CHAPTER - 2

REVIEW OF LITERATURES

There are numerous literatures in the field of Education Economics related to measurement of the performance of the institutions, efficiency of the institutions, demand for education, etc. These studies have been conducted in developed as well developing region, country and state. Some of the important empirical literatures from both Indian and global perspective have been reviewed and sited here to throw light on the present study. These literatures are reviewed in a systematic order in the following:

Das and Das (2014) have investigated technical efficiency of higher education institutions (HEIs) in Barak Valley by using stochastic frontier analysis (SFA) and compared the technical efficiency (TE) scores of National Assessment and Accreditation Council (NAAC) accredited HEIs with other HEIs and then compares the rank of the HEIs with respect to their TE scores and performance. The study reveals that NAAC accredited HEIs are more technically efficient and performing better than non-accredited HEIs.

Das et al., (2014) have examined the relationship between academic performance of the students of higher education with socio-economic background and their past academic performance. They have further analysed the differences in the achievements among different socio-economic groups. The findings of the study reveal importance of both socio-economic and academic backgrounds of the students in determining the performance of the students in higher education; however the academic factors are more dominant than socio-economic factors.

Burney et al., (2013*)* have investigated the technical and allocative efficiencies of public schools in Kuwait over four levels of schooling for two academic periods using DEA. They find that mean technical efficiency score varies across all levels of education; the

majority of schools at kindergarten, primary and intermediate levels are operating at a point where returns to scale are increasing, and there are considerable cost efficiencies to be gained. Among the determinants of efficiency, teacher salary has a positive effect and the proportion of teaching staffs who are Kuwaiti has negative effect; and these two determinants are highly significant in explaining school efficiency at all levels. The study also shows that all-girls schools have significantly higher efficiency than all boys' schools and there is limited evidence that geographical location affects efficiency.

Okioga (2013) examines the impact of students' socio-economic background on academic performance of students in Kisii University College and finds that the students' social economic background influences student academic performance. The study also reveals that middle class parents participates actively in their children's education and development by using controlled organized activities and fostering a sense of entitlement through encouraged discussion, while families with lower income do not participate in this movement, causing their children to have a sense of constraint.

Kirjavainen (2012) has used stochastic frontier models for panel data to estimate education production functions and the efficiency of Finnish general upper secondary schools. He has used grades in the matriculation examination as an output and explained with the comprehensive school grade point average, parental socioeconomic background, school resources, the length of studies and the decentralization of test-taking. The study shows that the inefficiency and rankings of schools based on their inefficiency scores vary considerably depending on the type of stochastic frontier model applied. The length of studies and the decentralization of test-taking negatively affect student achievement. Educational production function studies using register data, such as the present study, often suffer from two weaknesses.

Tochkov et al., (2012) have used DEA to measure relative efficiency of 46 accredited tertiary education institutions of Bulgaria. The study has also attempted to

identify the determinants of efficiency and then correlated the efficiency scores and official rankings of the HEIs. The study reveals that market share is an important determinant of efficiency, which implies that larger universities perform better in teaching and overall, which is most probably due to scale efficiency. Again more number of field study offered by the HEs in this study reflects lower technical efficiency score in terms of their teaching and overall outputs. Another finding of this study is that Bulgarian private universities are more efficient than public universities; it implies allocation of government subsidy has failed to encourage efficiency and also exacerbates the financial in equality across the universities.

Liu et al., (2012) analyze the technical efficiency of 40 Teacher's colleges of Thailand by taking a multiple input-output educational production function. The study also identifies the factors that affect the technical efficiency of these institutions. Since the teacher's colleges have a variety of departments and units with different inputs and outputs to achieve high academic performance, they use SE-DEA (Super Efficiency-Data Envelopment Analysis) model to measure the efficiency scores. After estimating technical efficiency scores, the Tobit regression has been used to analyze how factors affecting the efficient scores. They find that there are only seven out of forty colleges that perform the higher efficiency more than one. Meanwhile, nearly three-fourth of teacher's colleges faced the technical inefficiency. They also find that high personnel's quality, more intensity funds and more research and development have positive impact in the technical efficiency scores of teacher's colleges, while the years of establishment of the colleges has no impact on it.

Aristovnik (2012) measures relative efficiency of secondary education for Slovenia and Croatia and review some previous researches on measuring the efficiency of public (secondary) education sector as well as some conceptual and methodological issues of a non-parametric approach (DEA). The study reveals that Slovenia and Croatia suffer from relatively low technical efficiency in their secondary education as these are only ranked in the third and last quartiles among thirty-one OECD / EU countries, respectively. The

inefficiency is particularly problematic in Croatia where the poor results mainly stem from low enrollment rates (secondary and tertiary). On the other hand, in Slovenia the relatively good output / outcome is achieved at relatively higher costs. Public spending on secondary education is relatively high in both countries, particularly in Slovenia, without achieving respectively better outputs / outcomes than other comparable states.

Currier (2012) has applied DEA to dataset of 27 universities and colleges that were identified as the peers to University of Central Oklahoma in 2006 and found that these HEIs' mean efficiency score 0.74 with a standard error equal to 0.08. The study has further reported that efficiency scores are negatively skewed indicating suggesting the existence of inefficiency in at least some of the universities under study implying presence of inefficiencies from the existence of inefficient allocations of the total budgets.

Sav (2012) uses Stochastic Frontier Analysis to investigate possible differences in cost efficiencies of public relative to private for-profit Higher Educational Institutions in US. He takes panel data of four academic years. The findings suggest that private institutions operated at greater inefficiencies relative to their publicly owned counterparts. While the public minority serving colleges shows inefficiency deterioration over time, the findings point to private institution's efficiency gains. Institutional debt is one of the significant determining factors for higher inefficiency.

Perelman and Santin (2011) have examined the differences in Students' test performance across public and private-voucher schools in Spain by considering that education is a multi-input multi-output production process subject to inefficient behaviours using SFA approach. The study reveals that student's background, peer group, school characteristics and personal circumstances have a significant impact on educational outputs. Further they have suggested that consideration of educational inputs and potential bias due to school choice endogeneity brings no further unexplained difference between students' efficiency levels across public and private-voucher schools.

Kuah and Wong (2011) have applied a DEA model for evaluating the relative teaching and research efficiencies of universities using 16 inputs and outputs to measure the efficiencies of universities based on their teaching and research activities. The study reveals that application of DEA to identify deficient activities in their universities and take appropriate actions for improvement. The model has verified a strong discriminatory power in differentiating between efficient and inefficient universities despite considering more measures for a small sample size of 30.

Man and Fung (2011) have measured efficiency of Hong Kong Public Funded Universities. They have used output oriented DEA methods to study the performances of the seven public funded universities in Hong Kong for an eight years horizon. They find the high efficiency scores obtained by the assessed universities. Universities in Hong Kong are broadly divided into research universities and teaching universities. The study reveals that teaching universities are generally performing better than Research University in both teaching and researches. However, they observe that time is not a critical factor on the performances for both groups.

Agasisti and Johnes (2011) have applied SFA to evaluate the cost function and efficiency of Italian higher education institutions. The findings of the study demonstrate useful information about inter-institutional variation in cost structure and technical efficiency. Further they have found that HEIs in Italy that are large sized have exhausted scale and scope economies, and are experiencing diseconomies owing to their size and on average also the Italian HEIs are operating under decreasing returns to scale.

Vieira and Vieira (2011) have formulated a model of demand for higher education in Portugal considering a wide range of demographic, economic, social and institutional explanatory variables. The study suggests that policies that improvement in the birth rates, increase in the number of compulsory schooling years, higher rates of academic success in secondary education, avoiding gender discrimination in access to higher education and

promoting the restructuring and length reduction of tertiary education programmes have a positive impact on demand for higher education in terms of the number of applicants. On the other hand the study reveals that demand for higher education is negatively related to tuition fees and to unemployment rates which decreases the opportunity cost of education.

Daghbashyan (2011) investigates the economic efficiency of higher education institutions in Sweden. He determines the factors of efficiency differences among the 30 higher educational institutions and estimates the heterogeneity in utilization and allocation of resources by using Stochastic Frontier Analysis. In Higher educational institutions, some specific factors such as size, load, staff and student characteristics as well as government allocations are suggested to be the potential determinants of economic efficiency. The study attempts to examine the cost efficiency of Swedish HEI and find the determining factors of it. The study reveals that Swedish HEI differ in their cost efficiency. She analyzes the inefficiency by considering three groups of variables viz; university specific indicators, staff and student characteristics. The findings for university specific factors, in particular load per teaching / research staff, university size and the share of government support in total funding are ambiguous. Government financing is significant and negative in the model with time invariant inefficiency and insignificant in other models. The characteristics of the staffs are represented by the fraction of professors in teaching / research staffs which is found to have significant impact on the HEI cost efficiency. The models with pooled data also suggest that young teachers and researchers contribute more to the HEI performance in terms of economic efficiency. As to the student characteristics, the study shows that the age and quality of students do not affect the cost efficiency, whereas foreign background is a significant and negative factor to cost efficiency. Interestingly, foreign background is found to increase HEI costs, which might be the reason of the negative influence of students with foreign background on economic efficiency.

Thanassouli et al., (2011) have examined the cost structure, efficiency and productivity to higher education institutions in England by applying Data Envelope Analysis (DEA) panel data. The study shows that increase in student number of the order of 20–27 per cent is feasible through exploiting operating and scale efficiency gains and also adjusting student mix. The results of Malmquist index here reveals that for a majority of institutions' productivity has actually decreased during the study period.

Aristovnik and Obadic (2011) have applied DEA to assess the relative technical efficiency of higher education across countries, with a particular focus on Croatia and Slovenia considering quantities outputs / outcomes. The results of the study show that the relatively higher public expenditure per student in Croatia have resulted in a relatively better performance regarding the outputs/outcomes, i.e; a higher rate of higher education school enrollment, a greater rate of labour force with a higher education and a lower rate of the unemployed who have a tertiary education. The study also reveals that level of efficiency of Slovenia is higher than Croatia and many other comparable European Union (EU) and Organisation for Economic Co-operation and Development (OECD) countries.

Stein et al., (2011) have identified six factors that are strongly influencing the students' decision to enroll their name in a higher education programme. They found time out of school; possibilities for intellectual, personal, and career opportunities; institutional support; synchronizing learning and earning; reflective learner; and match with an academic reputation have the higher probability of enrollment. The study reveals that enrollment is the result of an interaction among situational, occupational, and institutional factors rather than primarily a desire or need to acquire knowledge as a commodity. The decision to enroll in a long-term commitment is a negotiated activity in which self-interests are balanced among various other interests, including the employer, family, friends, and identity as a learner. This study contributes to the literature by suggesting that time out of school is strongly related to the decision to enroll.

Bradley et al., (2010) have used DEA for 200 education providers in England to investigate the level of efficiency and change in productivity over the period 1999–2003. They find that the mean efficiency scores of English HEIs vary between 83 and 90 per cent over the period. Productivity change over the period was around 12 per cent, and this comprised eight per cent technology change and four per cent technical efficiency change. Further the study reveals that students-related variables such as gender, ethnic and age mix are more important than staff-related variables in determining efficiency levels, while the local unemployment rate also has an effect on providers' efficiency.

Kempkes and Pohl (2010) analyse the efficiency of 72 public German universities during the years 1998–2003, applying data envelopment and stochastic frontier analysis. Contrary to earlier studies, they accounted for the faculty composition of universities which proves to be an essential element in the efficiency of higher education. The main finding of their study is that East German universities have performed better in total factor productivity change compared to those in West Germany, while looking at mean efficiency scores over the sample period, West German universities still appear at the top end of relative efficiency outcomes.

Agasisti and Johnes (2009) have used DEA to measure the technical efficiency of Italian and English higher education institutions and found that in relation to the country-specific frontier, institutions in both countries are typically very efficient. Further for combined computation for performances it reveals institutions in England are more efficient in comparison to those in Italy. Evolution of technical efficiency scores over four-year period for this study reveals that Italian universities are improving their technical efficiency while English universities are obtaining stable scores.

Chakraborty (2009) has analyzed the role of socio-economic variables in efficiency of public education for 283 district schools in Kansa using panel data for three years. He has estimated an educational production function by taking standardized scores different

subjects as outputs, and socio-economic, school and non-school factors are taken as inputs for the study. He has used Stochastic Frontier Analysis to measure efficiency of public education and its inefficiency effect. The study reveals that students' socio-economic factors plays crucial role in efficiency of a school than school inputs; higher the expenditure lower is the performance of the school, while class size and teachers' educational level have no direct impact on it.

Corazon and Cabanda (2009) measure the technical efficiency of 16 selected private colleges and universities in Metro Manila, Philippines. They use data envelopment analysis (DEA) by taking academic data for the period 2001-2005. The study shows that the private higher educational institutions in Metro Manila are 81 per cent efficient based on an input-orientated variable returns to scale.

Tyagi et al. (2009) have measured the efficiency of 348 elementary schools of Uttar Pradesh state in India by using a linear programming based technique (DEA). They take a multiple input output production function for these elementary schools, where marks obtained by students in three different subjects are taken as output and the percentage availability of teaching, physical and ancillary facilities, parents' characteristics as Parent's education occupation index, number of students per teacher, Teachers' qualification and experience index are taken as input variables. They use four different models by taking constant returns to scale in production and find that in the first model 11 schools are efficient, in second, third and fourth model 33, 51 and 67 schools are efficient respectively. The study also provides school-wise planning information to policy makers.

Saiti and Prokopiadou (2008) have attempted to present the reasons for enrollment demand in Higher Education through self reporting responses of 400 students of secondary education in Greece by using binary Logit model. They find that Greek students choose to follow higher education mainly because it provides high level of knowledge that creates career opportunities. Among other factors family income appears to be an influential factor

for the demand for higher education, whereas parental involvement and family pressure were perceived neither as strong nor as influential factor.

Johnes et al., (2008) have estimated cost functions for English higher educational institutions by using random effect model and SFA model. The study reveals education for undergraduates and medical students are found to be the most costly; while for non-science students it is least costly. The estimates of economies of scale and economies of scope vary according to the choice of estimating technique.

Kao and Hung (2008) have applied DEA to assess the relative efficiency of the academic departments at National Cheng Kung University in Taiwan by taking total credit-hours, publications, and external grants as outputs of higher education while personnel, operating expenses, and floor space as the inputs of the departments. They have considered four groups of departments based on similar characteristics via efficiency decomposition and cluster analysis. The study identifies whether the department are utilising their resources efficiently or not and the area where more effort should be devoted for improvement in efficiency of the departments.

Johnes and Yu (2008) have applied DEA to examine the relative efficiency in the production of research of 109 Chinese regular universities during 2003-2004. They have taken impact and productivity of research as output variables and staff, students, capital and resources as input variables. Mean efficiency is just over 90 per cent when all input and output variables are included in the model, and this falls to just over 80 per cent when student-related input variables are excluded from the model. The rankings of the universities across models and time periods are significantly and highly correlated. Further they suggest that mean research efficiency is higher in comprehensive universities compared to specialist universities, and in universities located in the coastal region compared to those in the western region of China.

Psacharopoulos (2008) has analysed the principles of public funding of universities. The size of the social returns to investment in education gives an indication regarding the most efficient use of resources, while the difference between the private and the social rates relates to issues of equity. The available evidence is contrasted to higher education funding policies in several countries. It is concluded that there is a division between the research findings regarding efficient and equitable financing, and the actual public funding of universities. The reasons for this division are discussed in the context of political economy, rent-seeking by several stakeholders and, above all, vote-seeking by politicians.

Easton and Rockerbie (2008) develop a simple static model of an imperfectly competitive university operating under government-imposed constraints on the ability to raise tuition fees and increase enrollments. The model has particular applicability to Canadian universities. Assuming an average cost-pricing rule, rules for adequate government subsidies (operating grants) are derived under conditions of a forced reduction in tuition fees and limiting the increase in tuition fees in the face of increasing demand. These rules are simple to operationalize and interpret.

Anastasiou et al., (2007) have measured the efficiency differences and research outputs among 18 departments of typical Greek University. They have taken number of conferences and publications as research outputs, and total expenditure, number of academic staff and post graduates as inputs of the study. The study shows that only five departments out of 18 departments are efficient and the rest are relatively inefficient.

Castano and Cabanda (2007) have evaluated the efficiency and productivity growth of State Universities and Colleges (SUCs) in the Philippines. They determine the factors that lead to change in total factor productivity, technological, and technical efficiency from panel data of 59 SUCs over the period 1999-2003. They use output-orientated DEA-Malmquist index and find that the main source of productivity growth is due to technical efficiency than innovation. DEA multi-stage model (input reduction) is estimated for three inputs (faculty

members, property, plant and equipment and total operating expenses) and three outputs (Enrollment, Number of Graduates, Total Revenue). The study reveals that technical efficiency has an average of 95.4 per cent (Constant returns to scale DEA) compared to 96.6 per cent (Variable returns to scale DEA) and finally, the scale efficiency has a 98.7 per cent rating. This implies that in general, SUCs obtained a below frontier efficiency score. Thus, the study shows that SUCs are technically efficient due to positive pure efficiency and scale effects.

Kou and Ho (2007) use the stochastic frontier multiple product cost function model in order to empirically measure the cost efficiency of the University Operation Fund (UOF) on Taiwan's public universities. The study investigates the validity of the common perception that giving greater freedom over discretionary budgets to bureaucrats at public universities exacts a penalty in the form of cost inefficiency. In particular, it has looked into the effect of adopting the University Operation Fund on cost efficiency for a sample of public universities, arguing that this implies a shift from a budget constraint to a demand constraint. The study suggests that the adoption of the UOF has had a significantly negative impact on cost efficiency.

Konroy and Arguea (2007) conduct a study for Florida Public elementary schools by using Stochastic Frontier Analysis (SFA) by taking Half-normal distribution for error term ignoring the effect of heteroscadasticity. They examine the efficiency of Florida Public Elementary Schools and analyze the causes of inefficiency and suggested some corrective measures to remove such inefficiency. They find that high level teaching experience and student's background has positive effect on students' achievement while public expenditure, free lunch facilities and percentage of black and migrated students have negative effect on student's achievement.

Johnes (2006) has provided an overview of methods which might be used to assess efficiency in 100 higher educational institutes in England by exploring the advantages and

drawbacks of the various methods for measuring efficiency in the higher education context. The case with which data envelopment analysis (DEA) can handle multiple inputs and multiple outputs makes it an attractive choice of technique for measuring the efficiency of higher education institutions (HEIs), yet its drawbacks cannot be ignored. The study reveals that technical and scale efficiency of the English higher education sector appears to be high. DEA has the advantage over alternative (parametric) methods that it can be applied in a multiple input multiple output production context. The drawback of the study is that, there are no significance tests for comparing models, or for comparing the efficiency scores of individual or groups of DMUs. Developments of the DEA approach which attempt to overcome these drawbacks have been presented and illustrated using a data set of English universities.

McMillan and Chan (2006) have obtained the efficiency scores of 45 Canadian universities by using both DEA and SFA. They also compared the efficiency scores of these two methodologies for ten sets of efficiency scores (six from SFA and four from DEA). They have taken multiple input-output combination and estimated different model with and without environmental factors. The study shows divergent outcomes obtained from two different methodologies; hence they have given final ranking to the universities by computing average efficiency scores for each university from DEA and SFA results. Other findings of the study are that efficiency scores are sensitive to adjustment for environmental factors, and most of universities have mean ranks and cluster around mean efficiency score.

Lenton (2006) estimates cost functions for a two-year panel of 96 colleges of further education in England by comparison with two panels of 959 and 719 colleges in the US which includes both private and public institutions. They use random effects and stochastic frontier methods to analyze the efficiency of cost functions. Estimation of the linear specification by stochastic frontier analysis reveals that higher education vocational courses are the most cost-efficient. They find that the measure of student quality is insignificant;

however, teaching quality variables were found to be highly significant, thus the teaching quality at the institutional level must be taken into consideration when comparing levels of cost efficiency.

Kuksal and Naluaci (2006) measure relative efficiencies of fourteen academic departments of Turkish Engineering College by using DEA. The study have compared efficiency of departments of different disciplines and provided guidance to inefficient departments for its improvement. Input and output criteria are determined and measured utilizing the academic personnel performance measurement scheme of the College. The study reveals that only four departments are fully efficient for different model specifications. Other institutions' efficiency scores vary with the change in model specification.

Kempkes and Pohl (2006) find the efficiency of publicly financed universities in Germany. They analyze the efficiency of 72 public German universities for the years 1998 to 2003 by applying both data envelopment and stochastic frontier analysis. They find that faculty composition of universities proves to be an essential element in the efficiency of higher education. The main findings of this study are that East German universities have performed better in total factor productivity change compared to those in West Germany. They compare the efficiency scores obtained by DEA and SFA, and found that there is highly positive correlation between the two methods.

Renato et al., (2006) have examined the performance of undergraduate students admitted in the State University of Campinas from 1994 to 1997 and their socio-economic and educational background. The study is based on a hierarchical model and the result that students coming from disadvantaged backgrounds, in both educational and socio-economic aspects, have a higher relative performance than their complementary group. They also report on an affirmative action program established for undergraduate admissions and present evidence from initial evaluation of studies showing its positive impact.

Johnes and Johnes (2005) have estimated multiproduct cost function for 121 English higher educational institutions by using SFA with a panel data over the session 2000-01 to 2002-03. They have examined the impact on costs of inter-institutional differences in the cost function itself to be distinguished from inter-institutional differences in efficiency. In addition to that they have also reported on measures of average incremental cost of provision and on returns to scale and scope and found science undergraduates cost between twice and three times as much to produce as do non-science undergraduates, and that postgraduate education is markedly more costly than undergraduate education.

Afonso and Aubyn (2005) analyze the importance of public expenditure on health and education from the view point of efficient management of public resources. They have measured the efficiency in education and health sectors for a sample of Organisation for Economic Co-operation and Development (OECD) countries by applying two alternative non-parametric methodologies viz; Free Disposable Hull (FDH) analysis and Data Envelopment Analysis (DEA). The study reveals that countries are different in terms of proportion of public and private funding on education and health and one of the possible sources of inefficiency is the interaction between these. Among the other possible factors, a difference in population density or composition, levels of GDP per head or of educational attainment by the adult population could imply different outcomes in health or education, even under efficient public services.

Dotterweich and Baryla Jr (2005) have determined the factors that influence the non-resident enrollment percentage for public and private institutes of higher education (IHEs) and found positive correlation between the enrollment percentage and tuition for private institutes and no significance for public institutes. Their additional investigation of this research reveals that the highest-priced public and private institutes generally attract the highest percentage of non-resident students. This implies that the more costly institutes,

especially private, may enjoy a special cache that allows them more opportunity in setting non-resident tuition.

Worthington and Lee (2005) have investigated productivity growth of thirty-five Australian universities using nonparametric frontier techniques over the period 1998 to 2003. They have applied DEA to estimate a university production function with multiple outputs by considering full-time equivalent academic and non-academic staff, non-labour expenditure and undergraduate and postgraduate student load as inputs while undergraduate, postgraduate and PhD completions, national competitive and industry grants and publications as outputs in this study. The findings of the study have revealed that annual productivity growth averaged 3.3 per cent across all universities, with a range between -1.8 per cent and 13.0 per cent, and was largely attributable to technological progress. The study reveals productivity gain in research outputs are associated with pure technical and some scale efficiency improvements, while in case of teaching outputs the largest source of gain in that instance was technological progress offset by a slight fall in technical efficiency.

Valadkhani and Worthington (2005) have analysed the clustering and ranking of the research performance of 37 Australian universities over the period 1998-2002. They have measured research performance according to audited numbers of Ph.D. completions, publications and grants and analysed in both total and per academic staff terms.

Fathi et al., (2005) have investigated the efficiency of 22 university branches of five different regions in Iran by using DEA. They have taken university costs, number of faculties and students as inputs, while number of students graduated, number of books, articles, research periods and conferences held are taken as outputs. The study shows that only ten branches are efficient out of 22 branches and the rest are inefficient. They have also found that a very little variation in efficiency scores for cost function with CRS and VRS models.

McMillan and Chan (2004) conduct a study for 45 Canadian universities for the academic year 1992-93 by using both Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) for selected specifications and measured correlation coefficient of the efficiency scores of these two methodologies. They analyze ten sets of efficiency outcomes among which there is some inconsistency in the scores and rankings of universities. Correlations reveal divergent outcomes. The outcomes are analyzed using the sum of ranks method to determine a single ranking and to provide the range of potential rankings for each institution.

Chapple et al., (2004) present the empirical evidence on the relative efficiency of U.K. universities, based on a comprehensive data set and compare parametric and non-parametric approaches to productivity measurement. They find that there is a high degree of heterogeneity among the universities in terms of resource allocation. Universities located in regions with higher levels of Research and Development (R&D) and Gross Domestic Product (GDP) appear to be efficient in technology transfer, implying that there may be regional spillovers in technology transfer and with respect to evidence on the determinants of relative inefficiency and that having a medical school have a negative effect on efficiency.

Abbot and Doucougliagos (2002) use Data Envelopment Analysis to estimate technical and scale efficiency of Australian Universities and analyze the sensibility of degree of efficiency with respect to different inputs and outputs. They also use different inputs and output measures by taking a multiple input-output model. They find that Australian Universities are performing at a fairly high level of technical and scale efficiency.

Izadi (2002) has estimated multi-product constant elasticity of substitution (CES) cost function using SFA estimation techniques and constructed measures of economies of scale and scope which obtain in British higher education. The study reveals that fairly

modest presence of inefficiencies and the efficiency score of British HEIs varies from 0.37 to 0.99

Mizada et al., (2002) have measured technical efficiency of 2000 schools in Chile by both using DEA and SFA and compared the efficiency scores obtained from these two methodologies. Average scores for Mathematics and Spanish are considered as output for the study, where inputs for the study include students' characteristics, school characteristics and teachers' characteristics. The study shows that schools with similar characteristics and inputs differ in efficiency scores. DEA results shows that fee-paying private schools are more efficient than subsidized private and public schools, while SFA results dose not allows conclusions which type of school is better or efficient, although both the methodologies show significant difference between efficiency scores of different school types.

Avkiran (2001) has used DEA to examine the relative efficiency of Australian universities with the help of three performance models namely, overall performance, performance on delivery of educational services, and performance on fee-paying enrollments based on 1995 data. The study reveals that the university sector is performing well on technical and scale efficiency but there remains scope for improvement in performance on fee-paying enrollments. Further the study reveals that Australian universities are operating at decreasing returns to scale.

Koshal et al., (2001) have empirically estimated a multi-product total cost function and output relationship for comprehensive universities in the United States based on data for 184 Bible colleges. The study reveals that there are both economies of scale and economies of scope in higher education. In addition to that the study reveals that product-specific economies of scope do exist for all output levels and activities.

Worthington (2001) measures the educational efficiency by using frontier efficiency measurement techniques. He also measures of inefficiency in education and identifies the determinants of educational efficiency. He finds the educational institution is seen as analogous to a firm transforming inputs into outputs through a production process. Typical inputs in the education production function are the characteristics of the teaching and learning environment, while outputs are generally defined in terms of students' test scores. It follows that a strong assumption held in this type of analysis is that technical relationships are of central importance in the educational process.

Chakraborty et al., (2001) have used both the stochastic and non-stochastic production function approach to measure technical efficiency in public education in Utah for 40 schools districts in Utah for the academic year 1992-1993. The standardized test score for 11^{th} grade students is used as a measurement of school output, and two types of inputs are included. The first type is considered to be subject to control by school administrators and includes the student-teacher ratio, the percentage of teachers having an advanced degree, and the percentage of teachers with more than 15 years of experience. The second type includes uncontrollable factors such as socio-economic status, education level of the local population, and net assessed real property value per student. The stochastic specification estimates technical efficiency as summing half normal and exponential distributions. The non-stochastic specification uses two-stage data envelopment analysis (DEA) to separate the effects of fixed inputs on the measurement of technical efficiency. The empirical analysis shows substantial variation in efficiency among school districts.

Robst (2001) has measured cost efficiency of 440 Public Higher Education Institutions for the time period 1991 to 1995 by using ordinary least square and maximum likelihood estimator for a Stochastic production frontier. He has identified the factors

leading to inefficiency and evaluated the impact on efficiency scores with the change in revenue structure. The study reveals that increase in tuition fees lead to more inefficiency and institutions with less state share are more efficient than institutions with more state share.

Tam (2001) has applied various models of measuring quality in higher education institutions and contested views over quality measurements which inform the preferences of different stakeholders in higher education. The study suggests that to understand quality it is necessary to recognise different practical outcomes.

Cecilia (2000) has investigated the influence of family characteristics and labour market signal on demand of demand for higher education in Spain. He has also analyzed various factors that lead to demand for higher education in Spain. He has used Binomial Logit model to study the influence of family and labour market signal on demand for higher education by covering population of age group 19 to 24 years for 12 years. The study reveals that there are two important factors affecting the demand for higher education viz; income and employment expectation relevant to the level of education and the family background of each potential students. Higher the unemployment rate, lower is the demand for higher education while high socio-economic status has positive impact on it. Mother's education has more strong impact on probability of attending higher education than father's education, although both have positive impact on it. The study also shows that gender plays an important role in demand for higher education and a negative effect on the decision to obtain higher education.

Koshal and Koshal (1999) have estimated a multiple-product fixed total cost function and output relationship for comprehensive universities in the United States using data for 158 private and 171 public comprehensive universities. The study reveals that

comprehensive universities in the United States can reap benefits from both scale and scope economies. Here, large comprehensive universities appear to be more cost-efficient with some possibility that beyond some level of output, inefficiencies may exist. However, product specific economies of scope do not exist for all output levels and activities.

Rego and Sousa (1999) examine the relationship between the academic performance of university students on entrance grade and socio-economic background with the help of three independent samples taken from the University of Aveiro, Portugal. The study reveals that entrance grade explains only 12-28 per cent of the degree performance variance and socioeconomic background does not seem to influence performance in higher education.

McMillan and Datta (1998) assess the relative efficiency of Canadian universities using data envelopment analysis. Outcomes are obtained from nine different specifications of inputs and outputs. The relative efficiencies are quite consistent across the alternative specifications. The study reveals that universities that are input efficient are not always cost efficient although the two results are generally consistent. The major determinants of efficiency are captured by the DEA variables that is, environmental variables are not that much important in this study.

Soteriou et al. (1998) use the methodology of DEA to assess the efficiency of secondary schools in Cyprus and provides recommendations for improvement to inefficient schools and discusses managerial implications. The study reveals that there exist no significant differences in efficiency scores between schools operating in rural areas compared to those operating in urban areas and teachers' quality is positively influencing factor.

Wobbekind and Graves (1989) have analysed possible reasons for increasing demand for foreign students at the colleges and universities in the United States since the late 1960s.

They have provided a theoretical model of educational demand and to test the model they have employed both time series and cross-sectional data. The study shows that the stock variable, real domestic per capita income, and the aid variable were found to be the most significant (especially for Middle Eastern, Central American, and South American countries). For more industrialized countries of Europe, as well as Canada, New Zealand, and Australia, the transferability of technology is measured by the percentage manufacturing employment appeared important. Other critical variables are the real cost of education in U.S. dollars and the stock of prior migrants and excess demand is not a consideration for students from these countries in this study.

Koshal et al. (1997) have estimated demand functions for higher education in the United States for males and females separately. The study shows that the determinants such as potential students, tuition fees, median family income, expected rate of return and federal grants have significant influence on the demand for male and female higher education, while the rate of return on higher education is the only variable which impacts differentially on male and female enrollment.

Weiler (1987) explains the determination of enrollments in typical case where enrollments are limited by institutional constraints on the number of students the institution will accept to fewer than the applicants who meet widely posted admissions standards and estimate the coefficients of a student demand. The results are much better than those obtained from a conventional model of enrollment demand estimated using ordinary least squares. The tuition level is positively related with enrollment supply and negatively related with enrollment demand, while the yearly salary of new college graduates, financial aid per student, and the number of persons eligible for admission are found positively associated with enrollment demand.

Nichollas (1984) has measured demand for tertiary education and analyzed youth unemployment effect on demand for tertiary education in Australia. He has used linear regression model to analyze various factors that determines demand for tertiary education which are real household disposable income, number of eligible, youth unemployment rate and Government policy (tuition fees). He finds that youth unemployment rate negative effect on demand for higher education and number of eligible has no impact on it. Again effect of tuition fees on demand for tertiary education is very less, but affect negatively.

Strickland et al. (1984) have investigated that the demand for higher education based on human capital theory within a state wide system. They have applied a multiple regression by considering the ratio of high school graduates enrolled in a given institution to that institution's entering freshman enrollment as dependent variable, while eligible population, academic ability, educational attainment, income level, wage rate, unemployment rate, cost of attendance, and local environment as independent variables. Squared multiple correlations for the various models are found positively related and ranges from 0.3 to 0.5 indicating moderate influence of selected factors on demand for higher education.

Stephenson Jr. and Eisele (1982) have analysed the impact of financial aid on women's demand for higher education. They have used multiple regression models for analysing impact of marital status, parental background, geographic locations and economic characteristics, and tuition in enrollment demand women's for higher education. These study suggests that policy attempts to stimulate the higher education acquired by enrolled young women by increasing the availability of financial aid are well founded.

Doyle and Cicarelli (1980) have examined the partial elasticities of demand for higher education by taking enrollment as the indicator of demand and relevant price variable, average income of applicants, the quality of education provided by the school, and

the degree of direct competition with which the school must contend as determinants of enrollment demand. The study reveals negative influence of income with respect to enrollment demand which implies that public education is an inferior good, the coefficient of the competition variable is negative and inelastic which denotes that more number of competitors a given college has harder it will be for that school to maintain enrollment. The study also shows that by lowering tuition fees or by improving academic quality at a public college will not improve enrollment in these colleges in the short run. However, in the long run, such changes may in fact have a pronounced affect on enrollment, but only a time-series study could verify or refute that hypothesis.

Knudsen and Servelle (1978) have estimated enrollment demand for higher education in private institutions with moderate admissions standards, and measure the cross elasticity of demand between public and private universities, using cross-sectional institution-specific data of a nearly homogeneous set of private institutions. The study reveals that tuition fees and income are significant determinants of enrollment at private institutions of moderate selectivity. Enrollment is generally inelastic with respect both to average tuition and fees and effective tuition and fees and elastic with respect to income. The cross-elasticity term in the demand function is not significantly different from zero, which implies that even with a large difference in tuition fees between the public and private institutions has reported limited difference between enrollment at public and private institutions. Further they found that moderate tuition increases at public institutions will not result in a significant increase in enrollment at private institutions. The large tuition difference between the public and private tuitions in the sample has limited the substitution effect between enrollment at public and private institutions.

Sloan (1971) has presented a model of demand for medical education in order to analyse the determinants of student demand for medical education. The results of the study show that student career decisions are robustly related to inter-occupational differences in tuition and expected incomes. Students with excellent college records are somewhat less responsive to monetary incentives for medical education. Substantial increases in medical school tuition fees and relatively low stipend levels have decreased student interest in medicine as a career.

Previous literatures related to measurement of efficiency have concentrated on measurement of technical efficiency either by using parametric or non-parametric technique only, while a very few of them has considered on both techniques for a consolidated analysis. Majority of these studies have been conducted for developed nations where secondary data set available at macro level of various nations are available. However for developing country like India no study has addressed the issue in an extensive manner. Further no studies till date has dealt with the issue of efficiency and demand together, which has been attempted by this study. The present study attempts to measures efficiency of higher education institution in a developing region of India situate in the southern part of north-eastern state, Assam with the help of both primary and secondary information related to the HEIs of the region. Further the study compare the level of technical efficiency with demand for the HEIs which is distinguishes the present study from others with an exceptional novelty.