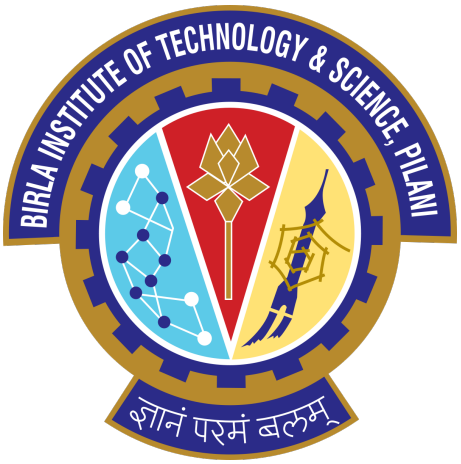
Enrollment Trends in Higher Education

A Panel Data Analysis

ECON F342 : Applied Econometrics



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Abstract

The main focus of this paper is to analyze the relationship between different independent variables and university enrollments. This is done using a panel dataset with information regarding different universities worldwide at various cross-sections of time. This paper tries to answer how multiple variables, such as region, income group, specialization, privatization, etc., affect the number of students enrolling in a university. The regression analysis was performed using the random effects model. The random effects model was used per the results obtained from the BPLM and the Hausman tests. The analysis results have shown that if a student receives b_grant and m_grant, then the effect of phd_grant is negligible in determining enrolment. Also, it has been determined that high-income group students tend to have an advantage as they have access to better facilities and resources. Improvement in this area can be brought about if these universities from high-income countries work with the universities in low-income countries.

Contents

1 Introduction

Education is an essential aspect of life that offers individuals the knowledge, skills, and opportunities required to succeed in different fields of endeavor. As a result, one of the most important measures of how efficiently the educational system is working is the percentage of students who enroll in colleges (Baek & Song, 2021).

The motivation of this paper comes from the fact that student enrollment is also a statistic which for private colleges, is their main source of income because, except those with enormous endowments, they depend on tuition and other fees to cover operating costs. The situation for public institutions is becoming more comparable as they depend more on tuition and fees and less on state funding, a process known as "the privatization of public higher education" (Romero Jr, 2016).

UNESCO (2022) estimates that the global tertiary enrollment rate climbed from 19% in 2000 to 38% in 2020. The enrollment percentage is not distributed equally, though; in 2020, low-income nations had the lowest enrollment rate of 9% while high-income countries had the highest of about 77%.

The enrollment ball game works a little differently based on whether the university is private or public. The public institutions get huge fundings from the government and are able to attract a large number of students. On the other hand, the private universities are solely dependent on the fees that they charge and it is more difficult for them to present themselves as worthy institutions with every facility.

In fact, in countries with enormous populations like India where the disequilibrium is heavily biased towards the demand side, some specific government institutes are seen as a ticket to a better life and the competition to enroll in them is extreme. In countries where the government itself invests less in higher education, both the private and public universities face a similar difficulty in survival and the enrollment levels become the most significant factor for their survival.

Policies that increase access to financial aid and scholarships, such as the Free Application for Federal Student Aid (FAFSA), have been instrumental in improving enrollment rates among low-income families . Additionally, policies that promote diversity and inclusivity, such as affirmative action, have also contributed to higher enrollment rates among minority groups (Chetty, Friedman, Saez, Turner, & Yagan, 2017).

Research by Lee & Lee (2016) has shown that usually, there is a very high competition among universities and this gives ample alternatives for students to choose from one among many colleges. This consequently leads to decline in enrollment in any one given college. Universities tend to take advantage of such competition by offering specialized courses. In this way, they try to differentiate their course structure from other universities to eliminate any competition in some particular domain. This way they try to ensure a larger enrollment through this method of specialization.

Newer strategies like mergers and acquisitions have also helped these universities to sustain

or grow themselves by enhancing their enrollment rates. Since 2016, around 60 institutions have announced plans of consolidation or have already merged with others in the United States Dive (2023).

The objective of this study is to realize these factors which most significantly affect the College enrollment rates across different locations of the world based on the aforementioned domain of research. This has been achieved through a panel regression analysis on the Global Longitudinal University Enrollment Dataset (GLUED) which spans over a period of 70 years. Panel Data specific regression diagnostics, including general tests of heteroskedasticity, omitted variable bias and multicollinearity have been conducted to ensure the correctness of our model.

2 Literature Review

2.1 Paper 1

> "Proposed Strategic Plan to Improve Student Retention and Enrollment at Universities: A Perspective Study"

By Maddah, Hisham A.

About the Paper

They investigated the university's goal and purpose statements, admission criteria and counsellors, recruiting methods, student involvement, student assistance, finances, and educational advice as part of the governed institution's strategic plan.

Use Case

As a result of reading this paper, we gained a deeper understanding of what we can expect from a research model, as the strategic plan is one of the major factors in enrollment

Methodology

In this paper, The strategic plan aims to increase student retention and enrolment by implementing IDEAL programmes to promote campus diversity, provide first-year assistance and counselling, and teach students through seminars and events. Also, managing orientation asks them for ideas using the "Turn and Talk" strategy.

Conclusion

Establishing a strategy for recruiting/successful students directly impacts providing high-quality, cost-effective service to suit their educational and financial needs.

2.2 Paper 2

"Predicting time to graduation at a large enrollment American university"

By Aiken, De Bin, Hjorth-Jensen, & Caballero (2020)

About the Paper

This paper examines their academic success at university and their integration into the social communities they belong to. Universities have distinct populations, student services, instructional styles, and degree programmes. They do, however, all gather institutional data.

Use Case

As a result of reading this paper, we gained a deeper understanding of what we can expect from a research model

Methodology

A prominent American research institution surveyed 160,933 students. A comprehensive overview of performance, registration, demographics, and preparatory characteristics can be found in the statistics. Tinto's Theory of Drop Out presents time-to-graduation hazard models. This paper compares the gradient-boosted trees machine learning technique with the maximum likelihood method. Models predict where a student will depart more accurately when enrollment variables (such as significant changes) are taken into account Than variables associated with performance (such as grades or preparation).

Conclusion

A student's dedication to graduation is more likely influenced by Tinto's dropout theory, which predicts social integration and college involvement. In the future, researchers will examine how Financial support and social media metrics information relate to student academic achievement and coursework participation.

2.3 Paper 3

"Tuition fees and equality of university enrolment"

By Coelli (2009).

About the Paper

In this paper, Coelli (2009) tries to understand how the changes in tuition fee impact university enrolment of youth whilst controlling for parental income group. The sample under observation is from Canada. In the paper the relationships between government funding of universities and cohort size and university enrolments are also analyzed.

Use Case

In this study, the author estimated the relation between enrollment and tuition fees. He employed within-province variation over time.

Methodology

In this paper The Canadian literature has not consistently estimated a negative relationship between tuition fees and university enrollment, while the US has found a negative relationship. Canadian literature has found mixed findings on the relationship between tuition fees and enrollment, with the most sensitive group being those with parents still living with them.

Conclusion

A student's dedication to graduation is more likely influenced by Tinto's dropout theory, which predicts social integration and college involvement. In the future, researchers will examine how social network metrics and financial assistance information relate to student academic achievement and coursework participation.

2.4 Paper 4

> "Factors Influencing Student's Enrollment Decisions in Selection of Higher Education Institutions"

By Mehboob, Shah, & Bhutto (2012)

About the Paper

The paper investigates the factors that influence students' decisions to enroll in higher education institutions. The study found that facility was the most significant among all the chosen factors. The study suggests that higher education institutions should focus on improving academic reputation, offering a variety of academic programs, and recruiting high-quality faculty to attract more students. The study provides insights into the factors that influence students' decisions to enroll in higher education institutions and highlights the need for higher education institutions to understand and address these factors to attract and retain students.

Methodology

The study used a questionnaire survey of undergraduate students in Pakistan to identify the factors that influenced their enrollment decisions. A total of 11 factors were selected for the analysis. There was a usage of a rank order survey in the questionnaire as well. To analyze the relationship between all the factors, multiple regression analysis was used.

Conclusion

The study concludes that there are three main factors that affect enrollment decisions. Among all the chosen factors, the most significant ones were found to be Facilities, Parents/friends and socioeconomic status. Further research in this area is needed to better understand the complexities of university enrollment and to develop effective strategies for universities to attract and retain students. By identifying and addressing the factors that influence enrollment decisions, universities can improve their overall enrollment rates and enhance their reputations as centers of academic excellence.

2.5 Paper 5

> "Factors Shaping the Students' Enrollment Decision in Private Universities for Higher Education during the Pandemic Environment"

By Sultana & Chakrobortty (2022)

About the Paper

The paper examines the factors that have influenced students' decisions to enroll in private universities during the COVID-19 pandemic. The study used a questionnaire survey of undergraduate and postgraduate students in Bangladesh to identify the factors that influenced their enrollment decisions.The study found that students' decisions to enroll in private universities were influenced by various factors, including the university's promotional strategies, its reputation, program offerings, tuition fees, and the quality of online learning facilities. The study also found that the pandemic had influenced students' enrollment decisions, with many students opting to enroll in private universities due to the uncertainty and disruption caused by the pandemic.

Methodology

The study was conducted in Bangladesh, and the sample consisted of 360 undergraduate and postgraduate students from different departments. The sampling type was non probability convenient sampling. Microsoft Excel was used to determine the cumulative percentages. A total of 352 questionnaires were examined to obtain the final result. The data was collected during Jan, 2020 and June, 2021.

Conclusion

The study found that almost half of the chosen candidates were influenced by their family/friend's opinions. It suggests that private universities should focus on improving their online learning facilities, enhancing their reputations and management, and offering competitive tuition fees to attract and retain students during the pandemic. The study also highlights the need for private universities to adapt to the changing environment brought about by the pandemic and to develop strategies to address the challenges faced by students in the current climate.

3 Data and Methodology

3.1 Methodology

In consideration of the panel nature of the data, the BPLM test performed suggests that the Random effect model is preferred over Simple pooled OLS regression and Fixed Effect Model here. The unit-specific unobserved effect is not correlated with independent variables and hence can be included in the idiosyncratic error term. The error component (u_{it}) is the sum of the individual specific random component (μ_i) and idiosyncratic disturbance (ϵ_{it}). In the regression analysis, year dummy variables have been included to include the time-fixed effects spanning over 2010-20, with 2010 being the base year. Among the six divided regions, East Asia and the Pacific are considered the base category. The regions are also divided into four categories based on income level, with high income being the base category. In the Regression Diagnostics section, we have checked if assumptions are holding or not.

3.2 Data

Table 1: Summary statistics of the dataset

Statistic	N	Mean	St. Dev.	Min	Max
private01	2,319	0.687	0.464	0	1
phd_granting	2,319	0.301	0.459	0	1
m_granting	2,319	0.467	0.499	0	1
b_granting	2,319	0.940	0.237	0	1
divisions	2,319	4.930	4.379	0	43
total_fields	2,319	18.437	21.522	0	269
unique_fields	2,319	16.589	15.494	0	102
specialized	2,319	0.160	0.367	0	1
students5_estimated	2,319	7,525.114	7,972.857	51	147,646

Students5

This is the dependent variable. It takes the number of students enrolled in an institute in that year. We have observations from 2010 to 2020, with the reading taken every five years. This variable, thus, shows how the enrollments have changed over the years in different institutes.

Region

The entire world has been divided into seven regions. The regions are East Asia and Pacific, Europe and Central Asia, Latin America, Caribbean, Middle East and North Africa, North America and South Asia.

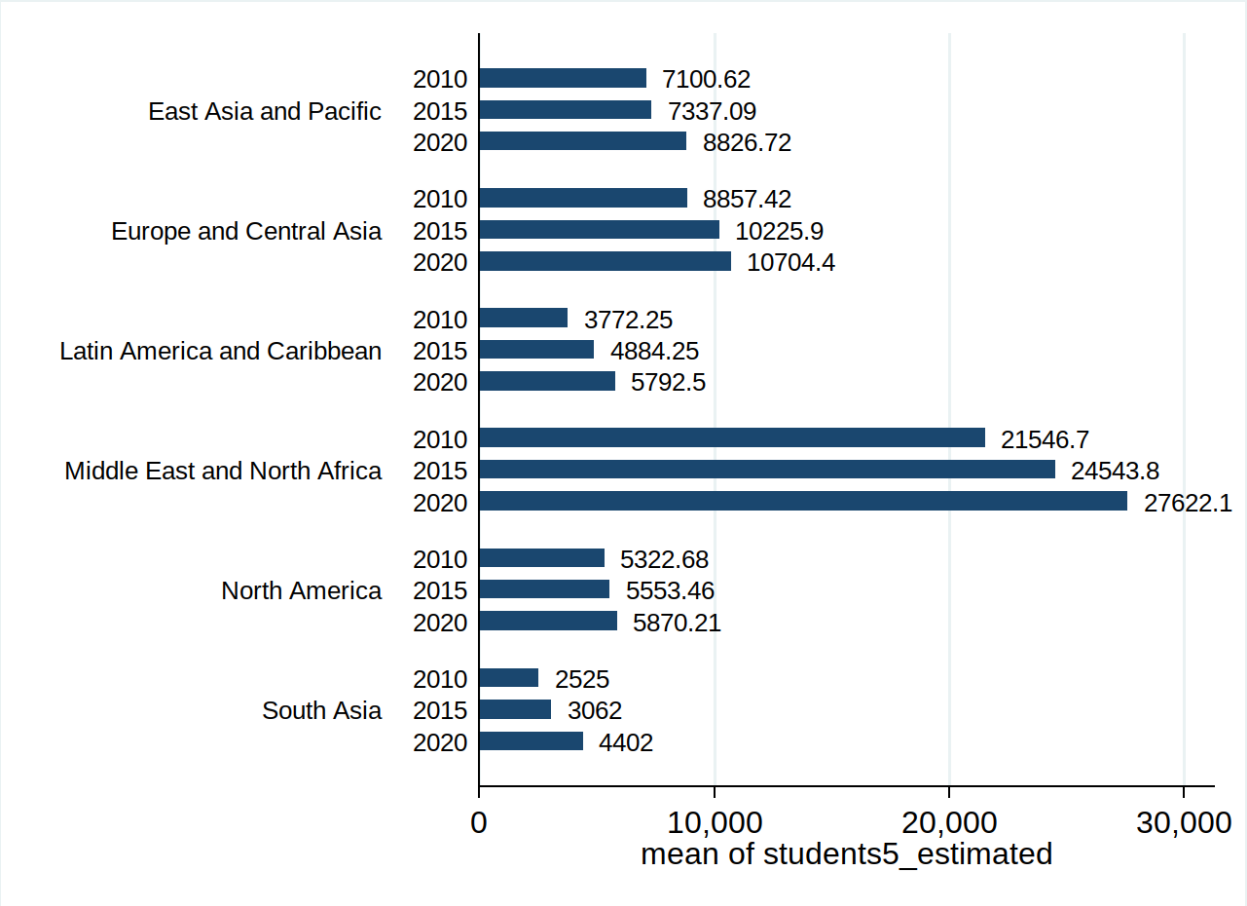
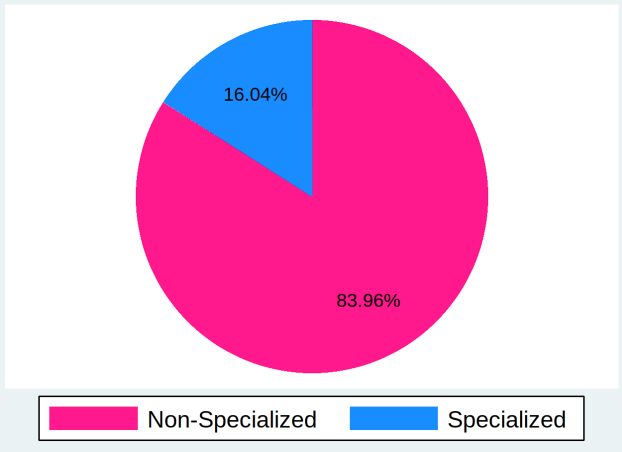


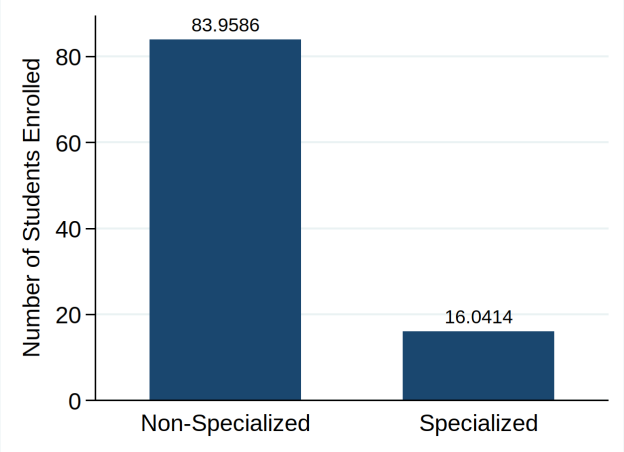
Figure 1: Regionwise distribution

From the graph, we can infer that the number of institutes in each region has increased. This might positively affect the number of enrollments in the institutes located in the regions showing the maximum growth in the number of universities.

Specialized

If the institute under consideration specializes in fields such as Arts or Music, the variable takes the value of 1 else, for all other cases, 0. It is observed from the data available that the number of institutions specializing in a domain is a lot more than the number of institutions that do not specialize. This might attract students who want to pursue a specific field, thereby increasing enrollments in the long run.





Year

For the analysis, the period under observation is from 2010 to 2020. The gap between two consecutive observations for an institute is five years. The year variable takes 2010 as the base category and creates dummies for all the other years till 2020.

Var1	Freq
2010	773
2015	773
2020	773

Income Group

All the students enrolling in the institutes have been divided into four categories High Income, Low Income, upper-middle-income, and lower-middle-income. The graph shows that the number of students enrolled in higher education institutes is more from high-income groups and less from lower-income groups. Thus, higher income can potentially point toward higher enrollment rates.

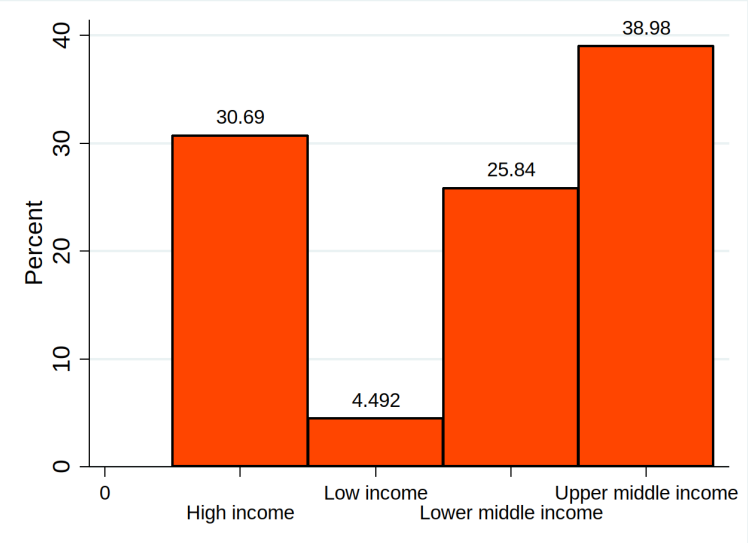


Figure 2: Income distribution

Founded Year

This variable captures the year in which the institute was established. It has been observed from our dataset that the majority of the institutions were found between the years 2010 and 2020. This has also led to an increase in the absolute number of students enrolling in institutes for higher education.

Private

This dummy variable takes the value of 1 if the institute is privately owned and 0 otherwise.

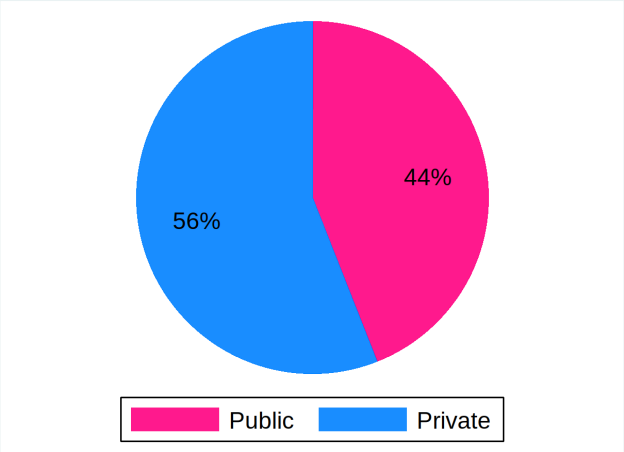


Figure 3: Income distribution

From the dataset under observation, we see that the number of private institutes exceeds

that of public institutes. As a result, the absolute number of students enrolled in private institutes is more than the number of students enrolled in public institutes.

Phd_granting

This dummy variable which takes the value 1 if the university offer grants for admissions in phd.

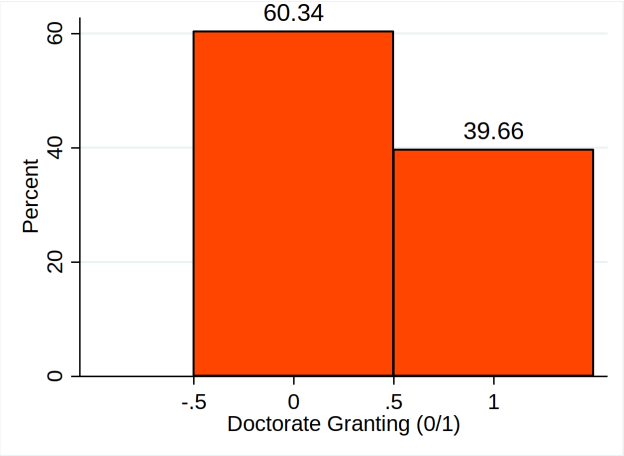


Figure 4: PhD Granting distribution

M_granting

This dummy variable which takes the value 1if the university offers grants for admissions in masters programmes.

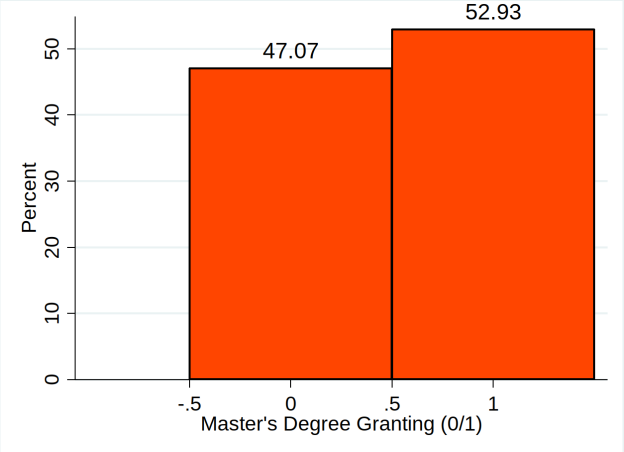


Figure 5: Masters Granting distribution

B_granting

This dummy variable which takes the value 1if the university offers grants for admissions in bachelors programmes.

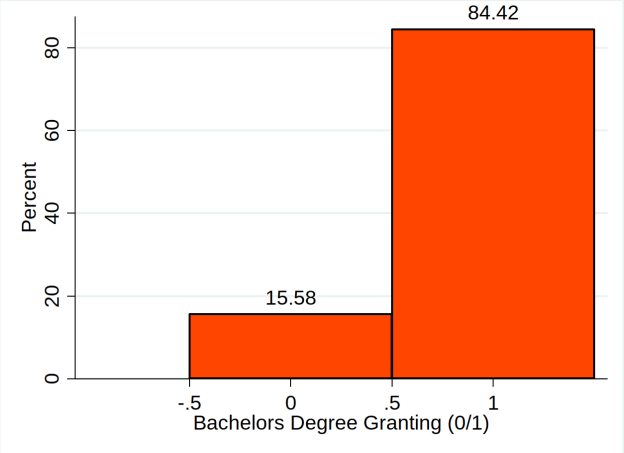


Figure 6: Bachelors Granting distribution

Divisions

It shows a university's total number of departments, like Economics, Arts, Theater, etc. The rationale behind including this variable was that greater diversity in the number of may attract more students.

Unique Fields

This is the total number of fields in which the university offers a degree program. In this case, if an institution provides, for example, MA and BA in Arts, it'll be considered only once as the degree offered is in the same field.

Total Fields

This is the total number of degree programs offered in an institution. In this case, if the institution provides, for example, MA and BA in Arts, it'll be considered twice as even though the field is the same, the degree programs offered are different, increasing the number of students enrolled.

IAU_ID

This variable functions as a unique identifier used to identify various universities in the dataset uniquely.

4 Regression Analysis

4.1 Random Effects Model

VARIABLES	(1) students5_estimated
Europe and Central Asia	-7,453
	(7,069)
Latin America and Caribbean	-2,259
	(6,065)
Middle East and North Africa	6,794***
	(2,264)
North America	-489.7
	(2,851)
South Asia	-12,663**
	(6,152)
Low Income	6,370**
	(2,826)
Lower middle income	4,441
	(2,888)
Upper middle income	5,198
	(7,563)
foundedyr	-5.980
	(6.690)
private01	-5,982***
	(728.5)
phd_granting	1,562**
	(723.0)
m_granting	-427.2
	(651.2)
b_granting	76.94
	(1,050)
divisions	539.3***
	(69.93)
total_fields	-61.72**
	(26.52)
unique_fields	150.5***
	(40.58)
specialized	2,330***
	(645.9)
2015.year	394.9***
	(106.3)

2020.year	1,444***
	(106.3)
Constant	15,491
	(13,577)
Observations	2,319
Number of iau_id_num	773

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interpretation

- For the regions variable, keeping the region East Asia and Pacific as the base region, we observe 6,794 more enrollments per year on average for the universities in Middle Eastern and Northern Africa; and 12,663 less enrollments per year on average for the universities in South Asia.
- Keeping the high income group as the base for the income group, we observe 6,370 more enrollments from the lower income group families into universities.
- Private universities on average have 5,982 less enrollments per year than public universities.
- Universities which grant PhD get 1,562 more enrollments per year than those which don't.
- If the number of departments in a university increases by one, then the number of enrollments into that university on average increases by 539.3
- If the total number of fields in the university increases by one, then the number of enrollments in the university decreases by 61.72
- If the number of unique fields in the university, on the other hand increases by one, then the number of enrollments in the university increases by 150.5
- If the university specializes in a particular field, like Arts or music, then it witnesses on average 2,330 more enrollments than the universities which don't.
- Treating 2010 as the base year, universities on average witnessed 394.9 more enrollments in 2015 and 1,444 more enrollments in 2020.

Significant variables

- **At 99% level of significance**: Middle East and North Africa, South Asia, private01, divisions, unique_fields, 2015.year, 2020.year
- **At 95% level of significance**: South Asia, Low Income, phd_granting, total_fields

4.2 Fixed Effects Model

In the Fixed Effects Model, majority of the variables are dropped, because they appear to be constant over many of the observations.

5 Diagnostics

5.1 Checking for significance of Year Fixed Effects

To check for the time fixed effects, we use the command testparm and take dummy variables for all the years (2015 and 2020) keeping 2010 as the base category. The Null Hypothesis is that there are no time fixed effects and thus all dummy variables' coefficients take the value zero. Test result (Table 2) shows that p-values for the dummy variables are 0, i.e. the dummy variables are individually significant. The probability that the calculated F-statistic is less than the critical F-value too takes the value 0, suggesting that the Null Hypothesis is rejected and hence **there are time fixed effects**. Thus, the **year dummy variables cannot be dropped from the model**.

$$H_0 : \text{Coefficients for all years are jointly equal to zero}$$

Table 4: Test Results

	Values
2015.year	0.000
2020.year	0.000
F(2, 1544)	98.54
Prob > F	0.000

5.2 BPLM Test

We employ the Breusch-Pagan Lagrange Multiplier test to test whether there's a significant difference between the Random Effects estimates and simple Pooled OLS estimates. The Null Hypothesis is that variances across entities are zero and hence there's no significant difference across units (i.e. no panel effect). As the independent variables other than iau_id_num (i.e. Institute's ID) are binary variables (i.e. they take the value of 0 or 1), they are dropped since their variance has no meaning. The result (Tables 3 and 4) shows that the variance is high and the probability that the calculated Chi2 value is less than the critical Chi2 is almost zero, suggesting that the Null Hypothesis is rejected and hence **there's a significant difference between the Random Effects estimates and simple Pooled OLS estimates**. Thus, we can assert with reasonable confidence that the **Random Effects model is better suited** for the given dataset.

$$H_0 : \text{Var(random effects term)} = 0$$

$$\text{students5\_estimated}_{it} = Xb + u_i + e_{it}$$

Table 5: Estimated Results

	Variance	Std. Deviation
students5_estimated	6.36e+07	7972.857
e	4920066	2218.122
u	3.50e+07	5912.688

Table 6: BPLM Test Results

	Values
$\bar{\chi}^2$	1771.16
Prob > $\bar{\chi}^2$	0.000

The p-value is close to zero. Thus we can assert with reasonable confidence that the Random Effects model is better suited for the given dataset.

5.3 Hausman Test

We employ the Hausman Test to test whether the unique errors (ui) are not correlated with the regressors, the null hypothesis is they are not. If they are correlated with the regressor (i.e. the Null Hypothesis is rejected, then in Random Effects Estimation, where ui is included in the (idiosyncratic) error term, autocorrelation is present. In our case, as the Fixed Effects Model cannot be estimated, we cannot go for the Hausman test and have to **go forward with the Random Effect Estimation**.

5.4 Normality Test

We employ the Shapiro-Wilk test (Shapiro & Wilk, 1965) to check whether the error term is normally distributed or not.

H_0 : Error terms are normally distributed

Table 7: Normality Test Results

Variable	e
Obs	2319
W	0.58179
V	567.390
z	16.217
Prob > z	0.00000

The result (Table 5) shows that the probability that the calculated z-value is less than the critical z-value is close to zero which suggests that the Null Hypothesis is rejected and hence the error term is not normally distributed. This might be because many variables in the model are binary variables and hence nothing can be done to make the error term normal.

5.5 Testing for Omitted Variable Bias

We employ the Ramsey RESET Test (Ramsey, 1969) to check for omitted variable bias.

$$H_0 : \text{Model has no omitted variables}$$

Table 8: RESET Test Results

	Values
F(3, 2297)	305.27
Prob > F	0.0000

The result shows that the probability that the calculated F-value is less than the critical F-value is close to zero which suggests that the Null Hypothesis is rejected and hence at least one significant variable is omitted. This might be because many variables in the model are binary variables. Also, most of the variables are individually significant but jointly insignificant. So, another reason could be the presence of multicollinearity.

5.6 Testing for Multicollinearity

If the Variance Inflation Factor (VIF) is less than 10, then we assert with reasonable confidence that there is no multicollinearity in the system.

Variable	VIF	1/VIF
regionnum		
2	102.22	0.009783
3	4.00	0.250044
4	1.25	0.802392
5	35.70	0.028007
6	1.03	0.968398
incomegroup		
2	14.60	0.068477
3	44.01	0.022720
4	120.68	0.008287
private01	2.41	0.414796
foundedyr	2.17	0.460367
phd_granting	2.32	0.430173

Variable	VIF	1/VIF
m_granting	2.23	0.448611
b_granting	1.30	0.766632
divisions	1.98	0.505262
total_fields	6.88	0.145412
unique_fields	8.35	0.119813
specialized	1.19	0.842646
year		
2015	1.33	0.750000
2020	1.33	0.750000
Mean VIF	18.68	

The result shows that a few dummy variables are correlated with other variables and hence the average VIF too is higher than 10. But, we cannot drop the dummy variables. Hence, we do not change our model.

5.7 Test for Homoskedasticity

We employ the modified Wald test in order to test for Homoskedasticity.

$$H_0 : \text{Model is homoskedastic}$$

Table 10: Wald Test Results

	Values
χ^2_{773}	8.7e+14
Prob $> \chi^2$	0.0000

The result shows that the probability that the calculated χ^2 value is less than the critical χ^2 is almost zero which suggests that the Null Hypothesis is rejected and hence the model is heteroscedastic. To tackle this problem, the standard errors are made robust by using the robust option.

5.8 Contemporaneous Correlation

Cross-sectional dependency may bias test results in one direction or another. To ascertain if the residuals are connected across entities, one uses the cross-sectional dependence test (usually the Pasaran CD test). The absence of any correlation in the residuals between entities is the null hypothesis. According to Baltagi (2008), macro panels with lengthy time series (over 20-30 years) may be tested for cross-sectional dependence. Micro panels don't really

have a problem with this over a long period of time and a significant number of observations. As a result, we can state with confidence that our model (which includes 3 years and 773 institutions) has no contemporaneous relationship (cross-sectional dependence).

5.9 Serial Correlation

Macro panels with lengthy time periods (over 20-30 years) may be tested using serial correlation methods. The problem with autocorrelation (also called serial correlation) is that R-squared escalates and the standard errors of the coefficients are smaller than they should be. The Lagram-Multiplier test is used to look for serial correlation. The Null Hypothesis is that no autocorrelation is present. Again, Baltagi (2008) iterates that there is no issue with micro panels (with very few years). Therefore, we can confidently claim that there is no serial correlation (autocorrelation) in our model (with 3 years and 773 institutions).

6 Conclusion

On the basis of all our results, we can conclude that if a college student has received both b_grants and m_grants, he/she is pretty much indifferent to phd_grants because most of his education has been almost costless and this is visible from the coefficient value of phd_grant which is not very large. But, we should be careful in making this statement because if a student is extremely poor(which is less likely after a btech and mtech degree) he/she might still need it.

Also, high income group countries will always have an advantage in this domain because they have better resources and better methods to make students aware of college education. If only these universities work with low income nation universities, there is a much higher scope of improvement. Regarding this, some policy changes can be implemented such as that of a twin city partnership like that of the city of Aurangabad in Maharashtra and the city of Ingolstadt in the Free state of Bavaria, Germany who signed a letter of intent for establishing a sister city partnership where currently the German city is investing in Aurangabad, making them aware about employment and education opportunities in Germany and also teaching them German (India, 2022)

7 References

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