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# Determinants of Aggregate Demand for and Supply of Higher Education in India

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## Abstract

The present paper specifies system of demand and supply equations for enrolment in higher education. GER and log enrollment are dependent variables, covering from 1980-81 to 2018-19 and estimated with OLS and 2SLS. GER models perform better than log of enrolment models in both the cases. GER models indicate positive relationship with income per capita while negative relationship with poverty and literate population with both OLS and 2SLS. Regarding the supply equations, none of the included variables are found to be statistically significant though exhibit expected relationship. Reported negative ratio of boys to girls indicate gender disparity, raising concerns. The paper concludes with policy implications and suggested areas for future research.

## Keywords

Demand for Higher Education, Supply of Higher Education, OLS, 2SLS, India

## 1. Introduction

The demand for higher education in India has been growing at an unparalleled rate since the beginning of 1990s. Based on the data sources from the Ministry of Education, during the pre-1990s (1960-61 to 1989-90), the CAGR[1] of Gross Enrolment Ration (GER) in higher education is 1.84 percent, while during the post 1990s (2000-01 to 2018-19), the CAGR of GER is grown by 5.42 percent. Globalization and demographic changes have paved way for this growing demand for higher education. In 2018-19, 37.4 million students are enrolled in various courses offered at higher educational institutions in India (AISHE,

[1]CAGR refers to compound average annual growth rates, estimated by using the formula CAGR of GER = [GER latest/GER beginning]$^{1/t}$ − 1.

2019). In this, 80 per cent of total enrolment in higher educational institutions belongs to enrolment at undergraduate courses (AISHE, 2019). In the new millennium, enrolments in higher educational institutions have increased at an average rate of 9.3 per cent per annum during 2000-01 to 2018-19[2]. Not only in India, but also globally, there has been rapid expansion and as massification of higher education happening. Nonetheless, these 37.4 million enrollments depicts a gross enrolment ratio (GER) of 26.3 per cent in 2018-19, which is considerably low in comparison to many developed nations, including China (51.6 per cent[3]). Even with such higher growth rates of GER, India could enroll only 26 per cent of the eligible age group population; the target was to increase it to 30 per cent by 2020. The young India combined with low GER clearly indicates the prospects of growing demand for higher education in the coming years. In this context, the present paper attempts to understand the factors that determine the aggregate demand for higher education.

Demand for higher education is influenced by the demographic trends and supply of higher secondary passed out graduates. Among them, it is those who are willing and economically capable of pursuing college education become the proximate determinants of enrolment in higher education. From the human capital theory, it is the economic calculations of the cost and benefits of education, from the investment perspective. More precisely, it suggests that an individual will purchase a college education if the present value of the expected stream of benefits gained from the education exceeds the present costs of the education. The decision to enroll in college is also influenced by social and cultural factors to which the individuals and their families belong to. The threshold levels of income of each of these families vary depending on their social and cultural norms and values. Despite these differences, the skills and training are becoming increasingly important in a knowledge based and integrated world economies.

In this light, the present paper estimates the determinants of aggregate demand function for higher education. The rest of the paper is organized as follows: Review of earlier studies is briefly discussed in section two. Third section examines the methodology, objectives and formulating hypotheses. It also describes the data sources and variables used, while fourth section explains specification of models. Fifth section discusses the results of the aggregate demand function in India and across major states at selected points. The last section concludes.

## 2. Brief Review of Earlier Studies

The empirical literatures on demand for higher education is voluminous and

[2]Based on the enrolment data published by All India Higher Education Survey from 2000-01 to 2018-19 and fitting a trend growth rate, we arrive at this average annual growth rate of 9.3 per cent per annum.

[3]https://www.statista.com/statistics/1113954/china-tertiary-education-college-university-enrollment-rate/.

growing. It commences with the seminal work of Campbell & Siegel (1967)'s. Since then, enormous, and diverse literature has been developed. Based on the unit of analysis, we can classify the demand functions as aggregate and individual demand functions. Aggregate demand functions are the country level demand functions using time series data or pooled data across provinces. These studies primarily use single equation demand functions and estimate the parameters and elasticities with OLS. Studies also employ institutions like universities and colleges as their unit of analysis over time. Studies that estimate individual demand functions, i.e., the choice of the decision to enroll or not in higher education, by and large use either micro survey and large cross section survey data. Such survey data-based studies primarily employ the binary choice models (logit or probit) to estimate the factors that determine the probability of students enrolling in higher education. We can also classify studies based on estimating the demand functions using single equation or a system of equations. However, this present review restricts itself to cover relevant studies on aggregate demand functions using times series and or pooled state level data.

Commonly, demand function studies in higher education attempt to test the investment and consumption motives of higher education. The early seminal work of Campbell & Siegel (1967) viewed individual investment decisions in higher education on the basis of variables such as expected cost, expected benefits and utility of educational points. Financial attributes of educational institutions e.g., tuition fee, financial aid, housing and cost of commuting are included in their models. They found that demand for enrollment is positively associated with expected monetary and real yields from education, income, and consumer price index and inversely associated with nominal and real cost of education.

Yet another influential study is Cohn et al. (1978), which estimated the demand for higher education in South Carolina in the United States. He employed explanatory variable such as educational attainment of adult population, overall rate of unemployment, rate of youth unemployment, population density, per capita income, proportion of Blacks in the population, distance, and average reading level of students. The significance of the inclusion of socio-demographic variables in demand functions comes out from his work. Chang & Hsing (1996) have examined some of the determinants of enrollment at private colleges and universities between 1964 and 1991. They defined demand for higher education as a function of tuition, and other costs, income, wage rate and unemployment rate. It was observed that increase in the unemployment rates leads to an increase in the enrollment for higher education while higher wage rates cause enrollment to decline. In a similar vein, Yang (1998) estimated the demand for higher education for the United States during the period 1955-1965.

Hopkins (1974) used expenditure per enrollment as one of the explanatory variables in the demand function. He found that there was a significant negative association between public expenditure and private enrollment. This study used the public expenditure per student a policy variable on public subsidy and ex-

pected positive relationship between public expenditure per student and enrollment. Income is an important factor which can influence the demand for higher education when education has a consumptive value. Alternatively, it is argued that credit market problems are alleviated when the average income increases (Canton & de Jong, 2005). However, both the views point a positive association between university enrollment and per capita income.

Another important argument in the aggregate demand for higher education is the unemployment rate. It is expected to influence income and employment expectation of students as well as opportunity costs of attending university. Since unemployment rates for upper (higher) secondary young graduates is very high, they have lower chances of getting a job and, therefore, opportunity cost of attending universities will be lower as well. Unemployment increases uncertainty, which implies an increase in the demand for higher education (Albert, 2000; Barr, 1989; Chang & Hsing, 1996; Yang, 1998). Expected employment motivates one to go for higher education. Expected employment means the prospects of opportunities of get job and earnings. The higher the unemployment rate of university graduates the lower the level of demand for university education (Barr, 1989). Many demand studies on education have not considered the supply side factors (Mueller & Rockerbie, 2005) but several demand functions on higher education operate with supply constraint. They argue that greater the availability of higher education facilities, higher is the enrollment demand. This adheres to the famous argument of Says' Law of "Supply creates its own demand".

Fredriksson (1997) explore the extent economic incentives influencing the demand for higher education in Sweden from 1967 to 1991. He argues that, university transition rate is attributed to three set of economic variables: 1) University graduates' wage premium, unemployment benefits and the subsidy value of study allowances; 2) Likelihood of employment for the two education categories (high school and university); 3) Control variables for e.g. changes in the proportion of eligible individuals and the reform of university education. By applying WLS and 2WSLS across male, female and total university transition rates, he finds that sizeable variation is attributable to fluctuations in the wage premium. Further, employment prospects for university graduates and good student stipend scheme emerge significant for the enrollment decision.

Sissoko & Shiau (2005) estimate the determinants of enrollment at Historically Black Colleges and Universities (HBCU) from 1976 to 1998 by Black students using OLS. Their results show that Black student enrollment is determined by the average cost of tuition and fees (negative), the average Pell Grant per student (positive), the retention rate (positive), federal policies (positive), and Black population trend (positive).

In the same year, but for China, Chow & Shen (2005) estimate the determinants of demand for education by real income and relative prices at the aggregate level from 1991-2002. It estimates the income effect by using cross-provincial data, while time series data are used to estimate the price effect. Changes in government and non-government spending through time are explained by the fac-

tors of demand. Demand for education services in the three levels of primary school, secondary school and higher education and aggregate demand for education services are explored.

Canton & de Jong (2005) investigate the role of economic factors in the university enrollment decision for the post-war period in the Netherlands from 1950-1999. They include factors that are central to education as an investment. The econometric results suggest that students are not responsive to tuition fees, but financial support (the sum of loans and grants), the college premium on future labor market earnings, and the alternative wage are important in the enrollment decision.

Considering demographic, economic, social and institutional explanatory variables, Vieira & Vieira (2011) estimated aggregate demand for higher education in Portugal, for the period 1977 to 2010. Unlike earlier studies, they measure demand in terms of the number of applicants to public institutions. Their results suggest that the number of applicants reacts positively to demographic trends, graduation rates at secondary education, female participation, compulsory schooling and the Bologna process. On the other hand, they find demand reacts negatively to cost i.e., tuition fees and to unemployment rates.

The select and limited earlier studies provide information set on several factors influencing the demand for higher education varying across the country/state/institutional contexts. However, it indicates that students' tendency to attend college generally differs by demographic and academic characteristics, socioeconomic characteristics like income, and by cost constraints as per student public subsidy, availability of higher education facilities, etc. Explanatory factors are attributable to both consumption and investment motive for higher education. The brief review here suggests that the conventional demand for higher education is denoted as a function of tuition, income, wage rate (expected earnings) and unemployment as primary arguments besides various socio-economic, demographic, financial aid variables. Going by the previous literature and considering the Indian context, the present study constructs and estimates an aggregate demand, supply equations.

## 3. Methodology

One of the challenges is identifying an appropriate measure of demand for higher education. Earlier work tends to focus on actual enrollment or enrollment relative to total pool of potentially eligible students (Strickland et al., 1984). The enrollment is modeled as a linear function of several explanatory variables, which were obtained by aggregating individual students, recorded from across each group. These records were from a database covering all undergraduates' enrolled specific states or national level during a specific period of time. Adapting to the law of demand, demand for higher education is specified as a function of price or cost of education (tuition), income, price of related goods, unemployment, wage rate and foregone earnings.

### 3.1. Data

The paper uses secondary data published by Ministry of Human Resources Development (MHRD), now referred to as Department of Education (DoE). These publications include Selected Educational Statistics, UDISE, Secondary Education Management Information System (SEMIS), UDISEPlus, Selected Statistics on Higher and Technical Education, All India Survey of Higher Education, Results of High School and Higher Secondary Examinations. Selected Educational Statistics and Analysis of Budgeted Expenditure on Education. Other data sources such as UGC Annual Reports, Economic Surveys of India published by Ministry of Finance, RBI, Manpower Profile, Selected socio-economic Indicators, India, Statistics of Indian Economy by Reserve Bank of India (RBI), and Census reports and Central Statistical Organization are used. Further, it uses the NSO data in its 52nd, 64th, 71st and 75th round data on Social Consumption on Education. The details of the data sources for each of the variables collated from different sources of data rereported in annexure Table A1. Period of study is from 1980-81 to 2018-19. To explore the determiners of enrollment decision, we review several potential explanations as suggested in the literature, adapted to the Indian context. The compiled data from these multiple sources are reported in Table A2 at the annexure at selected points of time from 1980-81 to 2018-19.

### 3.2. Formulating Hypotheses

A set of ten hypotheses are formulated which are associated with economic, social, demographic variables and supply side factors.

***Hypothesis* 1:** *Higher the level of the total cost of higher education, lesser will be the student enrollment.*

The total cost of higher education is arrived at by summing up the per student budget expenditure on higher and technical education with average annual household expenditures on higher education from the NSSO data and the average student loan from the Statistics Relating to Banks in India (SRBI) published by Reserve Bank of India. The household expenditure data relating to the 1995-96 (52nd round of NSSO), 2007-08 (64th round of NSSO), 2014 (71st round of NSSO) and 2017-18 (75th round of NSSO) are used. We have extrapolated the household expenditures for the in-between years. The average student loan data relating to the commercial bank loan is available from 2001[4].

***Hypothesis* 2:** *Greater the per capita income better will be the access to higher*

[4]However, the National Scholarship Scheme was launched in 1961 and administered by the central government. Eligibility criterion is merit-cum-means and offered in post-matric studies. Number of scholarships awarded per year is fixed and allotted on the basis of population. Scholarships for post-graduate studies are on the basis of merit. It is renewable annually provided that the student get more than 50 per cent aggregate marks. It is not only the amount of scholarship is meager, but also the coverage is minuscule, 0.005 per cent of the students enrolled in public institutions. The number of scholarships have been fixed and not revised with the increase in enrolment. Due to its low recovery and high default rates, this loan scholarship scheme was written off in 1993. With the intervention of Supreme Court of India, a new scheme was launched in 1995 only for Professional education.

*education*.

Income is one of the predominant factors influencing demand for higher education. It is positively related to enrollment (Campbell & Siegel, 1967; Duchesne & Nonneman, 1998). When average incomes of population increase, demand for higher education also increases, owing to perceived benefit of education as consumption good. Yet another reason as their real income goes up, credit constrains get tapering. Both the arguments indicate a positive relation between higher education enrollment and per capita income (Canton & de Jong, 2005). Also in theory, expected earnings likely from an investment in university education would be the incremental cash flows expected to be gained from that education over the amount expected if that education is not attained. This discount rate is difficult to measure. Instead, we use per capita income as a proxy. The decision to invest in higher education is similarly influenced by the availability of finances. Per capita income can serve as proxy for this.

***Hypothesis* 3:** *High secondary unemployment increases the enrollment in higher education*.

Within human capital theory sphere, unemployment influences positively demand for higher education. Increase in youth unemployment causes opportunity cost of higher education to fall which leads to increase in the demand for higher education (Barr, 1989; Chang & Hsing, 1996; Yang, 1998). Investment in new capital goods occurs when those currently used are no longer adequate. Unemployment rate is a measure of inadequacy of skills and level of education. Young people unable to find jobs go to college to augment the quality of their labor. People already in the work force enroll in higher education to improve skills or acquire the educational background to enter new fields. Demand for higher education should be positively related to the unemployment rate at secondary levels.

***Hypothesis* 4:** *Higher graduate unemployment will lead to lower demand for higher education*.

Graduate unemployment rate may lead to a decline in the perceived probability of employment upon completion (graduates) of a degree course, thus discounting the expected future earnings from higher education. Therefore, higher the unemployment rates of university graduates lower the level of demand for university education (Albert, 2000; Barr, 1989). Taking this argument further, Handa & Skolink (1975) positive effects (on enrollment demand) of increased unemployment of non-degree holders would be offset by the negative effect of the worsening of the expected prospects for degree holders. If unemployment rate of secondary school graduates is higher than unemployment rate of higher education graduates, then it is likely that secondary school graduates partially base their decision regarding additional education on expected employment prospects. Hence, a negative effect between graduate unemployment and higher education enrollment prevails. It can be noted that hypotheses 3 and 4 cannot be tested simultaneously, hence the most statistically significant relationship re-

tained.

***Hypothesis* 5:** *Higher GER in senior secondary pass out rates, increase the demand for higher education.*

Pass-out in senior secondary level are is a demand-side factor. It is the school preparedness of eligible entrants into the higher education institutions.

***Hypothesis* 6:** *An equity capturing variable in the demand equation introduced is the ratio of boys to girl's enrolment in senior secondary education. Higher the value of the ratio, more demand for higher education.*

There are two main influences on the demand for higher education, changes in the population from which students are drawn; if there is more participation of girls in higher education that in turn will increase the **demand** for higher education, and the ability and willingness of this population to participate in higher education.

***Hypothesis* 7:** *Lower the proportion of people living below poverty line higher will be the rate of enrollment in higher education.*

An inverse relationship exists between per cent of people living below poverty line and enrollment demand.

***Hypothesis* 8:** *Increase in the literacy rates of people will lead to greater demand for higher education.*

Literate parents come forward to educate their children and as a result lead to higher demand for higher education.

Hypotheses from 1 to 8 relates to aggregate demand equation of higher education. The rest of the hypotheses discussed below relate to the supply of higher education.

*On the supply equation, we prefer to use the number of higher educational institutions available for eligible cohorts of students will indicate the supply.* Since GER in higher education is used as an indicator of the demand for higher education, the supply ideally should measure the number of seats available in higher education institutions as a percentage of the total population in the same age group. It is estimated as the number of higher educational institutions per one lakh eligible age group population.

***Hypothesis* 9:** *Increasing public expenditure on higher education and technical education in the system will lead to increase in the institutional capacity for higher education.*

***Hypothesis* 10:** *Higher GER in senior secondary increase the eligible supply and hence institutional capacity of higher education.*

***Hypothesis* 11:** *Public expenditure on secondary education will enable the universalization of secondary education, which indirectly facilitates the Institutional Capacity to improve. Hence, it is viewed as a supply side factor.*

This paper tries to validate the hypothesis or the theoretical relationship postulated across the demand for higher education across these eleven arguments, by fitting the model as specified in Equation (1) in the subsequent section on the Model. Prior to that we identify the appropriate or the proxy variables to represent

the propositions in made in this section. These identified variables or constructed indicators are discussed in the subsection on variables which explains the challenges and pitfalls of these various variables and indicators, while doing so explores the next best alternatives. Here we explain the GER in tertiary education, Total Cost of Higher Education, Per capita Income, Unemployment, Socio-demographic variables, and School Preparedness covering the hypotheses from 1 through 11. Details of the Variables whether actual data or derived data and their data sources are illustrated in **Table A1** at the annexure.

## 3.3. Variables

### 3.3.1. Gross Enrollment Ratio

GER is defined as total higher education enrollment divided by specific eligible age group (18 - 23) population. *Total Enrollment* includes students enrolled in various discipline like arts, science, commerce, education, engineering/technical, medicine, agriculture, veterinary, law and others in higher educational institutions. It covers graduate, post-graduates, research and diploma/certificate courses. Eligible population in the age group 18 - 23 is a six-year age cohort. Though there is no consensus on using this age cohort, we use six-year age cohort. Eligible population data comes from single age population of census of 1981, 1991, 2001 and 2011. For intervening years, we projected using Compound Annual Average Growth Rate (CAGR).

However, demand studies have used data on applicants which covers information on all individuals wishing to attend higher education, but not merely those who are enrolled in an institution (Vieira & Vieira, 2011). Yet another demand measure used in the literature is enrollment participation rates (EPR's). They are total degree enrollment in colleges and universities as a percent of the sum of high school graduates for the current year and three preceding years, (Levine et al., 1988). An EPR exceeding 100 percent implies university enrollment is supported by students from non-traditional sources: older students enrolled to enhance their education and out-of-state and foreign students. The use of data on GER and enrolments is an imposed choice by unavailable information on applicants. In most higher education systems, individuals apply directly to as many distinct institutions as they want. For instance, Portugal has the centralized application system. In a vast and diversified higher education systems like Centrally funded, state funded, private self-funded, affiliating and non-affiliating universities and colleges, etc, the structure and organization of the entry into a higher education system is highly complex in India.

### 3.3.2. Total Cost of Higher Education, Per Capita Income, Unemployment

These demand determinants include economic variables, either microeconomic (cost) or macroeconomic (unemployment). Price of higher education which is cost of higher education is more important, especially for lower income families, is the opportunity cost of attending higher education, measured by expected foregone wage income. But this cost must be balanced against the returns from

higher education, particularly the expected wage premium. As discussed earlier, we use total cost. Average household disposable income or, more indirectly, real GDP, its growth rate or GDP per capita, or even unemployment rate, all indicate how the economy is nationally and globally performing and therefore how families can cope with costs of higher education. Job seekers data is considered as proxy for unemployment, which is a self-reported and registered data on seeking employment.

#### 3.3.3. Socio-Demographic Variables

Most studies that estimate student choice models, widely agree that parents' educational attainment greatly influences their children's choice to attend higher education. Nature, nurture and income can all help explain this effect: either offspring inherit a genetic disposition to be better students, or their parents provide a more promising learning environment at home or can afford more expensive schools (Vieira & Vieira, 2011). However, in aggregate terms this evidence is still emerging. The present paper, socio-demographic variables are used as the proxy to capture "nature and nurture combo", viz., people living below poverty line, literacy rates, and rural population.

#### 3.3.4. School Preparedness

Third factor is academic success in pre-tertiary schooling: how effective the educational system in bringing students to universities' doors. These factors are getting into the model through the supply equation. Higher GER in senior secondary and pass out rates in senior secondary examinations, increase the supply of students for higher education. Similarly, ratio of boys to girl's enrolment in senior secondary education has an important equity bearing in brining more girls to higher education.

Fourth group of institutional or public policy variables include availability of higher education facilities and a dummy variable to capture the impact of economic reforms. The policy variable economic reforms are given value 1 from 1990-91 onwards, and 0 otherwise.

#### 3.3.5. The Model

On the demand side, conventionally income and relative price are the two major determining factors as income affects government revenue and the ability to pay and relative price has the substitution effect. The fact that the government, or a part of it, happens to be the supplier of a part of total educational services does not invalidate the above conceptual framework of demand. Once the conceptual framework of demand for higher education is set, yet the problem of simultaneous equation bias remains when we use a single-equation approach to estimate price and income elasticities (Gujarati, 2002; Chow & Shen, 2005). Hence the present paper tries to estimate the simultaneous equation model of demand and supply of higher education at the aggregate level.

Our goal is to specify a system of demand and supply equations for student enrolment in higher education in which total cost of higher education and per

capita income are the key determinants. Further student's school preparedness, macro demographics and socioeconomic status characteristics influence both demand for and supply of student enrolment in higher education. Using the hypotheses from 1 to 8, we specify the demand equation as:

$$Q^d = a_0 + a_1\text{TCHE}_t + a_2\text{PCY}_t + a_3\text{USEC}_t + a_4\text{Results\_HS}_t + a_5\text{RBGSrSec} + a_i Z_{it} + \varepsilon_t \quad (1)$$

where $Q^d$ is the Gross enrollment ratio (GER) of higher education, TCHE refers to total cost of higher education, PCY refers to per capita net national product, USEC refers percent of unemployed secondary educated graduates, Results_HS refers to passed out rates in senior secondary, and RBGSrSec refer to ratio of boys to girls enrolment in senior secondary education. Zi refers to a set of socio-economic and demographic variables such as percentage of people living below poverty line and literacy rate, and $\varepsilon_1$ is the error term. All variables included in demand equation are assumed to be exogenous, except TCHE.

Since the regression analysis uses a number of time-series variables, the usual tests for stationarity and autocorrelation, which is the unit roots tests of the selected variables are reported at the annexure **Table A3**. It is found that all variables are integrated of order 1 except the PCGDP and RBGSr.

In the supply equation, we add a set of institutional and policy variables which shift only supply of higher education students and is specified as:

$$Q^s = b_0 + b_1\text{GXHT}_t + b_2\text{GERS}_t + b_3\text{GXSECED}_t - b_4\text{D\_eco-ref} + \varepsilon_2 \quad (2)$$

where $Q^s$ is institutional capacity of higher education, GXHT refers to government ex[enditure on higher and technical education, GERS refers to GER in senior secondary education, GXSECED refer to public expenditure on secondary education and D_eco-ref denotes a dummy variable capturing the economic reforms since 1991. **Table A4** at annexure reports expected or a priori relationship with proposed variables in demand-supply equations.

The demand equation in **Table A4** implies the two alternatives examined in the paper GER and Lenrol. Similarly supply equation corresponds to the institutional capacity of higher education. The first column of this **Table A4** lists out the filtered variables to be included in the model either in the demand or supply equations. Serial numbers 1 to 9 correspond to the explanatory variables used in the demand equation, the + or – sign indicate the positive or negative relationship with the dependent variable in the demand equation (GER or Lenrol). In the same fashion, the serial numbers 10, 11 and 12 correspond to explanatory variables in the supply equation.

Finally,

$$Q^s = Q^d \quad (3)$$

is an identity and completes the system of demand and supply equations.

## 4. Discussion

Models 3 and 4 are estimated with 2SLS corresponding to GER and Lenrol as

dependent variables respectively. These tables are reported here:

In GER model 3, Results of the senior secondary examination is negative here also and statistically significant. It could be of attrition factors, however to be explored. Ratio of boys and girls is negative and statistically significant. Also exhibit the expected negative relationship with GER and statistically significant in both models. As the expected sign was negative, hence it indicates it is not favorable to girls, indicating the existing or prevailing gender disparity in the system. Poverty (BPL) does reduce the enrolment ratios and statistically significant in both models. Literate population is statistically significant, but exhibit negative sign. On the supply side, none of the variables are statistically significant as found in OLS. However, they depict the expected relationships.

Model 4 with Log of enrolment as the dependent variable in the demand-supply equations is found to be poorly performing as only results of senior secondary found to be statistically significant but with not expected relationship. On the supply side, none of the variables are found to be statistically significant though exhibit the expected relationships.

However, prior to the discussion of results on 2SLS reported in Table 1 and Table 2, it is customary to check the correlation co-efficient matrix before fitting the regression model (see Table A5 and Table A6 at Annexure). It confirms the expected relationship with the dependent variable GER and LEnrol on the demand side as well as Inst_Capa on the supply side and are reported in Table A5 and Table A6 at annexure.

We estimate the equations and 1 and 2 using OLS as a preliminary step. The results of the same are reported in Table 3 and Table 4 respectively. It can be

Table 1. On results of 2SLS regressions: model 3 GER.

| 2 SLS Model 3 GER | Demand | | | | | Supply | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coef. | Std.Err | t | P > t | | Coef. | Std.Err | t | P > t |
| TCHE D1. | 5.07E−06 | 8.22E−06 | 0.62 | 0.54 | GXHT D1. | −1.81E−08 | 7.37E−07 | −0.02 | 0.981 |
| LPCGDP | −0.09878 | 0.501314 | −0.2 | 0.844 | GERSrSe D1 | −0.01414 | 0.036434 | −0.39 | 0.699 |
| unem_HS D1. | −0.03778 | 0.085092 | −0.44 | 0.659 | GXSECED D1 | 5.60E−07 | 6.47E−07 | 0.87 | 0.39 |
| Results_HSS D1. | −0.12959 | 0.050028 | −2.59 | 0.012 | eco_ref | 0.498593 | 0.549904 | 0.91 | 0.368 |
| RBGSrSec | −1.12462 | 1.126589 | −1 | 0.322 | _cons | −0.08709 | 0.446256 | −0.2 | 0.846 |
| BPL D1. | −0.15186 | 0.077427 | −1.96 | 0.054 | | | | | |
| Lit_pop D1. | −1.81652 | 0.480519 | −3.78 | 0 | | | | | |
| _cons | 5.289574 | 6.884856 | 0.77 | 0.445 | | | | | |
| Model 3 | Obs | Parms | R-sq | F-Stat | | | | | |
| Demand | 38 | 7 | 0.5576 | 5.4 | | | | | |
| Supply | 38 | 4 | 0.0888 | 0.8 | | | | | |

Endogenous variables: D.GER D.Inst_Capa. Exogenous variables: D.TCHE LPCGDP D.unem_HS D.Results_HSS RBGSrSec D.BPL D.Lit_pop D.GXHT D.GERSrSe D.GXSECED eco_ref.

**Table 2.** Results of 2SLS regressions: Models 4 LENROL.

| 2SLS Model 4 LEnrol | Demand | | | | Supply | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coef. | Std.Err | t | P > t | Coef. | Std.Err | t | P > t | [95% |
| TCHE D1 | 1.66E−07 | 1.25E−06 | 0.13 | 0.895 | GXHT D2 | −1.81E−08 | 7.37E−07 | −0.02 | 0.981 |
| LPCGDP | −0.08901 | 0.076144 | −1.17 | 0.247 | GERSrSe D1. | −0.01414 | 0.036434 | −0.39 | 0.699 |
| unem_HS D1 | 0.000378 | 0.012925 | 0.03 | 0.977 | GXSECED D1. | 5.60E−07 | 6.47E−07 | 0.87 | 0.39 |
| Results_HSS D1 | −0.02238 | 0.007599 | −2.95 | 0.005 | eco_ref | 0.498593 | 0.549904 | 0.91 | 0.368 |
| RBGSrSec | −0.23089 | 0.171116 | −1.35 | 0.182 | _cons | −0.08709 | 0.446256 | −0.2 | 0.846 |
| BPL D1 | −0.01698 | 0.01176 | −1.44 | 0.154 | | | | | |
| Lit_pop D1 | −0.10571 | 0.072985 | −1.45 | 0.152 | | | | | |
| _cons | 1.454021 | 1.04573 | 1.39 | 0.169 | | | | | |
| Model 4 | Obs | Parms | R-sq | F-Stat | | | | | |
| Demand | 38 | 7 | 0.3066 | 1.89 | | | | | |
| Supply | 38 | 4 | 0.0888 | 0.8 | | | | | |

Endogenous variables: D.LEnrol D.Inst_Capa. Exogenous variables: D.TCHE LPCGDP D.unem_HS D.Results_HSS RBGSrSec D.BPL D.Lit_pop D.GXHT D.GERSrSe. D.GXSECED eco_ref.

**Table 3.** Results of OLS regressions: Models 1 GER.

| | Model 1: OLS_GER_Demand Eq | | | | Model 1: OLS_Inst_Capa-Sy Eq | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D.GER | Coef. | Std.Err | t | P > t | D.Inst_Capa | Coef. | Std.Err | t | P > t |
| TCHE D1. | 5.07E−06 | 8.22E−06 | 0.62 | 0.542 | GXHT D1. | −1.81E−08 | 7.37E−07 | −0.02 | 0.981 |
| LPCGDP | −0.09878 | 0.501314 | −0.2 | 0.845 | GERSrSe D1. | −0.01414 | 0.036434 | −0.39 | 0.700 |
| unem_HS D1. | −0.03778 | 0.085092 | −0.44 | 0.66 | GXSECED D1. | 5.60E−07 | 6.47E−07 | 0.87 | 0.393 |
| Results_HSS D1. | −0.12959 | 0.050028 | −2.59 | 0.015 | eco_ref | 0.498593 | 0.549904 | 0.91 | 0.371 |
| RBGSrSec | −1.12462 | 1.126589 | −1 | 0.326 | _cons | −0.08709 | 0.446256 | −0.20 | 0.846 |
| BPL D1. | −0.15186 | 0.077427 | −1.96 | 0.059 | | | | | |
| Lit_pop D1. | −1.81652 | 0.480519 | −3.78 | 0.001 | | | | | |
| _cons | 5.289574 | 6.884856 | 0.77 | 0.448 | | | | | |
| Adjusted R^2 | 0.4544 | | | | Adjusted R^2 | 0.0888 | | | |

**Table 4.** Results of OLS regressions: Models 2 LEnrol.

| | Model 2: OLS_LEnrol_Demand Eq | | | | Model 2: OLS_Inst_Capa-Sy Eq | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D.LEnrol | Coef. | Std.Err | t | P>t | D.Inst_Capa | Coef. | Std.Err | t | P>t |
| TCHE D1. | 1.66E−07 | 1.25E−06 | 0.13 | 0.895 | GXHT D1. | −1.81E−08 | 7.37E−07 | −0.02 | 0.981 |
| LPCGDP | −0.08901 | 0.076144 | −1.17 | 0.252 | GERSrSe D1. | −0.01414 | 0.036434 | −0.39 | 0.700 |
| unem_HS D1. | 0.000378 | 0.012925 | 0.03 | 0.977 | GXSECED D1. | 5.60E−07 | 6.47E−07 | 0.87 | 0.393 |
| Results_HSS D1. | −0.02238 | 0.007599 | −2.95 | 0.006 | eco_ref | 0.498593 | 0.549904 | 0.91 | 0.371 |
| RBGSrSec | −0.23089 | 0.171116 | −1.35 | 0.187 | _cons | −0.08709 | 0.446256 | −0.20 | 0.846 |
| BPL D1. | −0.01698 | 0.01176 | −1.44 | 0.159 | | | | | |
| Lit_pop D1. | −0.10571 | 0.072985 | −1.45 | 0.158 | | | | | |
| _cons | 1.454021 | 1.04573 | 1.39 | 0.175 | | | | | |
| Adjusted R^2 | 0.1448 | | | | Adjusted R^2 | 0.0888 | | | |

noted from the estimated results that the educational variable like school preparedness measured in terms of results of the senior secondary examination is statistically significant at 1% level of significance and confirmed the expected positive results with demand for higher education in the GER equation. The other proximate education variable that is literacy rate of the population is statistically significant but surprisingly showing a negative correlation with the dependent variable GER. The population living BPL is statistically significant at 5% per cent level of significance and show the expected negative relationship. Rest of the variables in the model is not found to be statistically significant even though they exhibit the expected relationships. $R^2$ of this OLS equation is 0.45. With regard to the supply equation, reported in the right-side panel of **Table 3** indicate that the none of the variable are statistically significant but they depict the expected relationship. Hence $R^2$ of this supply side of OLS equation is mere 0.09.

The estimated results of OLS of log of enrolment equation reported in **Table 4** indicate that only unemployment at the higher secondary level and results of the higher secondary are statistically significant. Unemployment at the higher secondary level exhibit the expected positive relationship with enrolment but the same is not the case with results of senior secondary examination. $R^2$ of this OLS equation is 0.14. On the supply side, none of the variables are found to be statistically significant.

As explained in the methodology section, due to the simultaneous nature of the demand supply equations, OLS can yield biased and inconstant estimators, on account of the violated OLS assumptions. Hence, we try to estimate the model using two-stage least squares (2SLS) to address the correlation between regressors and disturbances.

## 5. Summary and Conclusion

Our goal is to specify a system of demand and supply equations for enrolment in higher education. Gross Enrollment Ratio and log of enrollment are alternatively used as dependent variables. In the demand equations, explanatory variables are grouped according to their function in the models. They are key factors traditionally associated with demand analysis and based on existing literature such as total cost of higher education, per capita net national product, percentage of secondary (graduates) unemployment, passed out rates in senior secondary, ratio of boys to girl's enrolment in senior secondary education, percentage of people living below poverty line, and literacy rate of population. Supply equations are specified as function of institutional capacity of higher education facilities equal to government expenditure on higher and technical education, GER in senior secondary education, and public expenditure on secondary education along with a dummy variable on economic reforms. The models are estimated using OLS and 2SLS.

Based on the estimated results we can say that GER explains the demand than enrolment in higher education. The inference from the estimated results indi-

cates the probable causes for the way they are performing is as follows:

1) The demand-supply mismatch of the higher education enrolment and supply of places could be one of the attributes. It may be noted this somehow also depict the ground reality.

2) The supply side variables could not capture the actual supply due to the non-availability of data.

3) Understanding the demand-supply conundrum is an on-going process. As we get more better data or proxy to capture the supply sides, as the education system of the nation progresses.

### 5.1. Policy Implications

Improving the data on the higher education system in terms of supply in a vast country like India is a challenge. Yet the technology and in the robotic revolution, improving and centralizing the prevailing supply of places needs to be made available at one place. This however needs to be examined in terms of the higher secondary pass-out rates and numbers. Yet another concern is the girl's schooling and investment on girls' education is equally important to improve the overall higher education. Targeted subsidy for the neediest in the higher education while provision of good quality secondary education with better public resources will improve the higher education scenario in the country. Some of the important key variables due to measurement errors or non-availability creates spurious relationships. Some of the examples on key variables like cost of higher education and availability of higher education facilities are discussed here.

### 5.2. Cost of Higher Education

Information is barely available on cost of higher education in the public domain, except budgetary allocation towards higher education. Clearly, this is not representative of the cost of higher education because of a couple of reasons: (i) A part of the cost of education, even in public universities, is borne by the families and budgetary allocation (public subsidy on higher education) does not include the household expenditure incurred by families (which is comparatively much higher in engineering, medical and management courses even in publicly funded colleges) and (ii) In recent decades, there has been a rapid expansion of the private sector in the field of higher education and the cost of education in private institutes is far higher than public institutes which are borne entirely by the families. Thus, the cost of higher education, even after including the education loans and household expenditure on higher education imputed from the NSSO data can hardly capture the total cost of higher education.

### 5.3. Availability of Higher Education Facilities

India occupies the second largest network of higher educational institutions and enrolment therein in the world. Indian higher education space is home to a variety of higher educational institutions. The Indian structure of higher education consists of universities, research institutions, deemed to be universities which

are at the highest level of higher educational institutions. One can examine the layers/tiers of institutions viz., central universities, Institutions of National Importance, State Universities, Deemed Universities (DU) with government funds and DUs (self-financing). At the next level, it is the colleges by disciplines such as general arts and science, professional including engineering, management, medical, agriculture and law colleges. Yet another dimension is institutional type by management. The educational institutions in India and in its states are of three basic types based on funding and provision: that 1) government provision and financing of higher educational institutions; 2) private provision and government financing referred as private aided institutions and 3) private provision and financing referred to as self-financing institutions. Internationally, three most prominent types, such as culturally, pluralistic type, consisting of religious, charity, and philanthropy purposes, termed as the fused private-public entities. These are somewhat like the private aided sector in many states as in India. Yet another dimension will be on the short term and long terms diploma, under graduate, post graduate, above PG levels of higher education. One more dimension is on the subject choice of students across disciplines. On the one hand, we can celebrate this diversity of the institutions and the structure and the enrolment therein, the handicap is to get an inclusive data base at the centralized system is a challenge on the other hand.

Arriving at this number on the availability of seats in higher education is a real challenge. Even though, it is outdated information, yet serves the purpose that is being illustrated here; as of 2008, India's post-secondary institutions offer only enough seats for 7 per cent of India's college-age population (Newsweek, 2011 as quoted in (Sheikh, 2017)).

Hence, it is high time and pertinent to note to improve the quality of consistent data on such key variables like cost of higher education, availability of higher educational facilities, etc.

### 5.4. Issues for Further Research

In this section, the paper raises more questions than it has answered on the issue of demand and supply of higher education and its relationship with fees, grants and family characteristics. The increasing trends in the social demand for higher education raise a number of questions viz., what is the relationship between demand and the cost of higher education across courses? Can the technology-induced higher education reduce the individual cost of higher education? Can it be accessible equally and affordably to the first-generation learners across regions, caste groups, gender in realizing the demand in attaining the higher education? How does it vary between public and private institutions of higher education? An attempt to answer these questions would require information at the institutional level on the cost of higher education (fee structure and other direct cost of higher education) by public and private institutions vis-a-vis enrolment in these institutions. Data on enrolment by public and private institutions is availa-

ble from All India Higher Education Surveys. Information is barely available on cost of higher education in the public domain, except budgetary allocation towards higher education. At least on public universities, the budgets are available. With strenuous efforts, one can estimate the cost of higher education by courses at an institutional level. Many institutional and state level studies are required for an informed and evidence-based policy making in the Indian context.

## Conflicts of Interest

There is no conflict of interest and competing interest of this study.

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## Annexure

**Table A1.** Details of the variables and their data sources.

| Notation | Variables | Derived or Actual | Data sources |
|---|---|---|---|
| GER | Gross Enrollment Ratio | calculated | Selected Educational Statistics, AIHES, Census, 1981, 1991, 2001 |
| LEnrol | Log of Enrolment | calculated | Selected Educational Statistics, AIHES, |
| PXPSH | Public Expenditure per student | -do- | Selected Educational Statistics, Analysis of Budgeted Expenditure on Education |
| PCGDP | *Per capita Income* | -do- | Indian Economic Survey, CSO, census, 1981, 1991, 2001 |
| unem_HS | *Unemployment* | -do- | Job seekers data |
| Inst_lakh | availability of higher education facilities per lakh eligible college going population | calculated | Selected Educational Statistics, Census, 1981, 1991, 2001 |
| BPL | Population living Below poverty line (in %) | Actual | NSSO |
| Lit_pop | Share of literate population | Actual | Census, 1981, 1991, 2001 |
| RuralPop | Share of Rural Population | Actual | Census, 1981, 1991, 2001 |
| GERSrSe | GER in senior secondary | calculated | Selected Educational Statistics, Census, 1981, 1991, 2001 |
| Results_HSS | Pass out rates in senior secondary examinations | Actual | Results of High School and Higher Secondary Examinations |
| RBGSrSec | Ratio of boys to girl's enrolment in senior secondary education | calculated | Results of High School and Higher Secondary Examinations |
| Inst_Capc | Institutional Capacity | derived | estimated as the number of higher educational institutions per one lakh eligible age group population; Selected Educational Statistics, Census, 1981, 1991, 2001 |

Source: Authors.

**Table A2.** Data used in the paper at selected points of time from 1980-81 to 2018-19.

| year | GER | PXPSH (Rs, in lakhs) | HHX_HE (Rs, in lakhs) | Stu Loan (Rs, in lakhs) | Total cost of HR Ed (Rs, in lakhs) | Per Capita GDP | % unem_HS | Higher Education Institutions (UC/AC) (in Nos.) | Results of Sr Sec | Population of Below Poverty Line (%) | Literacy Rate (%) | % Rural Pop | GER Sr Se | PX on Sec Ed Comb (Rs in Lakhs) | Ratio of PXPSHr to PXPSSEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980-81 | 3.83 | 2132 | 837 | - | 2969 | 2166 | 82.96 | 7571 | 56.43 | 57.42 | 43.56 | 77.39 | 14.18 | 103,690 | 2.25 |
| 1985-86 | 4.33 | 3610 | 1270 | - | 4880 | 3769 | 82.77 | 8864 | 51.55 | 51.77 | 47.62 | 76.09 | 17.97 | 229,387 | 2.60 |
| 1990-91 | 5.09 | 6271 | 1927 | - | 8198 | 6867 | 83.03 | 11,755 | 59.70 | 44.79 | 52.20 | 74.93 | 21.90 | 553,111 | 2.33 |
| 1995-96 | 6.01 | 7793 | 2923 | 76,743 | 87,458 | 12,991 | 82.22 | 14,855 | 54.35 | 43.90 | 58.49 | 74.80 | 25.33 | 955,045 | 2.03 |
| 2000-01 | 7.22 | 12,084 | 4295 | 89,088 | 105,467 | 21,000 | 82.59 | 17,004 | 62.58 | 39.27 | 64.83 | 72.84 | 17.45 | 1,974,317 | 1.62 |
| 2005-06 | 11.55 | 10,242 | 6310 | 136,128 | 152,680 | 32,840 | 78.00 | 20,769 | 72.71 | 37.25 | 69.84 | 67.75 | 30.96 | 2,780,464 | 1.41 |
| 2010-11 | 19.40 | 14,488 | 15,986 | 184,759 | 215,234 | 64,372 | 77.95 | 33,513 | 75.31 | 30.12 | 74.04 | 63.86 | 44.16 | 7,045,067 | 1.06 |
| 2015-16 | 24.48 | 21,856 | 42,204 | 234,508 | 298,569 | 106,847 | 73.50 | 39,870 | 76.94 | 18.65 | 79.76 | 65.94 | 53.27 | 12,995,868 | 1.08 |
| 2018-19 | 26.30 | 20,561 | 34,890 | 270,624 | 326,075 | 142,873 | 73.48 | 40,924 | 76.97 | 16.95 | 83.41 | 64.20 | 49.25 | 13,452,149 | 0.96 |

Source: various sources as indicated in **Table A1**.

**Table A3.** Unit root test results of the selected variables.

| Variables | ADF Statistics At level | ADF Statistics at st difference | Critical value (0.01) | Critical Value (0.05) | Critical Value (0.10) | Order of Integration | Remarks |
|---|---|---|---|---|---|---|---|
| GER | 1.774 | −5.578 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| Enrol | 1.739 | −5.509 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| Inst_Capa | 0.300 | −7.295 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| PCGDP | 22.353 | - | −3.662 | −2.964 | −2.614 | I(0) | Stationary |
| Unemp_HS | −0.720 | −7.904 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| BPL | 0.008 | −5.972 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| Rur_Pop | −1.311 | −5.820 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| GERSrSe | −1.359 | −11.844 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| Results_HSS | −0.494 | −6.924 | −3.668 | −2.966 | −2.616 | I(1) | Stationary |
| RBGSr | −3.092 | - | −3.662 | −2.964 | −2.614 | I(0) | Stationary |

**Table A4.** Theoretical relationship with demand (GER and Enrolment) and Supply (institutional capacity) in higher education.

| Sl no | Explanatory Variables | Expected effect | |
|---|---|---|---|
| | | Demand Eq | Supply Eq |
| 1 | Total Expenditure on Higher Education | + | |
| 2 | Per capita income | + | |
| 3 | Secondary unemployment | + | |
| 4 | Passed out rates in senior secondary board examination | + | |
| 5 | Ratio of boys to girl's enrolment in senior secondary education | - | |
| 6 | Availability of HE facilities | + | |
| 7 | Below poverty line | - | |
| 8 | Literacy rates | + | |
| 9 | Rural population | - | |
| 10 | GER in senior secondary education | | + |
| 11 | Public Expenditure on Higher Education | | + |
| 12 | Public Expenditure on Secondary Education | | + |

Source: Authors based on the Hypotheses section.

**Table A5.** Correlation coefficient matrix appearing in demand equations.

| | GER | LEnrol | TCHE | PCGDP | unem_HS | Resul~SS | RBGSrSec | BPL | Lit_pop | Rur_pop |
|---|---|---|---|---|---|---|---|---|---|---|
| GER/LEnrol | 1 | 1^ | | | | | | | | |
| TCHE | 0.9596* | 0.9699* | 1 | | | | | | | |
| PCGDP | 0.9828* | 0.9159* | 0.9492* | 1 | | | | | | |
| unem_HS | −0.9354* | −0.8972* | −0.9084* | −0.9168* | 1 | | | | | |
| Results_HSS | 0.8784* | 0.9227* | 0.9248* | 0.8353* | −0.8573* | 1 | | | | |
| RBGSrSec | −0.8158* | −0.9411* | −0.9028* | −0.7831* | 0.7652* | −0.8861* | 1 | | | |
| BPL | −0.9596* | −0.9767* | −0.9560* | −0.9390* | 0.8778* | −0.8798* | 0.9173* | 1 | | |
| Lit_pop | 0.9024* | 0.9795* | 0.9655* | 0.8822* | −0.8520* | 0.9237* | −0.9784* | −0.957* | 1 | |
| Rur_pop | 0.8555* | 0.9494* | 0.9234* | 0.8328* | −0.7889* | 0.8601* | −0.9775* | −0.951* | 0.9781* | 1 |

Note: *Indicate significant at 5% level of significance.

**Table A6.** Correlation coefficient matrix appearing in supply equations.

| | Inst_C~a | TCHE | Inst_l~h | GERSrSe | PXPSSEC |
|---|---|---|---|---|---|
| Inst_Capa | 1 | | | | |
| TCHE | 0.9737* | 1 | | | |
| Inst_lakh | 1.0000* | 0.9737* | 1 | | |
| GERSrSe | 0.9321* | 0.9181* | 0.9321* | 1 | |
| PXPSSEC | 0.9794* | 0.9647* | 0.9794* | 0.9168* | 1 |

Note: *Indicate significant at 5% level of significance.