Chapter 1
Introduction

1.1 Motivation for study

Inter-regional differences in growth of income and standards of living of people have been persistent in the process of economic development of developing countries. Even small differences in growth of income/output between regions would result in large differences in standards of living over a long period of time. In order to gain understanding of impact of these differences of growth of income to achieve equitable standards of living, it is important to (a) inquire into the nature and causes of differences in growth rates and levels of income; (b) explain the forces and mechanism that cause differences in growth rates and levels of living; and (c) understand the nexus between the economic growth and its spread across different regions. It is essential because inequality would lead to unequivocal negative effects on subsequent growth and development\(^1\), and worsen the economic, social, and political tension among countries and regions leading to misallocation of resources.

Thus, understanding of the factors, which influence the nature, patterns, determinants and impacts on long run regional growth of income, is essential to formulate appropriate policies and to develop accommodating institutions to mitigate the differentials in growth rates and standards of living in different regions.

India is a democratic, federal republic and welfare state with constitutional demarcation of functions and sources of finances between the Central and State (or regional) Governments. It has been pursuing economic policies to promote economic development as well as attempts at reducing regional imbalances through inter-regional allocation of resources. Nevertheless, regional inequity has been persistent and continues to be a matter of serious concern.

India had adopted the strategy of planned economic development in the form of Five Year Plan periods at the national and state levels. An important objective of planned economic development has been to reduce inter-regional growth of income

\(^1\) Economic growth means increase in per capita real income but economic development is a multidimensional concept. It is ultimately assessed for impact on quality of life (more and better schooling, health, nutrition etc.) and human well-being (Planning Commission, 2002).
through direct participation of public sector and incentives for private sector participation in the process of growth.

Further, there has been significant change in the process of inter-regional growth in Indian economy after the initiation of India’s economic reforms in the mid-1980s and acceleration of pace of reforms following the balance of payment crisis in 1991. The macroeconomic strategies, such as, import substitution and public sector led planned economic development have shifted to export-oriented and private led economic development driven by market forces. This has resulted in a significant change in the growth of real national income as well as a large scale structural transformation of Indian federation. In essence, consequent upon the liberalisation, and privatisation of Indian economy with the re-integration of the rest of the world in a globalisation context; the structures of policies and institutions of Union and State governments have undergone remarkable changes to meet with requirements of achieving greater efficiency in resource allocation. These are reflected in the reduction of discretionary functions of Central to State Governments and by strengthening of local governments (decentralisation) through reforms in intergovernmental transfer system. Discretionary controls with more efficient forms of regulation have been thrusted in the areas such as financial sector, power and telecom industries after removing the licensing controls to allow for privatisation. Further, globalisation has exposed domestic economic aspects for greater national and global competition. Competition has been a prime mover for efficient allocations for gaining greater access to foreign capital and technology for enhancing economic growth. Besides the external liberalisation, economic reforms (e.g., tax and regulation polices) have facilitated for mobility of goods and factors within and between the subnational jurisdictions in India’s federal system. As a result of this transition from plan to market based economic development in India, the sub-national governments realise their greater role to provide physical and social infrastructure and to create accommodating investment climate through public-private partnership to reap the benefits from the market based reforms.

With these changing and restructuring of Indian federal, mixed economy in a global scenario due to financial sector reforms, assignment of regulatory powers, infrastructure reform and development, privatisation of public sector units, tax reforms, reform of centre-state fiscal transfer mechanisms, local government reforms;
many factors are impacting upon inter-state growth and productivity with new dimensions to the size and quality of growth processes. This has provided different opportunities in different states. As a consequence, differences in the ability in different states to avail these opportunities have given rise to a number of issues on the differences in the growth performance [i.e., inter-state (regional) growth of income] and hence, the subsequent differences in the standards of living in different states. One major issue, which emanates in this context is the need is to design and implement policies and institutions in order to achieve balanced regional growth and regional convergence in terms of per capita income and consumption, and combat poverty by spreading the benefits of growth process among regions in India. Thus, there is a need for thorough understanding of the reasons for differences in growth rates to evolve with effective policies and institutions to spread the benefits of growth process to different states.

In this changing scenario of India’s economic-socio-political environments since mid-1980s, it is important to look into the economic factors— which (a) affect the inter-regional (state) growth process before and after the reforms; (b) explain and predict the convergence or divergence of inter-regional growth in income; and (c) determine differential growth rates across regions. This analysis calls for a detailed examination of the nature, patterns, determinants and impacts of differences in inter-regional (state) growth rates so as to achieve the objective of balanced regional growth and equity in India’s economic development under federal and mixed economy framework.

The above analysis has several implications in distinguishing economic factors in regional growth by contributions of private sector, regional policy and non-policy, and federal policy government intervention. Further, the analysis shall help in distinguishing the above factors before and after the reforms. Thus, the implications of this analysis are useful for design of balanced regional development in the process of national economic development.

Therefore, this study is motivated to analyse the economic factors that contribute to variations in average growth rates before and after the economic reforms and to derive imperatives for achieving balanced inter-state growth of income in Indian federation. In particular, a systematic economic analysis of convergence or divergence process in growth rates and levels across the states and to suggest for
policies and institutions to achieve balanced regional growth in Indian federation is the ultimate motivation for this study.

1.2 Review of literature

Despite voluminous literature that exist on regional growth and disparities in India, the review of literature is focussed on growth and convergence to identify the factors—that explain, determine and affect the differences in growth rates and predict convergence or divergence in income across states of Indian federation. Attempt is made to explore lapses and find research issues in these studies to pursue the present study. Thus, a review of the theoretical literature on growth and convergence is carried out in general while a brief review of empirical studies is provided in particular on inter-regional growth and convergence in Indian federal context. The review of literature excludes the conventional pure empirical analysis to explain the wide disparities in per capita income growth across states (Dholakia, 1985; Rao, 1985; Ahluwalia, 2001).

1.2.1 Theoretical review of literature

Growth theory and growth accounting can help explain to understand the vast differences in standards of living and determination of future rate of growth of income over time. For instance, neoclassical and endogenous growth models provide the explanation and prediction for differences in growth and levels of income and hence, convergence and divergence across countries and regions. Convergence property predicted in these growth models is reviewed below.

Neoclassical growth model of Solow-Swan

The basic source of convergence property is derived from neoclassical growth theory. This model aims at explaining differences in growth rates and levels of income of different economies (regions) towards steady state and determines whether the economies are converging over a period of time or not. It satisfies the neoclassical form of production function and assumes constant returns to scale, diminishing returns to each input, and some positive and smooth elasticity of substitution between

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2 A steady state is a situation in which the various quantities (output, saving, gross investment etc.) grow at constant rate (Barro and Sala-i-Maritn, 1995). Solow (2000, p.4) defines a steady state as the requirement that output and employment be growing at some constant proportional rates and that net saving and investment be a constant fraction of output. For then net investment must be growing at the same proportional rate as output, and so must be the stock of capital, which is the sum of past net investment.
two inputs. In this model, the key factors are aggregate production function, capital accumulation over time, and determinants of economic growth, which are exogenously given (e.g. saving rate, $s$, population growth rate, $n$, and rate of technical progress at the rate, $g$).

On account of the property of constant return to scale, the aggregate production function can be transformed into intensive form of production function to get per capita capital, per capita output and per capita consumption. The characterisation of the output growth and capital accumulation in the neoclassical growth model comes from the property of diminishing marginal returns. It predicts an inverse relationship between the initial level of per capita income and its growth rate during the transition dynamics. The growth rate decreases monotonically as capital per capita accumulates. In other words, the lower the initial level of per capita income, the higher is its growth rate. Hence, convergence hypothesis stems from the fact that poorer economies grow faster than richer economies. It measures the speed of an economy from an initial position to its own steady state level, and to the steady levels of other economies. Along the transition, the growth rates of per capita output and consumption exhibit same dynamics as capital per person does. Further, the steady state capital per person is directly proportional to the saving rate and is inversely proportional to the growth rate of population and rate of depreciation of capital.

Introducing the labour augmenting technological progress\(^3\) to the Solow-Swan (1956) model, the same mechanics of characterising transitional dynamics and the steady state can be applied by correcting for the effective depreciation rate\(^4\). In this case, the capital-labour ratio ($\hat{k}$) is defined as the amount of capital per efficiency unit of labour; increases in the number of efficiency units because of technological progress tend to decrease the capital-labour ratio. In the steady state, the investment offsets the reduction in capital-labour ratio due to depreciation, population growth, and technological progress. Therefore, the steady state growth rate of capital, output

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\(^3\) Technological progress is the improved knowledge about methods of production that shifts the production function upward (Barro, 1997). The labour augmenting technical progress raises output in the same way as an increase in the stock of labour. It shows the relative input shares to remain unchanged for a given capital-labour ratio (Harrod, 1942).

\(^4\) Effective depreciation rate consists of population growth rate ($n$), rate of depreciation of capital ($\delta$), and rate of technological progress ($g$) due to labour augmenting technological progress introduced into the basic model.
and consumption per efficiency unit of labour in the Solow-Swan model with technological progress are zero since capital, output and consumption per efficiency unit of labour are constant in the steady state. The per capita variables (capital-labour, output-labour, and consumption-labour ratios) grow in the steady state at the rate of technological progress \((g)\). On the contrary, the level variables (capital, output, and consumption) grow in the steady state at the rate of population growth and technological progress \((n+g)\). The shifts in the saving rate and technology may affect the long-run steady state level variables (quantities per efficiency unit of labour) but not the steady state growth rates. Therefore, the Solow-Swan model shows that only technological progress can explain persistently rising standards of living across economies (Mankiw, 1997). The central prediction of Solow-Swan model concerns the impact of saving and population growth on real income. The model implies an elasticity of per capita income with respect to the saving rate, and elasticity with respect to effective depreciation rate [Mankiw, Romer, and Weil (MRW), 1992].

With the introduction of the technological progress, the Golden Rule level of capital accumulation can be modified as the steady state that maximises consumption per efficiency unit of labour. Steady state consumption at Golden Rule level of capital is maximised if the net marginal product of capital, (marginal product of capital minus depreciation), equals the rate of growth of total output, (growth rate of population plus rate of technological progress). As real economies experience both population growth and technological progress, this criterion must be used to evaluate whether they have more or less capital than at the Golden Rule steady state or not (Mankiw, 1997).

**Augmented Solow-Swan model**

The Solow-Swan (1956) model with human capital gives the strong implications of convergence phenomenon. When this model is augmented by human capital then the speed of convergence is higher and it provides an improved explanation for differences in income levels across countries and regions. Since accumulation of human capital is correlated with the saving rate and population growth rate, once differences in saving and population growth rate are accounted for, there is convergence at the rate the model predicts (MRW, 1992). Thus, in the Solow-Swan model, the growth of income per capita is a function of the ultimate determinants of steady state and the initial level of per capita income. This is the

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5 Human capital refers to education, health, experience, knowledge etc.
extended version of neoclassical growth model (Barro and Sala-i-Martin, 1995, and 1997). Growth of income increases with steady state value for given value of initial income while it decreases with initial level of income for given value of steady state value. The target value of income per capita depends on an array of choice and environmental variables. Private sector’s choice includes saving rate, labour supply, and fertility rate. Each of these depends on the preferences and cost. Government choice involves spending on the various categories such as tax rate, the extent of distortion and business decisions, maintenance of rule of law and property right, the degree of political freedom, the terms of trade etc. Therefore, for a given value of choice and environmental variables, a higher starting level of per capita income implies a lower per capita growth rate. This type of effect is called conditional convergence.

Thus, once the determinants of steady state are controlled for, the neoclassical growth model predicts conditional convergence in the sense that a lower starting value of per capita real income tends to generate a higher per capita growth rate. In other words, the neoclassical growth model predicts that each economy converges to its own steady state and that the speed of this convergence relates inversely to the distances from the steady state (Barro and Sala-i-Martin, 1995).

**Ramsey-Cass-Koopmans model**

Besides Solow-Swan (1956) model, Ramsey-Cass-Koopmans model of consumer optimisation within the neoclassical growth framework provides the explanation and prediction of convergence across economies. However, there are two models of household behaviour, namely, the overlapping generation model (Samuelson 1958, Diamond 1965, and Blanchard 1985) and the representative consumer model (Ramsey, 1928; Cass, 1965; and Koopmans, 1965). These models can approach the Solow-Swan model into a rigorous general-equilibrium model. In overlapping generation model, the economy can accumulate too much capital and reach a steady state with the capital stock greater than what Phelps (1962) called Golden Rule level. This outcome is not possible in the representative consumer models because the representative consumer never chooses an allocation of resources that is dynamically inefficient. However, both the approaches give similar results for the issues addressed by neoclassical growth theory, where the economy can reach a steady state with a constant saving rate, and the steady state saving rate is higher when
consumer preference exhibits more patience. It also arises for specific functional forms and parametric values. The steady state in these models is much the same as the steady state in the Solow-Swan model.

The determinants of growth of output and steady state (i.e., saving rate, population growth and rate of technological progress) in the Solow-Swan model, are exogenous to the system. Incorporating the time preference (ρ) and intertemporal substitution (θ) parameters of household behaviour (representative agent) to choose the levels of consumption and saving over time in an aggregate economy, the saving rate can be endogenously determined in the Ramsey-Cass-Koopmans model of consumer optimisation. Barro and Sala-i-Martin (1995) synthesise the Ramsey (1928), Cass (1965), and Koopmans (1965) models of consumer optimisation within the neoclassical growth paradigm. In fact, Cass (1965) and Koopmans (1965) endogenously determine the saving rate by incorporating the Ramsey's model of consumer optimisation back into the neoclassical growth model.

Since saving rate may be different in different regions and may rise or fall as the economy develops over time, assumption of exogenous constant saving rate may not be valid. Ramsey (1928) constructs consumer optimisation behaviour with infinitely lived households that choose consumption and saving to maximise their dynastic utility, subject to an intertemporal budget constraint. Further, Cass (1965) and Koopmans (1965) refine Ramsey model to determine the saving rate endogenously in their model. Barro and Sala-i-Martin (1995, Chap. 2) show combining the behaviour of households and firms, the Ramsey-Cass-Koopmans model gives the general-equilibrium structure of a competitive market. If saving rate increases with capital-labour ratio (k), then the speed of convergence in Solow-Swan model may be slower and vice versa. But then it still holds the convergence property. Therefore, the Solow-Swan model with a constant saving rate is a special case of Ramsey model.

The steady state values of capital, output and consumption per efficiency unit of labour can be determined within this Ramsey-Cass-Koopmans model. At the same time, the Golden Rule of Optimum Growth determined by equality between interest rate (marginal product of capital in efficiency units minus depreciation) and the steady state growth of output (rate of technical progress plus rate of population growth). This is called the Golden Rule Growth (Von Neuman, 1937; Phelps, 1962, 1966).
Therefore, the saving rate that maximises the steady state consumption per person is called Golden Rule Saving rate. The golden rate of capital accumulation states that “do unto others as you would have others do unto you” (Phelps, 1961,1966). Furthermore, when the steady state interest rate equals the effective discount rate then it is called the Modified Golden Rule (Cass and Koopmans version of consumer optimisation). The optimal path of capital accumulation should not involve any left over in terms of present value in the end. This is called as transversality condition in dynamic optimisation (Intriligator, 1971).

Thus, capital, output, and consumption per unit of effective labour are constant in the steady state while per capita variables (capital-labour, output-labour, and consumption-labour ratios) grow at the rate, \( g \). However, the level variables (capital, output, and consumption) grow at the rate of \( (n+g) \), where \( n \) is population growth plus rate of technical progress in the steady state. Hence, the dynamic inefficiency in Ramsey-Cass-Koopmans model does not occur in the transitional economies as in the Solow-Swan model because the level of ‘s’ in the former model is dictated by the underlying parameters and cannot be chosen arbitrarily. However, it is an arbitrary choice in the Solow-Swan model. This outcome is not possible in the Ramsey-Cass-Koopmans model.

The steady state growth does not depend on the parameters that describe the production function, or on the time preference and intertemporal substitution parameters that characterise households' attitudes about consumption and saving. These parameters have long run effects on levels of variables. Although the saving rate may rise during the transition, it cannot rise enough to eliminate the inverse relation between the growth rate of per capita terms and initial level of income per person or capital per person. Thus, the endogenous determination of saving rate does not eliminate the convergence property for capital per effective worker in Ramsey-Cass –Koopmans growth model.

It is interesting and important to note that these household behaviour models can also continue to hold the same five predictions of the neoclassical growth model (Solow-Swan 1965). Mankiw (1995) presents these five predictions as follows: (1) In the long run the economy approaches a steady state that is independent of initial...

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6 Effective discount rate is equal to time preference (\( p \)) plus intertemporal substitution (\( \theta \)) parameter multiplied by rate of technological progress (\( g \)).
conditions. (2) The steady state level of income depends on the rate of saving and population growth. The higher the rate of saving, the higher the steady state level of income per person. The higher the rate of population growth, the lower the steady state level of income per person. (3) The steady state growth of income per person depends on the rate of technological progress; it does not depend on rate of saving and the population growth. (4) In the steady state, the capital stock grows at the same rate as income, so the capital to income ratio is constant. (5) In the steady state, the marginal product of capital is constant, whereas the marginal product of labour grows at the rate of technical progress. It should be kept in mind that the overlapping generation and the representative consumer models are not fully satisfactory. It is because they are based on the premise that people have the smooth consumption behaviour throughout their life. But, in reality, consumption smoothing is far from perfect.

**Endogenous growth and convergence**

When an economy reaches the steady state, the rate of growth of output/income per capita solely depends on the rate of exogenous technological progress in the neoclassical growth theory. The endogenous growth models attack the neoclassical growth theory on account of absence of diminishing returns to reproducible capital. In the endogenous growth theory, long run growth rates are determined within the model based on either constant returns to scale or increasing returns to scale (Romer, 1986; Lucas, 1988; King and Rebelo, 1990). Similarly the models by Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992) endogenise sources of long run growth in their specifications through international economic activities like research and development (R&D) investment. Thus, the endogenous growth models can provide a theory of technical progress by incorporating human capital and advancement in knowledge into the models to explain long run growth with either constant returns to scale or increasing returns to scale.

These models yield endogenous steady state growth as well as predict conditional convergence as in the neoclassical growth model, because the convergence property is still derived from the inverse relation between average product of per capita capital and initial level of per capita capital (Barro and Sala-i-Martin, 1995). The two-sector models of endogenous growth of Uzawa (1965) and
Lucas (1988), AK models of Technological Diffusion are also consistent with convergence evidence along with Solow-Swan (1956) growth model. Barro and Sala-i-Martin (1995) endogenise population growth within the neoclassical growth framework. Therefore, if the economies differ only in terms of their initial values, then one with smaller capital stock per capita will grow faster in per capita term than the other.

1.2.2 **Empirical of review literature**

The application of neoclassical growth paradigm to explain regional growth and disparities has led to a number of important studies in the recent years. Convergence is a strong empirical regularity in the process of economic growth across countries and regions (see Summer-Heston, 1988; Maddison, 1991; and Barro-Lee, 2001 data set]. Several studies focus on convergence in the cross-country and cross-regional analysis like US regions, European regions (Barro and Sala-i-Martin, 1991 and 1992), Japanese prefectures (Barro and Sala-i-Martin, 1991 and 1992; Shioji 1993), Australian Colonies (Cashin 1995), Canadian Provinces (Coulombe and Lee 1993), Sweden (Persson, 1997), Spanish Regions (de la Fuente, 2002; Sanchez-Robles and Villverde, 2001), Mexico (Juan-Roman, and Rivera-Batitz, 1996), Brazil (Magalhaes, Hewings, and Azzoni, 2000), Africa (Hoeffler, 2002), China (Yao and Weeks, 2000), Ireland (O’Leary, 2000), Greece (Petrakos and Saratsis, 2000), Bangladesh (Hossain, 2000), Pakistan (Ahmad and Naz, 2000), South Pacific countries (Cashin and Loaya, 1995) and Turkey (Gezici and Hewings, 2001).

A majority of the studies shows that (a) the ratio of saving and investment to GDP, (b) population growth, (c) the initial level of per capita income and (d) investment in human capital measured by the secondary enrolment rate etc, are robust variables (Thirlwall, 2003). Empirical evidence also shows that there is a regional convergence, and the speed of convergence is close to 2 per cent per year to narrow down the half of the gap between the initial levels of per capita income and the steady state levels of per capita income (see Barro and Sala-i-Martin, 2003). Nevertheless, despite this prolific literature on growth and convergence in recent years, there are some authors (i.e., Bosworth and Collins, 2003; Easterly and Levine, 2001; Durlauf (1996); Temple, 1999; Pritchet, 1997 and Quah, 1993, 1996) who contend the implications of empirics of convergence across countries and regions.
There are a few studies on growth and convergence across Indian states. As mentioned earlier, these Indian studies are reviewed here with a view to identify the determinants of inter-regional economic growth and convergence, which affect the standards of living of people in different regions of India. Further, investigation is also made to find research gaps to carry out the present study. The review is structured as follows.

**Factors mobility and convergence**

The literature on economic growth and convergence has given emphasis on the mobility of factors of production to equalise the incomes and factor prices in different regions. If factors of production are mobile across regions having access to similar structural characteristics, there exists regional convergence in per capita income in different regions and the speed of convergence is instantaneous and infinite (Barro and Sala-i-Martin, 1995). However, convergence may not occur across regions due to differential real rates of return to capital (resource immobility), and factor prices remain unequal across regions. If resource mobility is perfect, diminishing marginal productivity as reflected in the concavity of production function cannot do justice to the idea of prolonged convergence. In the presence of factor mobility, the differential growth rates across regions do not imply convergence due to diminishing returns. In other words, even if a negative relationship between initial per capita income and overall growth rate is observed, it may not indicate convergence (Marjit and Mitra, 1996). The analysis of Marjit and Mitra (1996) indicates that the scatter diagram between the base period of per capita net state domestic product and average annual growth rates over the study period (1961-1990) across states of India do not show any ‘negative’ relationship, and there is a considerable stretch of ‘upward trend’ denoting divergence. Richer states even grow faster than poorer states.

Labour mobility (migration) is another factor for regional convergence within the neoclassical growth model. Generally, population changes for three reasons: increase in fertility, reduction in mortality, and migration. But, migration is the only potential explanation of the positive relation between the rate of population growth and the stock of capital (Barro and Becker, 1989). In this regard, the study by Cashin and Sahay (1996) shows that the effect of migration on convergence of incomes is minimal across states in India. This result is similar to the findings of developed economies such as States of United States, Japan, European Regions (Barro and Sala-
i-Martin, 1991 and 1995; Shioji 1993). They estimate that a 10 per cent increase in
differential per capita income would raise net migration to each state by only 0.012
per cent per year. The response of migration to income differential across the states in
United States and Prefectures of Japan is larger. Nevertheless, this is on the expected
lines as the transaction cost of cross-regional mobility is substantially higher in India.

There are also a variety of other factors such as barriers to the mobility of labour,
strong local workers' unions which act to keep out of competing potential employees,
lack of housing in fast growing urban areas, and most important social, cultural, and
linguistic barriers to mobility.

**Central transfers and their impact on regional development**

Resources may also flow across regions (states) due to nature of federal
transfers intended for reducing regional disparities in income in a federal economy
such as India to achieve balanced regional growth and equity. Therefore, the study of
intergovernmental transfers is very important in Indian federal context. It is because
they ameliorate vertical imbalances, reduce horizontal imbalances, correct for inter-
jurisdictional spillovers, ensure minimum standards of basic services, pay for agency
functions undertaken by sub-national governments and return revenue to lower level
governments as a part of a tax-rental arrangement (Sen and Trebesch, 2004). Despite
this, the equity and efficiency aspects of intergovernmental transfers of different
federations are much debated in the literature (Buchanan, 1950; Scott, 1964; Boadway
and Flatter, 1982; Bagchi and Chakravarty, 2004 among others). The debate is not
only confined to the equity and efficiency of these federal transfers from the resource
allocation point of view but also seen in case of different conceptual treatment of
intergovernmental transfers to analyse their impacts on regional growth and
productivity. The latter arguments can be seen in the studies of Cashin and Sahay
(1996) and Rao and Sen, (1997) on the issue of intergovernmental transfers and
convergence in Indian context.

Cashin and Sahay (1996) have dealt with the explicit transfers, ignoring the
indirect channels like loans and advances from central government, and the allocation
of credits by financial institutions and banking system to the states. These explicit
transfers include statutory grants-in-aid given by the Finance Commission; grants for
plan assistance by the Planning Commission; and grants for centrally sponsored
schemes by Union Ministries. The per capita State Disposable Income they derive, is
the Net State Domestic Product (NSDP) plus the grants components of the explicit transfers divided by the population. In order to get real per capita real disposable income, it is deflated by national GDP deflator. In particular, State Disposable Income represents the total income available to residents of a given state for consumption and saving. But, this is not a perfect state-based analog of the national account definition of national disposable income since it does not take into account net factor incomes flowing across the border to residents of a state.

Cashin and Sahay (1996) also exclude the typical Indian definition of transfers those designed for center-state tax sharing and indirect transfers through loans (like invisible transfers). They give the justification of excluding the tax sharing transfers primarily due to the lack of transparency in determining the magnitudes of the income equalising component. Further, loans are different from grants in the sense that the former has to be repaid with due rate of interest. These are the limitations of their study that considers the intergovernmental transfers designed explicitly to reduce regional disparities.

Further, they have found absolute convergence in per capita income at the rate of 1.5 per cent per year and it would take 45 years to close the half of the gap between initial levels of per capita income and its steady state levels. The dispersion of state disposable income (SDI) and dispersion of net state domestic product (NSDP) have widened considerably since 1960s. The widening gap of the dispersion of real per capita NSDP (0.32) for Indian states, contrasts with the pattern observed in Australia, Japan, and United States. This reflects the higher barriers to flow of capital and labour across Indian states than in the developed economies, despite the poorer states are receiving higher grants from Central Government as compared to their rich counterparts. Moreover, their scatter diagram looks almost identical to that of Marjit and Mitra (1996). The interesting point in the paper is that the fitted negative slope line has only two points in it, whereas rest of the points are scattered around the line. This shows that there is more possibility of divergence rather than convergence.

Absolute convergence in real per capita SDI is not analysed in Cashin and Sahay's study (1996) rather they have examined the dispersion in PCNSDP and in real PCSDI to assess the impact of total explicit transfers designed to reduce the income

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7 Although most taxes are raised by the Central Government, shared taxes (tax-sharing) are also used to offset fiscal disabilities of the states (Rao and Sen, 1997).
disparities across 20 states from 1961-1991. They find the evidence of sigma divergence in both the measures of income per capita NSDP and SDI across the states during the period 1961-91 except the sub-period 1961-71. During 1961-71 sigma convergence is observed due to the better growth performance by initially poor states in comparison with rich states. Even though it is evident from their analysis that the poor states have been given greater grants relative to their rich counterparts, the trends in both measures of income have exhibited the same skewed distribution.

In the study by Rao et al. (1999) both explicit and implicit intergovernmental transfers are considered. Nevertheless, these transfers are not explicitly incorporated in the convergence regression for the reason that a significant part of state government expenditure is financed through the intergovernmental transfers. Therefore, the effect of expenditure on the economic growth of the state is indirect and may not be reflected in the regression equation once share of total state expenditure in NSDP is considered in the equation. As NSDP of a state is estimated using the income-originating approach, it includes the effect of federal grants.

The concept of estimating state disposable product (income) by adding transfers to NSDP is erroneous in the study of Cashin and Sahay (1996). In fact, it should be excluded from the personal income of states to measure the equalising impact of federal transfers (Barro and Sala-i-Martin 1991). Again, the exclusion of shared taxes in their analysis underestimated the contribution from the Central Government grants. But, Cashin and Sahay (1996) disagree that all tax devolution from the Centre should be included in the concept of income equalising transfers. However, a large component of these transfers could well be intended for equalising incomes (see Rao and Sen, 1997).

Intergovernmental transfers are the some of the reasons for divergence pattern of income growth across 14 major states as seen from Rao et al. (1999). Though the explicit central transfers have significant redistributive impact as seen by the negative income elasticity coefficients, this redistribution achieved through intergovernmental transfers is not adequate enough to offset the fiscal disabilities of poorer states arising from their low revenue capacities. Further, the inequitable transfers of resources may cause rich states richer due to implicit transfers.
Owing to non-availability of data on inter-state trade it is not possible to estimate inter-state tax exportation accurately. However, the important sources of implicit transfers arise from subsidised lending to states from the Central Government and the banking system. The extent and nature of intergovernmental transfers from this source depend on the pattern of inter-state allocation of loans and the difference between the market interest rate and the actual interest rate charged. Rao et al., (1999) find that while progressive nature of explicit transfers is due to the negative and significant income elasticity during the period 1981-82 to 1993-94, the positive and significant elasticity coefficients of implicit transfers show the regressive nature of these transfers. However, the progressivity of the transfers system is significantly reduced if implicit transfers are added to the explicit transfers.

**Public expenditure, infrastructure and economic growth**

In order to achieve balanced regional growth and to enhance productivity across the states, both Central and State Governments make developmental as well as non-developmental expenditure under plan and non-plan heads. Controlling these expenditures, Ghosh et al. (1998) find that Indian states have diverged in per capita income over the period for the last 35 years from 1961-62 to 1995-96. Nevertheless, they argue that this result does not nullify the role of planning through disbursement of development funds across the states. The Indian scenario exhibits the interesting relationship between the private and public capital at the state levels. There is strong statistical evidence in favour of divergence in income across Indian states over the period from 1961-62 to 1995-96. The allocation of plan funds across the states has been made in accordance with the levels of income of the states i.e. the poorer states are receiving proportionately larger amounts of development funds relative to their richer counterparts throughout the years. In the ultimate analysis, however, it is not just the account of funds but also efficient use of these funds that determines the convergence trend, which is equally important to explain regional growth patterns.

There is considerable emphasis on infrastructure development for economic growth and regional convergence (Akkina, 1996; Nagaraj et al., 1997; Rao et al., 1999; and Ghosh and De, 1998) to explain the differential growth performance of different states between the periods 1960s to 1990s. Public investment seems to be most effective when it is both targeted towards specific infrastructure and towards those states whose growth is constrained largely by poor infrastructure. Augmenting
infrastructure in poorer regions can have an important impact on accelerating growth and achieving convergence across Indian states. Despite the problems of multicollinearity and endogeneity of infrastructure variables, there is strong evidence that development of infrastructure (particularly power consumption, irrigation, density of the road network, primary school enrolment rate, and ratio of bank deposits to SDP) has a positive impact on the growth performance of the states (see Nagaraj et al., 1997).

While Akkina (1996), and Ghosh and De (1998) have examined the impact of physical infrastructure development indicators (i.e., transport, irrigation, spread of electricity, per capita consumption of electricity, and telephones), Nagaraj et al. (1997) have given emphasis on 14 different indicators of physical, social and economic infrastructure to analyse the differences in growth of per capita income across states. Rao et al. (1999) have also given importance to augmenting the quality of infrastructure in the poorer states to enable them to reap the gains from liberalisation by adopting appropriate policies and institutions, and creating economic environment. They all find no evidence for absolute convergence.

Using panel data Nagaraj et al. (1997) find very high speed of convergence more than 30 per cent per year during 1970 to 1994. But, the faster rate of convergence is consistent with smaller combined share of physical and human capital. This may indicate that conditional convergence may come from productivity or technology catch up or neoclassical type input transition dynamics (see Islam, 1995; Caselli et al., 1996; and Canova and Marcet, 1995 for cross-country analysis). Therefore, whether factor accumulation or total factor productivity cause the differences in growth rates across states or some other factors that are responsible for it, needs to be analysed for Indian states. Moreover, creating incentives for factor accumulation is more important than that of factor accumulation itself (Easterly and Levine, 2001). Another important question is that whether the states in India are in the steady states or in transitions, is an open empirical issue.

Nagaraj et al. (1997) have emphasised nonmeasured political and institutional factors (captured in state fixed effects) in explaining differences in steady state growth rates across states. But, an important issue with regard to assuming the growth performance relates to the identification of steady state. Dasgupta et al. (2000) have tried to answer this question, and have not been able to come to any definite way of
establishing or rationalising the existence of the state specific steady states. The issue is whether there is a unique steady state for all the states or there are different steady states for different states. At the same time, due to correlation between initial levels of per capita income and random disturbance term during the transitional dynamics from initial positions towards steady states, the estimate of common convergence coefficient beta (\( \beta \)) for all states may be biased. The high speed of convergence in their study implies that the states in India are very close to their steady states and transitional dynamics may not play greater role. Similar arguments can be applied to studies of Bajpai and Sachs (1999), and Aiyer (2001), whose conclusions are also identical to those of Nagaraj et al. (1997) and Rao et al. (1999) highlighting the importance of infrastructure, private investment, and nonmeasured institutional factors.

Further, Dasgupta et al. (2000) show convergence in terms of infrastructure. The performance of agricultural sector mainly plays important role in explaining the differential growth rates across states causing divergence. They find neither \( \beta \) nor \( \sigma \)-convergence in their descriptive analysis of states in India during time points 1960-61 to 1995-96 to explain the observed discrepancies across states and overall performance in Indian economy. There has been a clear tendency of divergence of growth rates across states in terms of per capita income (SDP) but convergence in the share of the different sectors in SDP. Another contribution of their study on the issue of inter-state disparities is the construction of rank correlation matrix. This analysis shows the stability of state's performance with respect to its own average and national average over the studied period indicating that richer states have grown faster than their weaker counterparts.

In short, all these studies on convergence in income in Indian context are based on the steady state implications of convergence analysis of neoclassical growth theory. But, there are difficulties to take some factors into account to determine the steady states for all states in order to analyse absolute and conditional convergence. This is because the required information on capital stock, saving (investment) and technology is not available across states of Indian federation. As a consequence, Indian studies have attempted to focus on this issue by taking some proxy variables to account for these differences in the steady states across the states (province) (Akkina, 1996; Nagaraj et al., 1997; Sinha and Sinha, 2000; Aiyer, 2001; and Sachs and Bajpai,
2002, Trivedi, 2003). The non-availability of regional (state-wise) data on saving, capital formation, [investment (both private and government)] and capital stock, makes it difficult to accurately control for differences in the steady states across the states. Therefore, the degrees of intensity to account for differences in saving rates and differences in technology across the states in the true sense differ from one study to other depending on the reliability of proxy variables to capture these differences in the steady states of different states in India.

Geography, policies and regional growth

It is not only infrastructure or agricultural productivity that account for differences in regional growth patterns across regions in India but also geographical features like urbanisation and market-oriented reforms that matter for differences in inter-regional growth. Sachs et al. (2002) find very weak forces of convergence for both absolute and conditional convergence. They mention several possible reasons for the lack of convergence. First, the geographical differences are larger in India and China than in States of United States, Europe, and Japan. Second, population movements in the United States, Europe or Japan more readily arbitrage differences across regions. Third, policies of the national and regional governments prevented convergence in India and China. Lastly, economic convergence is easier at higher levels of economic development than in China and India. It is also expected that India’s growth will continue to be urban-led, favouring those states where urbanisation is already high—perhaps due to coastal access or to the relatively high productivity of agriculture. Therefore, there is little evidence of ensuring equalisation of incomes across regions.

Interestingly, the study of Sinha and Sinha (2000) that shows political stability and political will of the ruling governments are more relevant factors than other kinds of infrastructure and general/social conditions to explain the differential growth performance of states in India. This has been shown in their study of 17 Indian states, which does not provide any evidence in favour of β- convergence or conditional β-convergence.
Consumption as an alternative measure of standard of living

One of the most important shortcomings of all Indian studies is that it analyses convergence in per capita income (SDP), whereas the focus should be on convergence in total income accruing to the state. The debate however, centers around the conceptual and methodological problems to deal with the issue of explaining regional disparities in standards of living. Usually standard of living is measured by per capita real income and hence accordingly the differences that persist over time are analysed. Since standard of living is a broader concept that encompasses many aspects of social well being, per capita real income alone cannot take into account all aspects of standard of living.

It may happen that while measuring the extent of income inequalities in different regions of a country like India problems arise due to unavailability of strictly comparable and consistent data on state income (Dholakia, 2003). There are well known limitations in the use of per capita income in evaluating social well being on account of conceptual and methodological ambiguities (Planning Commission, 2002; p. 32-35). Despite these limitations, in Indian context several studies of descriptive and analytical nature have tried to focus on the issue of measuring income disparities and poverty across different regions (Datta Roy Choudhury, 1993; Cashin and Sahay, 1996; Marjit and Mitra, 1996; Rao et al., 1999; Ahluwalia, 2001; Sachs et al., 2002 among others) on the basis of data on State Domestic Product (SDP).

SDP reflects the productive capacity and productive efficiency of the resources employed within a state. Conceptually it is based on production approach, that is, income-originating within the geographical boundary of a state. It does not include the net factor incomes accruing to normal residents of the state from the residents living outside the boundary of a state. Therefore, there is a difference between the income accruing and income originating in a state if there is significant factor (i.e., capital and labour) mobility\(^8\) across the borders of the states. This may result in substantial difference between SDP and personal disposable income\(^9\) in a state. Moreover, transfer payments like pension, foreign remittances and interest on public debt can be very substantial in a state (like Kerala) with historically high level

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\(^8\) Factors mobility is one of the reasons for convergence and it leads to factor-price equalisation across regions (see, Barro and Sala-i-Martin, 1995; Cashin and Sahay, 1996; Marjit and Mitra, 1996).

\(^9\) Personal disposable income is the income of the individuals after tax and non-tax payment, which can be either consumed or saved (Mankiw, 1997, pp. 31).
of human capital development and migration (Dholakia, 2003). Thus, the personal disposable income is likely to be much higher than SDP in such a state (Jeromi, 2003). Analyses of different measures of regional growth and inequality in terms of per capita income across the Indian states do not take into account a part of the income accruing to a state outside its boundary. However, there has been no estimate of this income for any state of India (Rao et al., 1999). This is because although the income-accruing approach relates to the income-accruing to the normal residents of a state, it is very difficult to estimate state income applying this approach, due to lack of data on flows of factor incomes to/from the boundaries of the state. But, the estimates of national income (Gross and Net National Product) are based on income-accruing approach (EPWRF, 2003).

Since SDP does not include the net factor incomes accruing to a state on the one hand, while on the other hand, there is no estimate of this income; analysing the differential growth patterns of levels of living among states in India may pose a serious data problem. Nevertheless, understanding the intra-regional and inter-regional distribution of standards of living is extremely relevant in India’s economic development (Das and Barua, 1996). There are a few studies (Vaidyanathan, 1974; Chatterjee and Bhattacharya, 1974) that have attempted to explain the inter-regional disparities in consumption expenditure in India. Using simple measure of growth and inequality Datta Roy Choudhury (1993) has made an attempt on similar lines to examine the inter-state and intra-state variations in economic development and standards of living across 15 major states in India from 1967-68 to 1979-80. The study has found that the extent of inter-regional variations in per capita real consumption is less pronounced as compared to variations in per capita real income during the reference period. Singh et al. (2003) and Deaton and Dreze (2002) have also shown the divergence pattern in growth of average per capita expenditure across the states. However, since per capita consumption is a better measure of social well-being as compared to per capita income\textsuperscript{10}, it is interesting to examine the convergence

\textsuperscript{10} Per capita consumption expenditure is better measure of social well-being than per capita income for the reasons that—(a) it relates to the started level of disaggregating at the sub-state levels or rural and urban areas while income estimates are not available; (b) it is an indicator of individual’s command over resources; (c) NSSO consumption data is based on a direct survey unlike the residually derived income estimates from the national accounting framework; and (d) personal consumption expenditure, an individual’s economic attainment and well-being is influenced by his/her access to social and public transfers, as well as access to and consumption of publicly provided goods and services (for more details see NHDR 2001, Planning Commission, 2002).
issues at more disaggregated levels (i.e., rural and urban) to understand the regional inequality in India. On these lines, studies examining convergence in per capita consumption within the neoclassical growth paradigm is hardly seen in the Indian context.

**Panel data approach to study growth and convergence**

Convergence literature reveals different techniques used to analyse convergence in a cross-section of economies. The estimate of rate of conditional convergence in a single cross-sectional analysis over a period of time may suffer from at least three problems. First, reducing each time series explanatory variables to a single (average) observation would mean that all-available information is not used. Second, it is likely that single cross-section regression suffers from omitted variable bias due to unobserved state-specific effects, which are assumed to be uncorrelated with the explanatory variables. Third, one or more of the regressors may be endogenous (Hoeffler, 2002).

The single cross-section estimator (OLS) gives consistent estimates as long as the state-specific individual effect is captured by random disturbance term and assumed to be uncorrelated with explanatory variables. Since the unobserved state-specific effects are positively correlated with initial levels of per capita income, omitting the state-specific effects (due to differences in the initial levels of technology, resource endowments and climatic conditions across the states, which may also affect the investment activities of the states) lead to upward bias in the coefficient of lagged per capita income causing a downward bias in the estimate of convergence coefficient, $\beta$.

There are various techniques to control this unobserved state-specific effects e.g., Minimum Distance (MD) approach, Least Square and Dummy Variable (LSDV) approach (Islam, 1995), First Difference Generalised Method of Moments (GMM) (Arellano and Bond, 1991), System of GMM (Blundell and Bond, 1998), (Easterly and Levine, 2001), (Hoeffler, 2002) and (Wooldridge, 2002), among others.

When controlling for unobserved state-specific effects, the most important issue, which would arise is whether the technological effect is treated to be ‘fixed’ or ‘random’. If the effects are random, they are assumed to be uncorrelated with the exogenous variables included in the model. As the effects are considered to be
correlated with saving rate and population growth rate and this correlation forms the basis of the argumentation for the panel approach, the assumption of random effects is considered to be unsuitable. The LSDV estimator, which is based on the fixed effects assumption, is permissible. One possible problem with LSDV arises from the dynamic nature of the panel data model. The presence of a lagged dependent variable makes LSDV inconsistent estimators, when asymptotic are considered in the direction of $N \to \infty$. However, the asymptotic properties of panel data estimators are in the direction of $t$, and Amemiya (1967) shows that when considered in that direction, LSDV proves to be consistent and asymptotically equivalent to Maximum Likelihood Estimator (MLE). Many other estimators start by eliminating the individual effects term through first differencing. Therefore, it does not matter whether the effect is fixed or random and whether $\varepsilon$ is correlated with the exogenous variables. Yao and Zhang (2001) find that the LSDV estimator generated results that are robust although they are only consistent in the direction of $t$. Islam (1995) uses both the LSDV and MD estimators proposed by Chamberlain (1982). He finds that there is no significant difference between the two estimators. Therefore, the use of LSDV is an adequate approach. However, the theoretical properties of most of these estimators are asymptotic, and in terms of these properties they are equivalent.

Caselli, Esquivel and Lefort (CEL) (1996) argue that almost all existing cross-country regressions, either based on cross-section, or panel data techniques, have been estimated inconsistently. Without accounting for the omitted variable bias and endogeneity of regressors, the speed of convergence is potentially bias and inconsistent. Islam (1995) attempts to solve the first problem using panel growth framework after allowing for country-specific unobservable effects that are correlated with the explanatory variables. But endogeneity is still a problem unaddressed in Islam's work. CEL (1996) try to sort out these two problems by applying a GMM estimator in a dynamic panel growth regression to obtain the rate of convergence and other growth parameters. They find the most striking result of the implied estimate of convergence coefficient to jump from 2-3 to 10 per cent. The main implication of a high rate of conditional convergence as interpreted in their study is that economies spend most of their time in a neighbourhood of their steady states. This implies that the large differences in observed levels of per capita income as arising from differences in steady state levels, rather than from differences in the position of
countries along similar transitional paths. Further evidence is also observed that substantial differences in technology might play an important role in generating dispersion in steady state levels.

Nevertheless, Arellano-Bond (1991) show that first difference GMM estimator can be applied in a panel data regression with fixed effects and a lagged dependent variable. If the data set is 'small T and large N', a standard fixed effects estimator may be subject to a rather considerable bias. In small sample weak instruments can produce biased coefficients since consistency of the GMM estimator depends on the validity of the instruments (Easterly and Levine, 2001).

Further, Barro and Sala-i-Martin (2003) highlight one potential problem with the fixed effect approach that makes use of short time spans (i.e., two to five years) to study growth convergence. The problem is that the existence of business cycle tends to bias upward the estimates of speeds of convergence. If the measurement error introduced by business cycle is corrected for, then the estimated speed of convergence from panels with fixed effects is still close to 2 per cent per year (Shioji, 1997).

**Criticism of distribution dynamics approach on conventional growth and convergence**

Distribution dynamics approach originates from recent empirical research on patterns of cross-country growth (see Quah, 1996a, 1996b). It criticises the conventional growth and convergence literature based on cross-section, panel data, and time series approaches. It may be helpful to explain the intra-distribution of income dynamics. The standard $\beta$-convergence regression analysis only considers average or representative behaviour and says nothing about what happens to the entire distribution (Barro & Martin 1992, Bajpai and Sachs 1996, Cashin and Sahay 1996, and Nagaraj et al. 1997 for Indian case, and many others). Neither $\beta$ nor $\sigma$-convergence analyses are able to inform researchers of any prospect of interregional mobility. They cannot reveal the relevant intra-distributional dynamics, which would lend insights into any intra-regional pattern of economic interaction. The study of Bandyopadhyay (2000a) has documented the dynamics of convergence in income across Indian states over the period 1965-88. She has found that cohesive tendencies (it means the tendency towards equality of incomes across the states) are observed in the late sixties; these are considerably weakened over the following years with increasing divergence tendency accompanied by the clear emergence of two
convergence club, one at around 130 per cent of national average and the other at 50 per cent of the national average.

The other study by Bandyopadhyay (2001) has shown that the model reveals "twin peaks" dynamics or polarisation across Indian states over 1965-98, which would not be revealed under standard empirical method of cross-section, panel data, and time series econometrics. The dominant cross-state income dynamics are that of persistence, immobility and polarisation, with some cohesive tendencies in 1960s only to disperse over the following three decades. These findings contrast starkly with those emphasised in works of Bajpai and Sachs (1996), Nagaraj et al. (1997) and Rao et al. (1999). Another interesting point is that infrastructure seems to strongly explain the formation of the lower convergence club, while fiscal deficits and capital expenditure pattern explain club formation at higher income levels. These stylised facts are interesting for policy purposes in tracking the forces, which govern growth dynamics across Indian states.

Some methodological fallouts in convergence analysis in India

From the above discussion, some issues can be raised regarding the analysis of convergence across Indian states. There are a number of analytical problems associated with the studies in India. Conceptually the findings of interregional convergence in the levels of output/income could be explained by interregional convergence in price levels with no real convergence (Sala-i-Martin, 1996). The preliminary finding in Marjit and Mitra (1996) is also marked by non-availability of regional deflators. Inter-state price variations are not corrected for in Marjit and Mitra (1996) and Ghosh et al. (1998) and many others. Although Dasgupta et al. (2000) have tried to avoid this bias by using the conversion of series of SDP at 1970-71 prices into those at 1980-81 prices for the earlier years, this procedure cannot correct for inter-state price variations due to change in the production group from one series to other. Even when the study period is broadly identical the findings have been different due to the different approaches and data sets adopted in them.

Problems in estimating convergence coefficient

The studies on convergence across Indian states do not properly take into account the determinants of steady state. Studies differ with regard to control for differences in the determinants of steady states across Indian states due to non-availability of appropriate data and hence, the rates of convergence so differ. The
magnitudes of parameter estimates obtained from these studies do not have the compatibility with the findings of each other towards a robust estimate of speed of convergence and significant differences do exist. However, the results obtained from the studies for developed countries such as States of United States, Europe Regions, and Japanese prefectures, OECD countries (Barro and Sala-i-Martin 1995) show robust estimate of speed of convergence at around 2-3 per cent per year.

**Differential rate of returns on capital**

Other parameters (depreciation of capital, $\delta$, population growth rate, $n$, and rate of technical progress, $g$) remaining constant, convergence coefficient ($\beta$) depends upon only parameter ($\alpha$) that is, share of capital in state (or national) income. In Indian case, none of these studies has calculated the share of physical capital in the state income, which determines the speed of convergence. After estimating $\beta$, it is also possible to estimate the capital share and hence, labour share in state income to know the contributions of each input to the growth of income. The rate of investment varies over time and so does depreciation rate. Thus, differential rate of return to physical capital may vary across Indian states, and so is the convergence coefficient depending upon its economic environment. Hence, if the variations in investment and depreciation are not captured, this may lead to underestimation of convergence coefficient.

**Incorporation of human capital and convergence**

When human capital is included in the growth regression then the speed of convergence increases. In Indian studies, the incorporation of literacy rate, and either primary or secondary education as proxy for human capital (Nagaraj et al., 1997; Rao et al., 1999) may be a crude measure, as it does not reflect the exact information for human capital. An average schooling rate as a proxy for human capital may be a better measure for this purpose (Klenow and Rodriguez-Clare, 1997). Hanushek and Kimko (2000) find that the quality of education is strongly linked with economic growth. But, Benhabib and Spiegel (1994), and Pritchett (2001) argue that increases in human capital resulting from improvement in educational attainment have not positively affected the growth in output per worker (perhaps because of the mismatch between education and the skill needed for activities that generate social returns). Further, for developed countries convergence analysis gives meaningful results due to
availability of data set for a longer period. In Indian context, it is difficult to get such kind of data set for a long period of time.

**Method of data analysis**

Most of the studies in Indian context are based on Barro and Sala-i-Martin log-linear formulation (1991) to steady state as an approximation to estimate the speed of convergence across Indian states. The problem is implicit to the original Barro-Sala-i-Martin methodology (1991). Indian studies that follow this would necessarily have this problem. In this analysis, it is not clear whether the control variables in the regression analysis are serving proxy for differences in states’ (country) steady state income levels or for differences in states’ (country) long run growth rates. There are two problems with these estimations of rates of conditional convergence. First, the coefficient on initial levels of income may not accurately reflect the speed of conditional convergence because some of the control variables contain information about transitional dynamics. Second, imperfect proxies for steady state income differences will lead to underestimation of the rates of convergence (Klenow and Rodriguez-Clare, 1997). Therefore, this methodology needs to be re-examined and re-modified to explain the differences in growth rates and levels of income across states in India in order to get proper estimation of absolute and conditional convergence.

**Problems in econometric modelling**

There are severe econometric problems in the cross-country and cross-regional regressions in identifying the determinants of growth. Four problems in particular affect this entire analysis. Mankiw (1995) lists the first three problems in his study of ‘Growth of Nations’. The **simultaneity problem** is the most obvious with cross-countries growth regression. The right hand side variables are not exogenous, but are jointly determined with growth rate. Second is the problem associated with interpreting cross-countries regression is the **problem of multicollinearity** i.e. the strong correlation among all the right hand side variables. High-growth countries have higher rate of investment, higher enrolment in primary schools, and secondary schools, lower rate of population growth rate, more developed financial markets, and fewer revolution and coups than the low-growth economies. These variables are associated with each other causing multicollinearity. Third is the **degree of freedom problem**, which raises many questions about the number of observations and time
period and not easy to solve. However, in cross-sectional analysis, *heteroscedasticity* is also a serious problem due to unequal variance of error terms associated with different cross-sectional units.

Moreover, the data problems across the states and regions do exist and result in measurement error in the growth regression analysis, because many variables like fertility rate, life expectancy and educational attainment aren't actually measurable at the period finer than five or ten years. It is not easy to measure the initial condition of technology. Hence, the calculation of convergence coefficient for different countries (regions) may not give the correct picture of differences in regional growth rates across the countries and regions.

**Social infrastructure and levels of income**

The explanation for differences in growth rates among regions and states (countries) can be attributed to differences in human capital, physical capital and total factor productivity (MRW, 1992; Dougherty and Jorgenson 1996). On the contrary, Hall and Jones (1999) argue that this can partially explain the variation in output per worker and hence, differences in growth rates may be transitory: countries grow more rapidly the further they are below their steady states. They show that much of the variations are explained by the differences in social infrastructure[^11]. This analysis differs from Barro’s (1991) analysis of growth rates because levels in income capture the differences in long run economic performance that are most directly relevant to welfare as measured by the consumption of goods and services. Similarly, appearance of conditional convergence may carry no implications for underlying parameters of technology and preferences due to the changes in domestic policies and institutions, political stability, and international relations (Skott, 1999).

Thus, the tendency of convergence toward a steady state in the neoclassical growth model is determined by control variables. Further, not only the debate on convergence of income across Indian states continues but also the rates of convergence differ from one study to another. Determinants of steady state and growth in Indian context identified from the review of literature are private and public saving (investment) rate, population growth rate, technological progress, human

[^11]: Hall and Jones, (1999) define social infrastructure as the institutions and governments’ policies that determine economic environment within which individuals accumulate skills and firms accumulate capital and produce output.
capital (educational and health attainments), physical and social and economic infrastructure, geographical features (i.e., urbanisation), quality of institutions and policies (i.e., economic reforms) etc. These variables affect the differences in inter-regional growth of income and hence, standards of living in different states (regions) over time. This study attempts to take up the following research issues to re-examine the inter-regional growth and convergence across Indian states.

1.2.3 Research gaps

Several issues have emerged from the review of literature on convergence in India. Conflicting results have emerged on the issue of convergence in income across states of India due to different data set and its measurements adopted, various methods of estimations, duration of time periods, and interpretations made in the various studies. A part of the analysis has not taken into account the conditions and pre-conditions of steady state. Especially, two important factors such as saving rate and technology that determine the steady state and hence convergence, have not been properly accounted for in ongoing analysis of convergence in income across Indian states. Therefore, differences in saving rates and differences in technology need to be controlled for while accounting the variations in growth rates across Indian states.

These studies examine convergence in income (NSDP), which is essentially income originating in the states. This does not represent total income accruing to the states. Besides, there are no estimates of net factor incomes accruing to a state from outside its boundary and therefore, the studies have not tried to explain convergence in income accruing to the states. Since the net factor incomes from outside the state influence the standard of living, it needs to be included to explain convergence or divergence across the states of Indian federation.

Although studies by Cashin and Sahay (1996) and Rao et al. (1999) analyse the role of intergovernmental transfers and issues of convergence in Indian federalism, the federal transfers in these studies are not explicitly introduced in the convergence regression equation but implicitly discussed the matter in the light of convergence or divergence in income in Indian context. Thus, the linking of distributional impact of both explicit and implicit intergovernmental transfers with the whole issue of convergence is essential to determine the balanced regional growth in the Indian federalism.
Besides these limitations, differences in non-measured inputs and productivity, and political and non-technological factors may cause differences in growth and levels of income during the transitional dynamics from initial levels of income to the steady state levels across the states in India. Accounting for these factors seems to put a major constraint to work on the issue of inter-regional growth and convergence in Indian economy because of non-availability of reliable data.

In short, three most important issues arising from the literature review are as follows. First, how to control for differences in determinants of steady state in general and differences in saving rates and technology in particular across Indian states, given lack of data on saving (investment) and capital stock data at the state levels. Second is to analyse convergence in per capita state income (NSDP) on total income accruing to the state, given that the non-inclusion of net factor incomes from outside the state. Third, fiscal transfers are intended to serve the purpose of reducing income disparities across the regions and states of Indian federation. Thus, they need to be included in the estimations of convergence or divergence of income between the states.

A systematic analysis of these issues may offer newer insights into the factors that explain and predict the convergence and divergence of income among the states in India. Such insights have policy implications for inter-regional growth of income in Indian federation. Thus, the basic motivation for this study is to derive these insights for policy purposes, as reflected in the following objectives of the study.

### 1.3 Objectives

The specific objectives of the study are as follows:

- To analyse the factors that influence the differential growth rates across the states of Indian federation, especially since 1991.
- To evaluate and critically examine the various studies on absolute and conditional convergence of the states of Indian federation, and to examine the relevance and applicability of absolute and conditional convergence in the context of India's inter-state growth.

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12 Non-technological factors include climate, the security of contracts, the intensity of competition, and respect for instrumental rationality as a mode of behaviour (see Solow, 2001).
To formulate an appropriate model to empirically examine the hypotheses on absolute and conditional convergence in per capita income and to examine absolute convergence in per capita consumption across the states of India.

To explain the convergence or lack of convergence empirically by relating it to explicit and implicit inter-state fiscal and financial flows.

To derive implications for balanced economic development of regions in India.

1.4 Methodology

The study employs the theoretical, descriptive statistics and econometric estimation techniques to accomplish the above objectives. The theoretical base is the Solow-Swan growth model (1956). In this model, output per worker is determined by the initial level of output per worker, the initial level of technology, the rate of technical progress, the saving rate, the growth rate of labour force, the depreciation rate of capital, the share of physical and human capital in output, and the rate of convergence toward the steady state during the transitional dynamics. Thus, the neoclassical model provides with a general framework for empirical estimation of determinants of inter-state (regional) economic growth and testing of hypotheses on convergence or divergence.

Statistical tools such as maximum, minimum, mean, standard deviation, variance, coefficient of variation and simple correlation, rank etc., are used to describe the characteristics of basic data. Further, using the basic data growth rate, average growth rate, average annual growth rate, investment rate, population growth rate, composite of human capital index, annual per capita consumption expenditure, per capita total expenditure, per capita explicit, implicit and total transfers are constructed for measurement of variables used in estimations.

Econometric techniques are used for different purposes. First, semi-log growth model is used to find trend growth rate of per capita real income with relevant correction for autoregressive structure. Second, the basic convergence regressions derived from the neoclassical growth model are estimated with the Ordinary Least Squares (OLS) and Non-linear Least Squares (NLS) methods of estimations to estimate the rates of absolute and conditional convergence in per capita real income as well as capital share parameter. In order to estimate $\beta$-convergence in consumption,
growth rate of household per capita consumption expenditure and its initial levels are used as dependent and independent variables, respectively. For estimation of conditional $\beta$ convergence, growth rate (either average growth rate or trend growth rate) is the dependent variable and a set of explanatory variables like initial level of per capita income, investment rate (or per capita), population growth rate, human capital variable (human literacy rate or human capital index etc.) are treated as independent variables. Several alternative specifications have been tried in order to get robust and plausible estimates of $\beta$. In addition, log-log model is applied to estimate income elasticity of intergovernmental transfers. Dynamic fixed effects panel growth model is estimated with fixed effects panel data model to account for omitted variable bias and endogeneity problems, and to obtain consistent and unbiased estimates of $\beta$.

Throughout, the estimations are done for 14 major states (i.e. Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal) and by three categories of states such as High Income States (HIS: Gujarat, Haryana, Maharashtra, and Punjab), Middle Income States (MIS: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, and West Bengal), and Low Income States (LIS: Bihar, Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh).

1.5 Timeframe

First, the study covers the time period from 1960-97(8) for estimations of absolute ($\beta$) and sigma ($\sigma$) convergence in per capita real income across 14 major states in India. Second, absolute and sigma convergence/divergence in per capita real state disposable income are also accomplished from 1976-2000. In addition, conditional convergence after controlling investment rate, population growth rate and human capital is carried out from 1981-2000, and with inclusion of intergovernmental transfers (both explicit and implicit) along with these variables from 1976-2000. Third, unconditional and sigma convergence in per capita consumption is analysed from 1983 to 1999-2000.

1.6 Data Sources

All data for this study are obtained from secondary sources. The main data sources are as follows. (i) The disaggregated Net State Domestic Product (NSDP) at
factor cost and population data at the state level are collected from \textit{Central Statistical Organisation} and \textit{EPW Research Foundation} from 1960-2000. Population figures at the state level are also collected from the \textit{Census of India}. (ii) EPW Research Foundation has brought out gross (fixed) capital formation data for few states from 1980-81 to 1986-87 and 1993-94 to 1999-2000 with 1980-81 and 1993-94 base. This data is not available for 14 major states over a period of time until recently. With the unavailability of investment (saving) data at the state levels, this study uses credits extended by all Scheduled Commercial Banks (SCBs) and assistance given by All Financial Institutions (AFIs) along with public expenditure (capital expenditure). The data on total outstanding credits extended by all SCBs from 1976-2000 and assistance furnished to different states by AFIs from 1981-2000 are collected, respectively, from various issues of \textit{Basic Statistical Returns, Reserve Bank of India} and \textit{IDBI Report on Development Banking in India}. (iii) Both revenue, capital expenditures of state government are collected from various issues of \textit{State Finances, RBI} from 1976-2000. (iv) Educational and health indicators and human development index etc. are collected from \textit{National Human Development Report 2001} provided by \textit{Planning Commission (2002), and Economic Surveys}. Mean Years of Schooling and per student expenditure are collected from \textit{Tilak, (1999)} and \textit{Six All India Educational Surveys, (1999)}, respectively. Expenditure on social sectors is also collected from \textit{State Finances, RBI} various issues. (v) Household Consumer expenditure data are collected from \textit{National Sample Survey Organisation} and \textit{Sarvekshana}, various rounds from 1972-73 to 1999-2000. On account of large and small samples surveys of NSS (Quinquennial and Annual Rounds), the household consumer expenditure data may not be comparable. But, the study uses comparable data series in estimating convergence in per capita consumption expenditure from 1983 to 1999-2000 from \textit{National Human Development Report 2001}. (vi) Data relating to explicit intergovernmental transfers and debt composition of state from which implicit intergovernmental transfers are computed from 1976-2000, are collected from \textit{States Finances, RBI; Report on Currency and Finance}; and \textit{Finance Accounts of Centre} and \textit{State}.

\textbf{1.7 Organisation of thesis}

This thesis contains seven chapters. The first chapter deals with introduction and motivation of the study, review of literature, research gaps, objectives, methodology and database, scope and limitations. In the second chapter a framework
to estimate types of convergence hypotheses in Indian context is outlined. Empirical analysis of convergence in per capita real income across states of India is presented in third chapter. Fourth chapter provides an empirical analysis of convergence in per capita consumption across states of India. Analysis of the volume of both explicit and implicit intergovernmental transfers, and empirical relationship between issues of convergence and intergovernmental transfers for Indian states are focussed in the fifth chapter. A dynamic fixed effects panel growth framework, derived from neoclassical growth model is used to test for convergence in India in the sixth chapter with special reference to the impact of federal inter-state transfers. Summary, conclusions and policy implications are presented in the concluding seventh chapter.

Further, Tables are sequentially presented and numbered by chapters e.g., Table 3.1 refers to Table number 1 in chapter 3 and so on. In the same way, Figures are also presented and numbered by chapters. For instance, Figure 3.1 refers to Figure 1 in chapter 3. The equations used for estimation purposes for all the chapters are presented and organised in chapter 2. Depending upon the nature of estimable equation in a particular chapter, it is referred from the chapter 2 accordingly. Notes are presented by footnotes on the bottom of the page. They are sequentially numbered for the entire thesis. Appendices are numbered by chapters e.g., Appendix 3.AI refers to Appendix 1 in chapter 3 and so on. These Appendices are presented at the end of respective chapters. All the references are consolidated at the end of the thesis. Abbreviations used in the text are listed and presented for the entire thesis before the beginning of the thesis.