CHAPTER 4

DETERMINANTS OF REAL WAGES

In labour-surplus developing countries, a positive or non-zero wage exists with large-scale unemployment or underemployment. There may be a situation where a perfectly elastic supply of labour with rigid wages, corresponding to a subsistence-level wages, exists. This may be due to various structural and institutional factors affecting wages in the agricultural sector. It is also possible that stable or even rising wages exist with large-scale unemployment. The basic question then is why unemployment among workers does not put pressure on wages to push them down to low market-clearing levels. In this situation, it is interesting to study the factors that determine wages in labour-surplus economies. The majority of the workforce in India resides in rural areas and works in the agricultural sector. A disproportionately large number of workers dependent on the primary sector are a reflection of uneven development of other sectors, which are thus unable to absorb labour. This may render the workers as skill-wise redundant outside the agricultural sector. The pressure to absorb labour falls on the agricultural sector in this situation. This gets compounded with increasing population. Hence there is a situation of large-scale unemployment and underemployment prevailing with low subsistence-level wages.

Further, from the previous chapter, it has been observed that some states have oscillated between very high and very low growth rates of real wages during the reference period of study. These states are West Bengal, Karnataka, Andhra Pradesh, Madhya Pradesh and Maharashtra. During the initial period 1960-61 to 1974-75, West Bengal recorded a insignificant growth rate which increased by 5.41 percent during 1975-76 to 1990-91 which, however, declined by 1.74 percent during 1991-92 to 2005-06. Similar trends in the growth of real wages were also observed in Maharashtra whereas Karnataka observed a very high growth rate of real wages during post reform period over
the insignificant growth of previous periods. The result suggests that there are various factors other than reforms which may have affected the growth rates of real wages. Labour market may have responded to the positive changes brought about by Green Revolution by shifting demand curve for workers to right thereby increasing demand for agricultural workers. Alternatively, there could be tightening of labour supply, on account of diversification of workers into non-agricultural occupation, thus shifting the labour supply curve to left. In addition to this, there are some exogenous factors, like reduction in investment in agricultural sector and irrigation during 1990s affected the growth of agricultural output directly which in turn affected the demand for workers in the labour market. Further, there are some state-specific factors for changes in growth rates of agricultural wages.

Hence an attempt is made in this chapter to explore the reasons or factors for such variations in the growth of real wages in Indian agriculture within the basic framework of demand and supply of labour. Second, to control for all state-specific factors for such changes. The Panel data regression analyses have been used to identify the determinants of wages over the entire reference period, 1960-61 to 2005-06. Further to see whether the determinants have changed over time, the entire period has been divided into sub-periods, such as initial period- 1960-61 to 1974-75, pre-reforms period-1975-76 to 1990-91 and post-reform period -1991-92 to 2005-06. There are number of factors other than the market forces, such as institutional and non-institutional factors influencing the determination of wages. Such factor, inter alia, includes migration of labour, bonded labour, effect of labour union and state intervention. However, exploring such factor falls outside the scope of the present chapter/study. Present chapter mainly confines to explore factors of determination of real wages within the neo-classical demand and supply framework thus ignoring various institutional and non-institutional factors.

In Section I, briefly outlines the existing hypothesis which explains the basic model of agricultural wage determination. A brief review of some of the relevant studies that explore the factors explaining variation in real wages within the demand and supply framework is done in Section II. Section III presents an analysis of the variables of
determinants of real wages. Section IV briefly discusses the concepts, data sources and methodology adopted in this chapter. Section V deals with the model and its interpretation and the last section Section VI contains the conclusion and the scope for further research.

Section I

4.1 Important Theories or Hypotheses of Wage Determination

There are broadly four important theories or hypotheses of wage determination:

   (i) Lewis-Ranis-Fei’s Efficiency wage model,
   (ii) The labour turnover model,
   (iii) The neoclassical model and
   (iv) The inter linkage model.

4.1.1 Lewis-Ranis-Fei’s Efficiency Wage Model

Classical economists are of the view that market wage higher than the natural or subsistence wage would increase the population and thereby labour supply and vice-versa\(^1\). An increased labour supply would push wages down to subsistence level. The Ricardian wage theory assumes that labour supply will be perfectly elastic at long-run supply price or subsistence wage and reproduced at constant cost. However, once the fertile land available for cultivation gets exhausted, food cost would rise leading to decline in the standard of living. Therefore, unless and until there is an improvement in productivity, labourers would find it difficult to maintain their position from further deterioration. According to the classical economists, factors which influence wages include price and extent of prime necessities of life, which are historically developed and naturally determined, cost of training and productiveness of labour. Given these

\(^1\) Natural wage or subsistence wage is the prime cost of reproducing labour. It includes the value of necessaries sufficient to maintain a labourer and his family whereas market wage is determined by demand and supply of labour.
specificities, labour may be compared meaningfully only in terms of labour time required per piece wage (labour intensity), the productiveness and intensity of which vary from one region to another.

Lewis (1954) and Fei and Ranis (1961) have propounded that in labour-surplus underdeveloped countries, the supply of labour is perfectly elastic and real wage rates in such economies are institutionally determined roughly corresponding to the subsistence needs of workers. Further, they argued that in these economies growth is a positive process drawing surplus labour from agriculture to rural non-agriculture without any loss of output. Once the surplus labour is used up, the wage rates would start arising in tune with the other non-agricultural sectors of the economy in such a way that wage rates in the agricultural sector would be equal to those prevailing in the other sectors.

There are other studies that have pointed out the coexistence of unemployment and high wage rates. The most influential version of the surplus labour model is the nutritionally based efficiency wage hypothesis. The "Efficiency wage model" propounded and refined by Leibenstein(1957), Majumdar (1959) and Mirrlees(1975) assumes the existence of surplus labour and rigid wages. These are institutionally fixed real wages, defined in the terms of nutrition-based efficiency wages. The theoretical proposition underlying the nutrition-based efficiency wage model is that it would be profitable for employers to pay a wage rate higher than the subsistence requirement of labourers. There is a positive association between the nutrition level of workers and their productivity. Given the demand for labour the optimum wage could be determined at the equilibrium point, where the marginal productivity of labour time converges with the marginal productivity of work units (in terms of labour time) and the maintenance demanded wage rate adequate to meet the minimum cost of work unit.

The model assumes that at low levels of income, there is a technically determined
positive relationship between nutritional level and labour effort. This income–nutrition–effort relation throws up a unique wage rate which at a certain given level of nutrition, minimizes the cost per unit of labour effort. The efficiency wage model states that labour productivity or effort per labour (or per unit of time) positively depends on the real wage received by labourers. Given the link between consumption and productivity and thus wages and efficiency of labour, it would be in the interest of employers to see that wages do not fall below a certain level because lower wages may not provide workers with the consumption necessary to work effectively.

Further, it demonstrates that given this basic relation, the employer’s profits are no longer strictly a non-increasing function of the real wages. Employers may pay more than the market-clearing wage rate and this may lead to a situation where one may find involuntary unemployment. At efficiency wage, one may find the existence of unemployed workers who may be willing to work at lower wage rates but are unable to find work because of non-availability. Employers are not willing to hire workers at wage rates lower than the efficiency wage, which may be the market-clearing wage rate, because of reduction in efficiency or profit associated with lower wages. Hence it may not be profitable for the farmer/employer to hire them. There exists a unique relation between the real wage and efficiency wage (We), which maximizes the profits for employers. This is also the wage which minimizes the cost per unit of labour effort. If We is less than the market-clearing wage rate (Ws), then the employer must pay Ws since no labourer would be willing to work at a wage less than the market-clearing wage rate. Similarly, if We is greater than Ws, a profit-maximizing employer must pay We which is more than Ws. Given the profit-maximization goal, large number of labourers relative to land and the assumed technical relationship between level of nutrition and work efficiency, it is clear that unemployment and positive or even high wages will coexist. If surplus labour is absorbed then the wage rate will rise in the conventional supply and demand way.

Rodgers (1975) attempted to empirically test the efficiency theory. The nutrition-based subsistence wage was empirically tested to explain spatial as well as inter-temporal
wage variations with data of seven villages in Kosi area in Bihar. He used mode of wage payment, labour-tying arrangements and interrelationships between wages and the dependency ratio in a labour household as empirical evidence of nutritionally determined efficiency wages. It was observed that seasonal wage stability and daily wage rate are negatively related to the earner-dependent ratio of labour households and labour-tying arrangements.

Many studies explaining the efficiency wage theory (Rodgers 1975; Bliss and Stern 1976) observed that efficiency wage higher than the existing wages is to either induce worker to perform better or designed to save time by providing a meal a day. However, it has been pointed out by Narayanmoorthy and Deshpande (2003) that empirical testing of this framework is difficult as it assumes homogeneity of efforts irrespective of the work involved.

Both subsistence and the efficiency-wage hypotheses imply the existence of subsistence or efficiency wage which will be paid to a worker regardless of the condition of competition or monopoly and the demand for and supply of labour (Ahmad 1981).

4.1.2 Labour Turnover Model

An extension of the efficiency wage model is the labour turnover model. It argues that under certain circumstances employers find it profitable to pay wages above the market-clearing levels. This is because of an inverse relationship between wages and the cost of labour turnover. A higher wage may reduce cost of labour turnover in two ways, first, through direct reduction in the workers' quit rate; second, by lowering the per worker replacement cost.

4.1.3 Neoclassical Model

Neoclassical economists developed a theory of wage determination based on the interplay of market forces, i.e. the theory of marginal utility. According to this the value of a commodity or labour is determined by the marginal utility of the good consumed or used. The neoclassical school argued that wage rate measured in terms of marginal productivity
of labour and the demand curve for labour reflected the marginal productivity of various quantities of labour. Neoclassical theory works within the framework of demand for and supply of labour. It assumes that under competitive conditions, prices are determined by marginal productivity. This implies that in a free market wage rates equal marginal productivity. There is an inverse relation between the real wage rate and demand for labour. Under perfect market conditions, a profit-maximizing firm would go on producing more without being constrained by aggregate demand until the wage rate equals marginal productivity.

4.1.4 Interlinkage Model

There exists a vast body of literature on the interlinkage between different types of agrarian institutions and wage rates for agricultural labour. According to the interlinkage model access to land, labour and capital are linked and jointly determine the demand and supply of labour and wages. (Binswanger and Rosenzweig 1984). The wage determination includes various things like contractual arrangements, transaction costs including those of hiring, search for and seasonal availability of labour. All the major markets are interlinked, land, labour, credit, into a single coherent model (Sarmah 2002).

The labour market within the agricultural sector is characterized by a number of informal arrangements involving labour and physical assets as well as social assets. Workers are engaged in multiple activities, extensively drawing upon each other's resources (Bliss and Stern 1981). There is creation and distribution of income which cannot really be explained by the marginal productivity-wage equation (Acharya 1989). Transactions in the labour market are linked with those in the land and credit markets. It is often found that employers give some part of or full wages in advance to labourers. This may either be used for current consumption purposes or to perform some customary function like marriage. It may be repaid, with or without interest, or settled through the wage deduction later (Datta 1997). Further, he points out that interlinkage can be an effective means of countervailing conventional or other bounds on prices in any single
market. This is also an important source of attached labour, current consumption credit often being the very basis of attachment.

4.1.5 Inter-Regional and Inter-Temporal Differences

Apart from the fixed wage theories, a large volume of research has been attempted which shows that wages in the less developed countries are subject to the conditions of demand for and supply of labour which may arise due to inter-regional and inter-temporal differences. Further, many assumptions underlying the fixed wage theories do not hold well. The labour market is imperfect because it prevents the free movement of workers from low-paid to high-paid states and similarly from low- to high-productivity zones. These arise because of differences in production relations or the existence of the family labour. Imperfections arise due to the fact that in a real world situation, many of the competitive conditions are not fully satisfied. Regional differences in wage rates and availability of employment are influenced by formal and informal arrangements between labourers and farmers. A part from these factors, institutional factors, socio-economic factors, etc., may affect the wage levels of agricultural labour.

There are several factors that result in variations in productivity due inter-regional and inter-temporal differences. This in fact leads to differences in levels of development in agriculture. Ishikawa (1972) has referred to the “forward rising” phase of the labour input-productivity relationship. In this phase, agricultural development leads to an increase in land and labour productivity; this in turns leads to increased application of the labour input. Agricultural development may be of four types, biochemical, hydrological (irrigation), mechanical and managerial. All these may contain “labour-using” and “labour-saving” components. In the conventional supply and demand framework, it is in generally believed that agricultural wages are positively related to the variables that increase the demand for labour. These variables include those associated with irrigation, cropping intensity and use of HYVs. The agricultural wage rate is negatively related to the factors affecting supply of labour. These include size of agricultural labour, availability of non-agricultural employment outside
agriculture, demographic pressure and inter-sectoral or inter-regional migration. A market-clearing wage rate would be positively related to the factor which increases productivity, by increasing demand for labour and negatively to the supply / availability of labour which affects man-land ratio unfavorably. Further, level of agricultural development in a region along with resource endowment, which results in inter-regional spatial differences, could also play a significant role in determining the levels of wages in particular region or state. Cropping pattern or operation and labour attachment also play a decisive role in the determination of real wages. It was argued that during lean seasons when high rates of unemployment existed, attached labourers received higher wages and had higher annual income than casual labourers notwithstanding the fact that the daily wage rate of casual labour was higher.

Notwithstanding above stated theories and empirical evidence of relationship between productivity and wages, the question worth investigating is if a similar relationship exists between developing countries.

Section II

4.2 Factors Explaining Variation in Real Wages: The Background

Several studies have been undertaken to analyse the different factors affecting wage rate in Indian agriculture. Variation in the real wages has been attributed to several factors; first, wage rate is linked to agricultural production (Herdt and Baker 1972; Lal1976; Jose 1988; Acharya 1989; Narayanamoorthy and Deshpande 2003; Jha 2007; Srivastava and Singh 2005, 2006). Second, wage rate has been related to cereal prices and the cost of living index (Bhalla 1993; Baby 1997). Third the movement of wage rates has been linked to trade unions (Bardhan 1970). Fourth, deals with the supply side factors affecting availability of labour. These include growth of population, occupational diversification, landlessness and labour-land ratio (Bhalla 1993, 1997; Vaidyanathan 1994; Parthasarathy 1996 Sharma 2001, 2005; Sarmah 2002; Jha 2007). Fifth,
institutional forces like in-migration and hired labour (Acharya 1989; Jose 1988; Sharma 2005) and possible alternative sources of income are other factors to which variations in wage rate have been attributed. Some studies suggest that intervention by the state in the form of fiscal expansion and capital formation also have significant impact on wage determination (Bhalla 1998). Last, poverty-alleviation programmes, relief works etc. also affect wages (Unni 1997).

Most of the earlier studies have focused on the demand and supply framework while explaining variations in real wages over time. The demand-side variables considered by the earlier studies are related to productivity, be it land productivity or labour productivity, while the supply side variable is the relative size of agricultural workers available for the agricultural operations to total workers. The studies of Bardhan (1973), Lal (1976), Papola and Misra (1980), Jose (1988), Sarmah (2002) and Narayanamoorthy and Deshpande (2003) emphasized the important demand-side important variables. These include irrigation, increase in cereal output, cropping pattern, variations in the level of output across states, gross cropped area per worker, cropping intensity and production of foodgrain per agricultural labour.

A more accepted version of the view emphasizing demand-side variables has been put forward by Lal (1976). In order to capture the impact of the Green Revolution in agriculture, he has taken percentage increase in cereal output as representing demand variables while percentage increase in male agricultural labour between 1961 and 1971 has been taken as the supply variable. Similarly, Sheila Bhalla (1979) while analysing the inter-district variations in Punjab found that productivity of male agricultural labourers accounts for significant variation in real wages during the early 1970s. Further, in the labour market, the forces of demand and supply acquired increasingly greater importance in the determination of real wage rate during the Green Revolution decade. Similarly, Jose (1988) while analysing the strength of the link between money wages and output per worker for 1970-71, 1977-78 and 1984-85 found a significant relationship between the two. Large parts of the variation in wages were explained by variation in levels of output across states. Growth of agricultural output leading to growth in real wage rates seems to
have held true in as many as nine out of sixteen states.

Increase in productivity affecting real wages as a consequence of the demand effect has been analysed by Acharya (1989). He studied male and female wage differentials separately at a disaggregated level for fifty-eight agro-climatically homogenous regions covering the period from 1970-71 to 1984-85. For the period triennium ending 1982-85, variables like land productivity, proportion of agricultural workers to total workers, land-labour ratio and proportion of labour to total workers in agriculture were considered. Out of these lands productivity and land-man ratio were found positively related to wages whereas the other two variables were negatively associated with it. Acharya stressed that real wages are sensitive to general upswings and downswings in the economy such as agricultural production and inflation.

Diversification among the other variables has emerged as an important factor over time affecting real wages, especially during the 1990s. Bhalla (1993) shows that for most states for the period 1971-72 to 1983-84 (time-series analysis) availability of non-farm work turns out to be a dominant factor affecting real wages and second is the change in the cost of living. She observes for cross-section data for year 1982-83 (thirteen states), variation in labour productivity constitutes the most significant factor in explaining variation in real wage rates. The incidence of poverty among self-employed agricultural households was found to have significant impact while employment structure (diversification) had no significant role in explaining inter-state variations during the same period. She concludes that over time rising labour productivity did not make a decisive contribution to the observed rise in real wage rates. Instead, its role was that of an enabling factor. The prime mover in all the states seems to have been workforce diversification rather than labour productivity.

Similarly, Parthasarathy (1996) used labour productivity and diversification to explain variation in wages. He used NSS data for 1982-83 and showed large variations in money wage rates of male agricultural labourers across states. The results of his inter-
state cross-section analysis for 1982-83 show factors such as labour productivity and diversification as much more important than the supply factor in determination of wage rates. He opines that in the context of surplus labour, wage is at a subsistence level. A slight increase in wages from a very low level is a possibility as a consequence of demand factors. A rise in the wage rate beyond subsistence level, however, cannot be expected in the absence of substantial rise in demand.

While analysing inter-state variations in real wages for the period 1983 to 1993-94, Sharma (2001) has found a positive and significant relation between real wages and productivity per worker and the proportion of rural workers employed in the non-farm sector. Proportion of landless households was also taken as one of the variables in his model, which turns out to be negatively related and insignificant with the real wage rate. Parthasarathy (1996) found landlessness variable with a positive sign which was dropped later to improve specification of the model and to improve adjusted R square.

Apart from the conventional demand and supply variables, Baby (1997) and Reddy (1998) have used retail price of rice and output price per quintal of paddy while explaining variations in real wages in Kerala and Andhra Pradesh respectively. Sarmah (2002), apart from irrigation and non-agricultural labour, has taken urbanization, male literacy and child mortality as variables in order to explain variations. He undertook inter-state cross-section analysis for 1970-71, 1980-81 and 1990-91. Variables such as irrigation and diversification were found to be significant and positively correlated with wage rate. However, urbanization, literacy and child mortality were found to be negatively correlated with wage rates.

Srivastava and Singh (2005; 2006) have co-opted capital investment along with other variables for their analysis. The other variables are agricultural productivity, agricultural diversification, non-farm diversification, capital investment and percentage of agricultural labourers to total rural workers. The variables are chosen in such a way as to reflect the impact of reforms on the demand for labour consequently affecting growth of real wages. According to their findings all the variables are significant and have the
expected signs. Time factor has also been taken into account and most of the variables are found to be significant with time interaction at different levels of probability. Each of the key agricultural growth variables has a significantly smaller impact on agricultural wages in the post-reform period. The major impact on agricultural wages appears to have come from the diversification of workforce away from agriculture and the responsiveness of wages to diversification has increased in the post-reform period. However, diversification has not been able to offset the diminished impact of agricultural growth on wages leading to significant deceleration in real agricultural wages.

Effects of diversification on wages along with labour productivity have also been analysed by Sharma (2005) and Jha (2007) as demand-side variables in the model. The proportion of agricultural labour households to rural households and labour-land ratio were used by Sharma (2005) and Jha (2007), respectively as supply-side variables to explain the variation in real wages. Ahmed (1981) is of the opinion that production uncertainty and proportion of agricultural wage labour to total rural workers negatively affect the supply of workers. Summing up, these studies show that important demand-side variables are irrigation, cropping pattern, gross cropped area, capital investment, agricultural output, labour productivity and yield while land-labour ratio, diversification, percentage of agricultural labourers to total rural workers and proportion of landless have emerged as important variables of affecting supply of agricultural workers.
Section III

4.3 Determinants of Real Wages: An Analysis of the Variables

Many studies, as already mentioned, have attempted to find the determinants of agricultural wages within the conventional supply and demand framework. A general consensus reached by most of the studies is that productivity is the important demand side variable and agricultural workers are important supply side variables. The sizes of workers are in turn determined by diversification of workers into other occupation. Present study has considered some select variables which are used in the previous studies. It is however, believed that it is the aggregative or cumulative effect of technological breakthrough on these variables which increases the demand for labour leading to increase in the productivity of labour and hence wages. We have tried to analyse the impact of the most important variables. Similarly, supply-side variables, those affecting the availability of labour or relative size of labour, are also analysed.

4.3.1 Output per Worker

In the conventional demand and supply framework, on the demand side, productivity has both direct and indirect effect on wages. An increase in productivity may lead to an increase in wages of workers by shifting the demand curve for labour to the right. Demand for labour shifts on account of an increase in multiple cropping, increased uses of HYVs of seeds and irrigation which in turn raises the wages. An indirect effect of increased productivity in the agricultural sector would enhance the demand for non-agricultural products. In order to fulfill this demand for non-agricultural products, i.e. industrial products, the industrial sector would also increase the labour input. One may safely assume that wages offered by the industrial sector would be higher than those in the agricultural sector. This would siphon extra/surplus workers away from the agriculture to industry sector thereby tightening the labour market in agriculture. As a result the diversification of workers into industrial sector would further
push up wages in the agriculture sector. It is observed that in less developed labour-surplus economies, a rise in agricultural productivity raises the purchasing power of farmers and their demand for consumer goods, in turn, provides a boost to non-agricultural employment with a tightening effect on the market for agricultural labour. Increased labour intensity or labour absorption in agriculture could technically be achieved through various operations that include increase in per crop per hectare labour inputs through intensification of operation, increasing cropping intensity or frequency of land utilization over a given time period, introduction of crops with higher labour absorption capacity, intensification of ancillary agricultural activity (capital contraction, processing of inputs and output, etc.) and non-crop agricultural activities such as animal husbandry (Wickramasekara1987).

4.3.2 Diversification

Diversification also has a major influence on wage rate. The proportion of non-agricultural labour in the total labour force is a measure of the availability of jobs outside agriculture and it also measures occupational diversification. In the literature, diversification of workers has generally been associated with workers getting engaged in non-agricultural operations/employment. Many have termed the growth of non-agricultural employment as distressed hypothesis. In a situation of rising wages, there is no need for workers to move into the non-agricultural sector. Vaidyanathan (1986) points out that when the absorptive capacity of agriculture and urban areas reaches its limit, the rural non-farm sector acts as a sponge and attracts surplus agricultural labour. Unemployment rate and non-agricultural employment have a strong positive association and operate as a "push factor". Rural non-agricultural activities become the new residual sector in rural areas. Singh (1989) provides a two-sided explanation of district-level workforce behaviour during 1971 and 1981 and goes on to explain the residual-sector hypothesis. He states that in regions of high growth of agriculture output sustained over two or more years, the agricultural sector due to its increasing ability to absorb labour pulls in workers at a sufficient rate to reduce workforce share in rural non-farm workers while in backward regions where agricultural growth is a recent phenomenon the push
factor predominates.

Diversification of agricultural workers into non-agricultural activities causes withdrawal of a part of the agricultural workforce into the non-agricultural sector and through tightening of the labour situation in the agricultural sector would increase the wage rate in agriculture. Similar is the situation in the non-agricultural sector, without an increase in the wage rate over and in excess of that prevailing in the agricultural sector it would fail to attract workers. Consequently, the situation arises wherein diversification leads to an increase in wages of agricultural workers by tightening their supply and strengthening their bargaining power both in the agriculture and non-agriculture sectors. An indirect effect of diversification is to push up agricultural wages by creating demand for agricultural goods in urban areas. Therefore, there is a need to see whether direct or indirect effect of diversification on wage rate is positive.

4.3.3 Net Sown Area per thousand Worker

Net sown area per agricultural worker indicates the land-man ratio, which inter alia is the function of demographic pressure on cultivable land. It basically reflects the supply of labour. Net sown area to worker also explains the intensity of supply of labour. Higher the ratio of net sown area to total agricultural worker means lower the supply of labour, i.e. the demand for labour relative to net sown area per agricultural worker is high. In this situation, net sown area per agricultural worker has a positive relation with wage rate. However, the relationship between them may turn out negative if the larger proportion of gross cropped area is rain-fed because the requirement/demand of labour per hectare is normally less in rain-fed area (Narayananmoorthy and Deshpande 2003). Further, as long as workers are being absorbed in growing numbers in various labour-intensive operations, the wage rate may increase. However, once the land constraint sets in and high population pressure results in higher growth of agricultural workers relative to land to work upon in excess of the demand for workers, the negative effect of land-man ratio starts operating. An unfavourable land-man ratio may influence the wage rate
negatively. Even for a given population and supply of labour, the wage rate depends greatly on average amount of land available per worker and other productive resources and their distribution. The smaller the amount of productive resources per worker and more unequal the distribution, the more would be workers depending on agricultural land. Similarly, the more unequal the distribution of land as landless labour or workers larger would be numbers of workers depending on land and greater the supply of workers. Further, high demographic pressure, along with unequal distribution of productive resources, leads to excess supply of labour in relation to land thereby creating unfavorable land-man ratio. In this case we may expect a negative relationship between wage rate and land-man ratio.

4.3.4 Irrigation

Irrigation has been taken as a separate variable explaining wages of agricultural workers. Irrigation is labour-intensive work. An increase in irrigation may increase the demand for labour causing increase in wages. It has been pointed out by Bardhan (1977) that the higher yields for wet crops, multiple cropping and the more intensive inter-culture agricultural operations required in irrigated cultivation serve to directly raise the demand for labour. Apart from the direct effects, maintenance of irrigation system indirectly requires labour. Hence a region with higher net sown area under irrigation can be expected to have higher wage rates for agricultural labour. Similarly, Vaidyanathan (1987) indicated that irrigated land is used more intensively (both in terms of extent of fallow land and of multiple cropping) such that it leads to higher productivity, high value crops and substantially higher average yields of practically all crops. Irrigation facilitates HYVs in raising of two or more crops though use of fertilizers and other inputs and makes labour activities attractive. Irrigation also helps in multiple cropping and may create/increase the demand for labour throughout the year. It increases labour productivity, thereby creating demand for labour and thus exerting an upward pressure on wages of agricultural workers. One may assume a positive relation between irrigation and wages via the demand effect.
Section IV

4.4 Data Description, Estimation of Variables and Data Adjustment

4.4.1 States Covered

Fourteen major states are covered here, namely Haryana, Punjab, Uttar Pradesh, Bihar, Orissa, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka, Kerala Tamil Nadu and West Bengal. These states contribute nearly 90 per cent of the total population and value of output of the country. Bihar, Madhya Pradesh and Uttar Pradesh include the newly created states of Jharkhand, Chhattisgarh and Uttaranchal respectively.

4.4.2 Data Description

For panel data analysis both demand side and supply variables are considered. All variables are transformed into their natural logs to manage the high magnitudes of the figures or to minimize the variations among them (except diversification and net area irrigated to gross cropped area which are in percentage). The description of the variables is given in Appendix on 3.2. State wise comparative scenario of selected variables of all the major fourteen states can be observed from the summary table at Appendix 4.1. It is evident from the table that there are wide variations at state level. States like Bihar mean value of real wages is as low as Rs.32.9 whereas in Kerala and Punjab it is as high as Rs.78.5 and Rs. 71.32 respectively. Similarly mean value of net irrigated area to gross cropped area is very high in Punjab (49 percent) whereas it is very low in Maharashtra (9.8 percent). The mean value of diversification of workers into occupation other than agricultural sector is very high Kerala (63 percent) followed by West Bengal (48 percent).

4.4.3 Estimation of the Value of Agricultural Output

For this study, the value of thirty-seven crops has been considered to arrive at the total value of output from agriculture. This covers the period from 1960-61 to 2005-06.
Appendix 4.2 lists the crops covered. The value of the thirty-seven crops is available at different constant prices, which are 1960-61, 1970-71, 1980-81, 1993-94 and 1999-2000. State-wise value of the thirty-seven crops has been aggregated at different prices from 1960-61 to 1999-2000 to arrive at 1999-2000 prices:


b) The data for rice were available for the period 1960-61 to 1980-81 at 1960-61 and 1970-71 prices. From 1980-81 onwards, paddy data were unavailable. To make it a comparable, a conversion factor of 0.66 is applied to paddy, for obtaining time-series data on rice.

c) From 1960-61 to 1964-65, Punjab data includes the value of output of Haryana and there was no separate data for Haryana for this period. To calculate the value of output for Haryana from 1960-61 to 1964-65, the ratio for Haryana was calculated from combined Punjab which included Haryana for the period 1965-66 and 1966-67. This ratio was 37.5 per cent. This ratio was applied to united Punjab for the period 1960-61 to 1964-65 and the value of output was arrived at for Haryana.

4.4.4 Methodology Adopted in Estimating Total Agricultural Workers

Population censuses are the main source of information on the labour force which inter alia includes information on the economically active population on a comparative basis. Many experts have, however, expressed their doubts about the conceptual comparability of censuses. Censuses vary in concepts and methodology, data collection and definitional change which ranges from the regular full-time worker to the non-worker who has not done even a single day's work in the entire year. This thus makes decennial population censuses strictly non-comparable. Another point which needs to be kept in mind is the fluctuations observed in censuses, particularly noticeable in the case of
female workers. These arose to due to the differing concepts and definitions relating to the economically active population adopted in various censuses. This has caused a perceptible fall in females reporting as workers.

In the 1961 census, the structure and order of economic questions laid greater emphasis on landholdings. Definitional change in concepts, methodology, data collection favoured inclusion / counting of marginal workers as much as possible among workers. Agricultural activities and household industries are considered the traditional economic sector with large number of marginal workers. Questions concerning these industries appeared among the first few economic questions asked in the 1961 census. Female workers reported as marginal workers rather than regular workers. Consequently female workers' participation rate was high according to this census. In the 1971 census there was a definitional change. The emphasis was on employment. A person was classified according to the activity in which he spent maximum time. A person could be worker or non-worker. Emphasis was on the main activity apart from the reference period. The question asked was whether a person was mainly a worker or mainly non-worker. This emphasis on main activity led to the exclusion or relegation of many marginal workers to non-worker status. Many female workers who had earlier reported as marginal workers fell into the category of non-workers in the 1971 census. Kundu and Premi (1992) point out that this led to significant decline in work participation rate of female workers in the 1971 census. The way in which questions on economic status in 1971 were canvassed resulted in the exclusion of a large number of female workers from the category of workers on a part-time basis or for whom work was a subsidiary occupation. The 1981 census introduced the concept of marginal workers. This includes people who work for some time during the year but not long enough qualify as main workers.

Consequently, it is difficult to compare workforce from the censuses of 1961, 1971 and 1981 because of the inclusion of marginal workers in main workers in 1961 and their exclusion from main workers in the 1971 and 1981 censuses (Bhalla 1981; Kundu
and Premi1992). Seal (1981) has pointed out that the question on secondary work was not appropriately canvassed and there was serious undercounting of non-workers having some secondary work especially of economically active persons among females in the 1971 census.

A survey was conducted (during December 1971-April 1972) to isolate the spurious change which was based on the economic question carried in the 1971 census and to estimate the actual participation rate. Two different sets of sample persons were chosen. One set was allotted the 1961 census economic question while the 1971 economic questions were given to other set. The whole process of conducting and estimating the survey was called Resurvey on Economic Questions. An interesting point emerged out this process that the number of female work participation in the rural India had decreased by around 15-17 million during 1961-71 and not 28 million as portrayed by the decennial population censuses of 1961 and 1971. It has been suggested by Bhalla (1981) that the 1961, 1971 and 1981 censuses can be made conceptually comparable by either counting main workers only or by counting both main and marginal workers using data from the Resurvey on Economic Questions. In this Resurvey, figures are given which translate the 1961 census data to the “main workers” bases actually used in the 1971 census. These compatible 1961 estimates are known as “adjusted 1961” figures. Similarly, “adjusted 1971” figures are given which are conceptually comparable to the original 1961 census data. Further, she has suggested using main male and female workers if one cannot do without female workers to compare “adjusted 1961” figures, which translate the 1961 census data to the “main workers” bases actually used in the 1971 census data, with main workers figures of 1971 and 1981.

The same procedure has been followed for this study. To achieve comparability in different census data, we have taken the main agricultural workers (cultivators + agricultural labourers). The adjusted 1961 census figures have been compared with the main worker figures of 1971 and 1981. The adjusted figures for 1961 have been taken from the Resurvey on Economic Questions. Likewise main agriculture worker figures have been taken from the 1991 and 2001 censuses. This procedure gives comparable

Decadal growth rates has been used to arrive at figures for main agricultural workers, total main workers including main workers in sectors, agriculture and non-agricultural main workers for 2006. Total agricultural main workers have been taken as a proportion of total main workers. Similarly, diversification away from the agricultural sector is measured as a proportion of non-agricultural main workers in total main workers.

Section -V

4.5 Models and Results

4.5.1 Specification of Models

Panel data are specified hypothesizing a functional relationship between inter-state real wage per worker and its determinants. We are using panel data for controlling individual heterogeneity of the real wages. It is more informative, more reliable, and more efficient and has greater degree of freedom. The cross-sectional information relates to state-wise data of different variables used. This cross-sectional information reflects the differences between subjects whereas time-series data show, the state wise different variables covering a period of 1960-61 to 2005-06. This would reflect the changes within the subject as well as over time. Panel data regression techniques give the advantage of different types of information.

Further, it has been pointed out that with the help of panel data, it is possible to control for some types of omitted variables even without observing them, by observing changes in the dependent variables over time. This controls for omitted variables that differ between cases but are constant over time. It is also possible to use panel data to control for omitted variables that vary over time but are constant between cases.

With repeated observation of enough cross-sections, panel analysis permits the
researcher to study the dynamics of change with short time series. The combination of
time series with cross-sections can enhance the quality and quantity of data in ways that
would be impossible using only one of these two dimensions (Gujarati 1995). Panel
analysis can provide a rich and powerful study of a set of people if one is willing to
consider both the space and time dimensions of the data.

In this section, our main purpose is to prove the working of real wages within the
demand and supply framework. We want to examine whether changes in real wages are
affected by demand and supply variables. The regression model has been constructed by
pooling all the cross-section data related to different variables over time.

Our general equation for explaining the behavioral pattern of real wages may take
the following form:

\[ Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \]

\[ rw_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \] \hspace{1cm} \text{(1)}

where,

\( rw \) = real wage in rupees at 1999-2000 prices

\( X \) = array of independent variables

\( \beta \) = array of coefficients of the variables

\( i=1,2,3,...,14 \) for the fourteen major states.

\( t \) = time period of the study, 1960-61 to 2005-06

\( \varepsilon_{it} \) = white noise

Equation (1) is the constant coefficient model where we have assumed constant
coefficient referring to both intercepts and slopes, i.e. neither significant state-wise nor
temporally.

In the above pooled equations, we have not controlled for heterogeneity of the fourteen major states. Not controlling for the heterogeneity of states in this particular cross-section and time series pooled data may run the risk of biased results. Further, there are variables which are state and time invariant which may affect the determination of wages. These variables are hard to obtain and not all \( \mu_i \) (state variant) or \( \lambda_i \) (time variant) variables are available for inclusion. Omission of these would lead to biased results.

In the case of the panel data model, the error term \( u_{it} \) is a composite residual and given in equation (5)

\[
u_{it} = \mu_i + \lambda_i + \varepsilon_{it} \tag{5} \]

Equation (5) consists of, first, time-invariant state-specific components \( \mu_i \) which capture various characteristics of the states, which are not observable but have a significant impact on their wage determination. Second, states’ invariant unobservable time-specific effects \( \lambda_i \) which are not included in the regression and, third, the remainder stochastic disturbance term \( \varepsilon_{it} \), which is assumed to be serially uncorrelated with mean zero and is possibly homoscedastic. The equation for the panel data model can be specified as:

\[
rw_{it} = \alpha + \beta X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{6} \]

4.5.2 Limitations of Pooled OLS Estimates

Equation (1) is the constant coefficient model where we have assumed constant coefficient referring to both intercepts and slopes, i.e. neither significant state-wise nor
temporally. In equation (1), $\varepsilon_i$ contains $\mu_i$. If $\mu_i$ is correlated with (some of the) $X_{it}$ (s), pooled OLS estimator of $\beta$ (s) will be inconsistent. This is called heterogeneity bias. Thus, even if $\varepsilon_{it}$ is uncorrelated with $X_{it}$ (s), pooled OLS estimator is inconsistent $\text{Cov}(\varepsilon_{it}, \varepsilon_{is}) \neq 0$ for $t \neq s$, as both $\varepsilon_i, \varepsilon_s$ contain $\mu_i$ and hence pooled OLS will also suffer autocorrelation problem.

In order to obtain efficient and consistent coefficient estimates the estimation procedure needs appropriate correction. The solution lies in the following two fixed and random effect models.

### 4.5.3 The Fixed Effect Model

Under the fixed effect model, equation (1) is rewritten as

$$y_{it} = \alpha + \beta x_{it} + \mu_i + \varepsilon_{it} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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Between Estimator.

However, this Between Estimator of $\beta$ will be biased and inconsistent when $\mu_i$ is correlated with $x_{it}$. The assumptions for the FE Model are

(a) Strict Exogeneity: $E(\epsilon_{it} / x, a) = 0$, which implies $E(\hat{e}_t / x_t) = 0$;

(b) Homoscedasticity: $Var(\epsilon_{it} / x, a) = \text{constant for all } t$;

(c) Non-autocorrelation: $Cov(\epsilon_{it}, \epsilon_{js} / x, a) = 0$ for all $t \neq s$.

It may be mentioned that under the strict exogeneity assumption, the FE estimator of $\beta$ is unbiased. If equation (7) contains any observed explanatory variable $z_i$ that is constant over $i$, it does not enter the within regression equation as $\hat{z}_t = 0$. If assumptions (b) and (c) hold for the given data, the FE estimator of $\beta$ will be efficient. Whereas for the pooled OLS estimator of $\beta$, the degrees of freedom is $(nT-1)$, for the FE estimator of $\beta$, the df is $(nT-n-1)$ [because for each cross-section unit the fixed effect transformation forces $\sum_i \hat{e}_{it} = 0$ and hence df reduces df by 1].

4.5.4 The Random Effects Model

As before, we write equation (1) as

$$y_{it} = \alpha_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_K x_{kit} + \mu_i + \epsilon_{it} \ldots \ldots \ldots \ldots (10)$$

The RE model makes the same strict exogeneity, homoscedasticity and non-autocorrelation assumption about $\epsilon_{it}$. Additionally, it assumes (strict exogeneity of $\mu_i$'s and $x$'s) – i.e., $E(\mu_i / x) = 0$; homoscedasticity of $\mu_i$'s – i.e., $Var(\mu_i / x) = \sigma_{\mu_i}^2; i = 1, 2, \ldots, n$; Now $E(\mu_i) = 0$, the intercept term $\alpha_0$ will capture the non-zero mean level of the $y$ data. Equation (10) becomes the RE model if
\[ \text{Cov}(x_{jt}, \mu_i) = 0; t = 1, 2, \ldots, T; j = 1, 2, \ldots, K. \] If this holds, OLS regression of \( y \) on \( x_1, x_2, \ldots, x_K \) based on the pooled data set will give unbiased and consistent estimate of parameters \( \alpha_0, \beta_1, \ldots, \beta_K \).

The composite error term \( u_u = \mu_i + \varepsilon_u \) of equation (10) is necessarily autocorrelated, because \( \mu_i \) is present in \( u_{it1}, u_{it2}, \ldots, u_{iT} \) for every \( i \). The correlation between \( u_u \) and \( u_{is} \) is given by

\[
\text{corr}(u_{it}, u_{is}) = \frac{\sigma^2_\mu}{\sigma^2_\mu + \sigma^2_\varepsilon}; r \neq s; \] this positive autocorrelation of error (which can be substantial) is taken care of in the RE estimation by the following transformation of equation (10)

\[ y_u - \bar{y}_i = \beta_0 (1 - \lambda) + \beta_1(x_{iu1} - \bar{x}_{i1}) + \ldots + \beta_K(x_{iuk} - \bar{x}_{ik}) + (u_u - \lambda u_i) \ldots \ldots (11) \]

Where \( \lambda = 1 - [\sigma^2_\varepsilon / (\sigma^2_\varepsilon + T \sigma^2_\mu)]^{1/2} \).

It may be mentioned that the Random Effect transformation will allow time-constant variables (like dummies for cross-sectional units) in the regression equation. \( \lambda \) is not known. An estimate \( \hat{\lambda} \) has to be obtained. This is done using the residuals obtained from the pooled OLS or FE estimation. OLS estimation of equation (11) [which is a GLS estimation of equation (10) using appropriate variance-covariance matrix of the composite error term] will give the RE Estimate. Under the RE model assumption this \( \lambda \) will be unbiased, consistent and efficient.

4.5.5 Estimation of Determinants of Agricultural Real Wages

By incorporating time and time interaction dummies with the variables, equation (1) which is a pooled equation is developed into the following;
\[
\ln r_w = \alpha + \beta X_i + \lambda t + \varepsilon_{it} \] ........................(12)

\[
\ln r_w = \alpha + \beta X_i + \delta_1 D_2 + \delta_2 D_3 + \lambda t + \varepsilon_{it} \] ........................(13)

\[
\ln r_w = \alpha + \beta_1 X_{it} + \gamma D_2 X_{it} + \omega D_3 X_{it} + \delta_1 D_2 + \delta_2 D_3 + \lambda t + \varepsilon_{it} \] ........................(14)

where,

\( r_w = \) real wage daily wages in rupees at 1999-2000 prices

\( X = \) array of independent variables

\( \beta_1 = \) array of coefficients of the variables

\( i = 1, 2, 3, ..., 14 \) for the fourteen major states.

\( t = \) time period of the study, 1960-61 to 2005-06

\( \varepsilon_{it} = \) white noise

\( \lambda = \) the coefficient of time variable

\( D_2 = 1 \) for 1975-76 to 1990-91; otherwise 0

\( D_3 = 1 \) for 1991-92 to 2005-06; otherwise 0

\( D_2 \beta X_{it} = \) time interaction slope dummy for period 1975-76 to 1990-91;

\( D_3 \beta X_{it} = \) time interaction slope dummy for period 1991-92 to 2005-06;

\( \delta_1 = \) array of coefficient of time dummy

\( \delta_2 = \) array of coefficient of time dummy

The time interaction model signifies the temporal effect on the set of variables.
characterizing cross-sectional unit over a particular time span. D2 and D3 depict the pre- and post-economic reform periods respectively. In our model, we have taken fourteen major states for forty-six years and it will be unrealistic to assume that errors (e) are independent and homoscedastic, i.e, \( E(u_i) = 0 \) for all observation and \( E(rw_{it}) = (\mu_i + \beta X_{it}) + E(e_i) \), when \( e_i = 0 \)

\[
E(rw_{it}) = \mu_i + \beta X_{it}
\]

Similarly, \( \text{var}(e) = E((e_i - E(e_i))^2) = \sigma^2 = \text{constant} \). We may have \( \text{var}(e) = \sigma e_i^2 = \text{not constant} \).

\[
\sigma_1^2 = \sigma_2^2 = \ldots = \sigma_{16}^2.
\]

We estimated two models with its three types, namely pooled, fixed effect and random effect models, to examine the determinants of agricultural real wage within the demand and supply framework.

**Model 1**

In model 1, we have used labour productivity, diversification and net area irrigated to gross cropped area as the explanatory variables with time and slope dummies.

\[
\ln rw_{it} = \alpha + \beta X_{it} + \gamma D_2 \beta X_{it} + \omega D_3 \beta X_{it} + \alpha_1 D_2 + \alpha_2 D_3 + \lambda t + e_{it}
\]

\( rw = \) real wage daily wages in rupees at 1999-2000 prices

\( X_{it} = \) array of independent variables such as \( \ln lp, \text{div, nigc} \)

\( \ln lp \) refers to logarithm of labour productivity

\( \text{div} \) refers to ratio of non-agricultural workers to the total workers

\( \text{nigc} \) refers to ratio of net area irrigated to gross cropped area.
$\beta_1 =$ array of coefficients of the variables

$i=1,2,3,\ldots,14$ for the fourteen major states.

t = time period of the study, 1960-61 to 2005-06

$\lambda =$ coefficient of time variable

$\gamma =$ coefficient of time interaction slope dummy for 1975-76 to 1990-91

$\omega =$ coefficient of time interaction slope dummy for 1991-92 to 2005-06

$D_2 = 1$ for 1975-76 to 1990-91; otherwise 0

$D_3 = 1$ for 1991-92 to 2005-06; otherwise 0

$D_2 \beta X_{it} =$ time interaction slope dummy for period 1975-76 to 1990-91;

$D_3 \beta X_{it} =$ time interaction slope dummy for period 1991-92 to 2005-06;

$\delta_1 =$ array of coefficient of time dummy

$\delta_2 =$ array of coefficient of time dummy

$\varepsilon_{it} =$ white noise

The results have been estimated by STATA 8.1 econometric package and are given in Tables 4.1 to 4.3.
Table 4.1 Pooled Regression Results: Dependent Variable: lnrw

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of Obs = 644</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>107.60</td>
<td>12.00</td>
<td>8.97</td>
<td>F(12, 631) = 186.44</td>
</tr>
<tr>
<td>Residual</td>
<td>30.35</td>
<td>631.00</td>
<td>0.05</td>
<td>Prob&gt;F = 0.000</td>
</tr>
<tr>
<td>Total</td>
<td>137.94</td>
<td>643.00</td>
<td>0.21</td>
<td>R-Squared = 0.780</td>
</tr>
</tbody>
</table>

| Coef. | Std. Err. | t   | P>|t| | [95% Conf.Interval] |
|-------|-----------|-----|-----|----------------|-------------------|
| lnlp  | 0.462     | 0.038 | 12.170 | 0.000 | [0.388, 0.537] |
| div   | 0.003     | 0.002 | 1.740  | 0.082 | [0.000, 0.007] |
| nigc  | 0.007     | 0.001 | 5.150  | 0.000 | [0.004, 0.010] |
| d2lnlp| -0.066    | 0.050 | -1.330 | 0.185 | [-0.164, 0.032] |
| d3lnlp| -0.132    | 0.054 | -2.460 | 0.014 | [-0.237, -0.027] |
| d2div | 0.002     | 0.003 | 0.830  | 0.404 | [-0.003, 0.008] |
| d3div | 0.003     | 0.003 | 1.250  | 0.211 | [-0.002, 0.009] |
| d2nigc| -0.002    | 0.002 | -1.250 | 0.210 | [-0.006, 0.001] |
| d3nigc| -0.009    | 0.002 | -4.680 | 0.000 | [-0.013, -0.005] |
| d2    | 0.566     | 0.410 | 1.380  | 0.168 | [-0.239, 1.370] |
| d3    | 1.368     | 0.447 | 3.060  | 0.002 | [0.490, 2.246] |
| t     | 0.009     | 0.002 | 4.520  | 0.000 | [0.005, 0.013] |
| constant| -1.159 | 0.314 | -3.690 | 0.000 | [-1.776, -0.542] |

lnrw = logarithm of real wages in rupees at constant (1999-00) prices
lnlp = logarithm of labour productivity in rupees at constant (1999-00) prices
div = ratio of non-agricultural workers to the total workers in percent
nigc = ratio of net area irrigated to gross cropped area.
d2 = 1 for 1975-76 to 1990-91; otherwise 0
d3 = 1 for 1991-92 to 2005-06; otherwise 0
The pooled regression analysis shows that all the three variables like labour productivity, diversification and net irrigated area to gross cropped area are statistically significant for the entire period i.e., 1960-61 to 2005-06. However diversification of workers into non agricultural sector is significant at 10 percent level. The time trend is statistically significant for the entire period and post reform period. The pooled regression analyses also include time interaction dummies. It is evident from the table that time interaction effect is positive and significant only with the labour productivity and net area irrigated to gross cropped area only in post reform period with coefficient 0.33 and 0.20 respectively. All other variables with time interaction effect are insignificant.

The above pooled regression analysis is constant coefficient model where constant coefficient is assumed with respect to both intercept and slope i.e, there are neither state- wise nor temporal differences exists for fourteen major states over forty six years. Further, in the pooled model, we have not controlled for heterogeneity of fourteen states. This may lead to biased and inefficient results. There are variables which are state specific but unobservable over time. Likewise time specific state-wise unobservable variables do also affect the wage determination across the states. To take into account the heterogeneity of states, the panel data analysis with fixed and random models has been considered for the present study. The intercept is allowed to vary which takes into account the state specific factors. Further by taking time dummies and time interaction dummies an attempt is made to capture factors determining wages during pre and post reform periods and change occurred, if any, over time. With Fixed Effect Model or Random Effect Model, the adjusted R square improves. Further to decide between Fixed Effect Model and Random Effect Model, Haussman test has been applied.
Table 4.2 Panel Data Regression Analysis: (Fixed Effect Model)

| Coef. | Std. Err. | t     | P>|t| | 95% Conf.Interval |
|-------|-----------|-------|------|-------------------|
| lnlp  | 0.266     | 0.046 | 5.740| 0.000             | 0.175 0.357 |
| div   | 0.006     | 0.003 | 1.760| 0.078             | -0.001 0.012 |
| niggc | 0.011     | 0.002 | 4.310| 0.000             | 0.006 0.016 |
| d2lnlp| -0.080    | 0.036 | -2.250| 0.025          | -0.151 -0.010 |
| d3lnlp| -0.198    | 0.039 | -5.120| 0.000          | -0.273 -0.122 |
| d2div | 0.004     | 0.002 | 2.090| 0.037             | 0.000 0.008 |
| d3div | 0.010     | 0.002 | 4.840| 0.000             | 0.006 0.014 |
| d2niggc| -0.001  | 0.001 | -0.490| 0.625          | -0.003 0.002 |
| d3niggc| -0.006  | 0.001 | -4.940| 0.000          | -0.009 -0.004 |
| d2    | 0.621     | 0.296 | 2.100| 0.036             | 0.040 1.201 |
| d3    | 1.716     | 0.337 | 5.090| 0.000             | 1.054 2.379 |
| t     | 0.009     | 0.002 | 5.050| 0.000             | 0.006 0.013 |
| constant | 0.480  | 0.439 | 1.090| 0.274             | -0.381 1.342 |

| sigma_u | 0.205742 |
| sigma_e | 0.144498 |
| rho     | 0.669675 |

F test that all u_i=0: F(13, 618) = 64.26 Prob > F = 0.0000

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Table 4.3 Panel Data Regression Analysis: (Random Effect Model)

|               | Coef.  | Std. Err. | t     | P>|t|  | [95% Conf.Interval] |
|---------------|--------|-----------|-------|------|---------------------|
| lnlp          | 0.289  | 0.044     | 6.630 | 0.000| 0.203 0.374         |
| div           | 0.006  | 0.003     | 2.280 | 0.023| 0.001 0.012         |
| nigc          | 0.010  | 0.002     | 4.400 | 0.000| 0.006 0.014         |
| d2lnlp        | -0.086 | 0.035     | -2.470| 0.014| -0.155 -0.018       |
| d3lnlp        | -0.204 | 0.038     | -5.390| 0.000| -0.278 -0.130       |
| d2div         | 0.004  | 0.002     | 2.090 | 0.037| 0.000 0.008         |
| d3div         | 0.009  | 0.002     | 4.680 | 0.000| 0.005 0.013         |
| d2nigc        | -0.001 | 0.001     | -0.470| 0.639| -0.003 0.002        |
| d3nigc        | -0.007 | 0.001     | -5.030| 0.000| -0.009 -0.004       |
| d2            | 0.677  | 0.289     | 2.340 | 0.019| 0.110 1.243         |
| d3            | 1.795  | 0.327     | 5.480 | 0.000| 1.154 2.437         |
| t             | 0.009  | 0.002     | 5.220 | 0.000| 0.006 0.013         |
| constant      | 0.265  | 0.404     | 0.660 | 0.512| -0.527 1.057        |
| sigma_u       | 0.1984947|
| sigma_e       | 0.1444979|
| rho           | 0.6536213|
From Table 4.3, it may be seen that all the variables are statistically significant and corroborate our a priori expectations. The Hausman test has been applied in order to decide whether random effect is to be accepted against the fixed effect model or not. The result of the Hausman test statistic of 23.98 rejects the null hypothesis of the difference in coefficients not being systematic and favours the fixed effect model which takes into account the heterogeneity of individual states. The adjusted R Square improves with fixed Effect Model to 0.82 from 0.77 of pooled regression analysis.

Variable like labour productivity, diversification and net area irrigated are found to be statistically significant with expected positive association with real wages. The temporal effect in the model is positive and statistically significant for the overall period of forty-six years. It is found to be significant during the pre- (at 2 per cent level) and post-reform periods.

The time interaction of the effect of the variables on wages is significant in the case of all variables taken up in the model both in the pre- and post-reform periods. The regression coefficients of the model show the following:

i) One per cent increase in the labour productivity results in 0.27 per cent increase in the real wages. The time interaction effect of labour productivity is significant but negative during the pre- (at 2 per cent level of significance) and post-reform periods. This indicates that in both the periods pre- and post-reform, i.e. the period 1975-76 to 1990-91 and 1991-92 to 2005-06 respectively, the responsiveness of real wages to labour productivity declined. In the pre-reform period, 1 per cent increase in the labour productivity results in only 0.19 per cent increase in real wages in agriculture. The responsiveness of real wages to labour productivity, however, declines to 0.07 per cent in the post-reform period. The result is in conformity with the state-wise analysis where labour productivity turns out to be a significant variable with correct sign in explaining variations in real wages (Acharya 1989; Parthasarthy 1996; Sharma 2001; Jha 2007). It is also in the line with other
studies that have reported a decline in the effect of labour productivity over time (Shrivastava and Singh 2005, 2006; Sharma 2005; Jha 2007).

ii) The proportion of non-agricultural main workers to total main workers away from the agricultural sector signifies diversification. Diversification for the entire period i.e. forty-six years has the correct sign and is statistically significant at 10 per cent. Further, the time interaction effect of diversification on wages has improved significantly during both pre-, i.e 1975-76 to 1991-96, and post-reform, i.e. 1991-92 to 2005-06, periods. It may be noted that the time interaction effect is of higher magnitude in the post-reform period.

A one percentage point increase in diversification leads to a 0.60 per cent increase in real wages for the entire time period, i.e. over forty-six years from 1960-61 to 2005-06. In the pre-reform period a 1 percentage point increase in diversification explains 1.00 per cent variation in real wages (significant at 0.3 per cent). The result is in conformity with the findings of studies in which diversification emerged as the prime mover of real wages since the mid-1970s (Bhalla 1993; Unni 1997; Parthasarthy 1996, Bhalla 1997). The responsiveness of real wages to diversification increases to 1.6 per cent in the post-reform period. The results are in conformity with the findings of other studies which have reported a positive effect of diversification of workers on real wages of agricultural workers and the increase in the responsiveness of real wages to diversification in the post-reform period (Srivastava and Singh 2005, 2006; Sharma 2005). The results shows that responsiveness of the real wages increase over time and had greater impact during post-reform period.

(iii) A one percentage point increase in net area irrigated to gross cropped area increases the real wages by 1.1 per cent for the overall period. Though the time interaction effect is negative in both the periods, i.e. pre- and post-reform, it is significant only in post-reform period. Further, the responsiveness of real wages to net area irrigated to gross cropped area declines over time.
which indicates an increase in gross cropped area under irrigation explains less variation in real wages during the post-reform period. A one percentage point increase in net area irrigated to gross cropped area explains only 0.5 per cent variation in real wages during the post-reform period. The above result is consistent with the findings of studies reporting decline in the responsiveness of the real wages to irrigation (Srivastava and Singh 2005, 2006).

4.6 Summary

The results of panel data analysis show that occupational diversification is the most important determinant of real wages in the agricultural sector. The effect of labour productivity on real wages has decreased over time. The results also delineate changing the nature of relationship between the variables and real wages over time especially during the pre- and post-reform periods. The responsiveness of real wages to demand-side variables has declined during the pre-reform period and with much higher magnitude during post-reform period. Consequently, major agricultural variables like labour productivity and irrigation have less impact on agricultural wages during the pre-reform period and even smaller impact during the post-reform period. The responsiveness of wages to irrigation, which is in the form of public investment, has declined over time. The main reason is decline in public investment in the agricultural sector during the 1990s which not only affected agricultural growth but also dried up one of the main sources of growth of agricultural wages.

Diversification emerges as the most important determinant of real wages in the agricultural sector and its responsiveness increases over time especially, during the pre- and post-reform periods. The result suggests that occupational diversification and irrigation, i.e. public investment which boosts agricultural infrastructure, are effective ways of enhancing agricultural wages. The policy implication is that only small parts of gains in labour productivity get translated into wage increase. Any land- or output-based strategy directed towards betterment of agricultural workers has
significantly limited or smaller impact on real wages. Efforts should be focused on the promotion of non-farm opportunities which would siphon off excess workers from the agricultural sector, thus contracting the supply to the agricultural sector and thereby enhancing wages of agricultural workers. The study also delineates the importance of public investment in irrigation to boost agricultural growth and also for enhancing wages in the agricultural sector.