO (2007), the GFCF is measured as the net fixed capital formation (NFCF) plus the depreciation. The NFCF is net value of fixed asset (closing as on) – net value of fixed asset (opening as on) – addition during the year due to revaluation. Hence, the GFCF is equal to net value of fixed asset (closing as on) – net value of fixed asset (opening as on)-addition during the year due to revaluation plus depreciation provided during the year. Further, except land, all other assets are considered as capital creating assets (CSO, 2007).

The information in Blocks A, B and C are combined over the years from 1993–94 to 2007–08 to give data on indicators related to GFCF, types of ownerships, types of industries, states, etc., at the enterprise level. First, private enterprises at the state level are picked from the data. Then the above methodology is used to estimate the private GFCF for all the enterprise at the state level. The indicators related to GFCF in the unit level data are at current prices. Hence, the estimated GFCF is also at current prices. There are various limitations including the coverage in the unit level data. The NAS provides the aggregate of GFCF for the private sector in India. Hence, the national private GFCF at constant prices (2004–05=100) is distributed over the states on the basis of their share by using the estimated private GFCF from the unit level data of ASI.

Table A2: Averages of income, wage rate, employment and private investment

Years	LC (in '0')	GSDP	PRI
1993	4470	1420	586
1994	4610	1633	592
1995	4980	1658	998
1996	4970	1730	1327
1997	5430	1872	1457
1998	5420	1886	1512
1999	5810	1897	1398
2000	6550	1730	899
2001	6660	1683	1086
2002	6770	1930	1175
2003	6860	2078	1218
2004	6240	2351	2153
2005	6430	2490	3474
2006	6530	2822	4337
2007	9300	3086	5644

Table A3: Descriptive statistics

	LGSDP	LLC	LPRI
Mean	7.29	10.95	6.76
Median	7.34	10.93	6.80
Maximum	9.03	12.15	9.78
Minimum	3.98	10.16	1.95
Std. Dev.	0.92	0.35	1.41
Observations	300	300	300

***Table A4**: Johansen Fisher panel cointegration test#*

No. of CEs	Fisher Stat*(From Trace test)	Fisher Stat*(From Max-eigen test)
None	180.6 *	159.3*
At most one	62.36**	58.22**
At most two	49.03	49.03

Note: * significant at 1% level. *#Probabilities are computed using asymptotic chi-square distribution.*
Source: Author's calculation using EViews 8.

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