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COMPARATIVE ACADEMIC ACHIEVEMENT OF THE UNIVERSITY STUDENTS IN BANGLADESH: AN EMPIRICAL INVESTIGATION

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ABSTRACT

This paper examines the comparative academic performances of male and female students at tertiary level education in Bangladesh. Using cross section data of 8,985 students from five private universities in Bangladesh located around Chittagong zone, the study finds that the average scores of female students are slightly higher than their male counterparts. Examining the final examination grades of 3,447 female and 5,538 male students, the paper observes the evidence of heteroskedastic partition in academic scores among the groups. Both the ordinary least-squares (OLS) and generalized least-squares (GLS) approaches have been employed to check the validity of the results. Descriptive and inferential measures have been used to explain the factors affecting the students' academic performance. The results suggest a general improvement in the performance of the students over time. Interaction between age and gender has been examined to serve expository purpose. Empirical investigation lends support in favor of such interaction. The paper also finds the variation in academic scores with regard to the difficulty of subjects studied. Findings of the paper may be useful to explain the source of heterogeneity in labor market returns to education in Bangladesh examined by Asadullah (2006).

Contribution/ Originality: This study is one of very few studies which have investigated the reasons behind the heterogeneity in returns to education. Our current research may be useful to explain why the estimates of returns to education for females, who in general outperform the males academically, are higher than those of males.

1. INTRODUCTION

Education as the means of human resource development is termed as a powerful tool in achieving economic development by providing people with necessary skill. Human capital plays an important role in generating income as well as wealth in an economy than the traditional factors of production, e.g., land (natural resources), capital and machinery. Education helps create awareness, welfare attitudes, skills and behavior as well as a sense of ethical responsibilities among people. Education for all and the assurance of quality education are fundamental objectives of the government of Bangladesh. Rapid economic growth through the improvement of productive capacity of the population requires formal education as an indispensable instrument to be controlled by the state. The knowledge, skills and enterprise of people are of crucial importance to sustain economic development in developing countries.

In the context of Bangladesh, enhancement of these qualifications requires higher education offered particularly by the universities. Currently a good number of public and private universities are in operation with this aim where more than half a million male and female students pursue their higher studies. Although the number of female students is less than their male counterparts, the performance of the former is considered to be better. However, no research has been carried out to examine the comparative performance of male and female students pursuing higher studies in Bangladesh.

Grade point average (GPA), in general, is thought to be the key indicator of academic qualification. The dominating factors determining GPA are, among others, gender, previous academic performance, age, living place, family status, social environment, the type and quality of high schools graduated from, the high school GPA, time spent for studying, learning ability and living place during the university life (Erdem, Sentürk, & Arslan, 2007). Other than these factors, students' health conditions, time spent reading in the library, parents' educational achievement and students' behavior towards schools are also found to be significant factors for the determination of the students' performance. The general objective of this study is to investigate whether there occurs any significant difference between male and female students' academic achievements and also to look at whether GPA improves or falls over the period. The remainder of the paper proceeds as follows. Section 2 summarizes the relevant literatures, Section 3 describes data and methodology, Section 4 presents the findings of the study and Section 5 draws conclusion highlighting the policy implications.

2. LITERATURE REVIEW

Our present study mainly focuses on the impact of gender and age on academic performance of tertiary level students. Although not under Bangladesh context, a good number of studies have been carried out to assess the impact of such biological and demographic factors on learning skill but unique conclusion could not be drawn. Some papers argue that male students outperform the females and some others view the opposite. Also, several researchers could not substantiate any difference between academic performances of male and female students.

In a study, Dayioğlu and Türüt-Aşik (2007) attempted to determine whether there are significant gender differences in academic performances among undergraduate students in Middle East Technical University in Turkey. They reported that a smaller number of female students managed to enter the university indicating the less competitiveness of female students. Tasisa and Tafesse (2013) concluded that there are significant differences between male and female students in academic achievement in both Ethiopian General Secondary Education Certificate Examination (EGSECE) and college cumulative GPA. Empirical findings supported better performance of male students than females. Lynn, Ivanec, and Zarevski (2009) found similar results that men obtained higher average scores on the g-factor intelligence test, on the general knowledge tests of natural and social sciences, world religion and customs, and knowledge of current affairs. There were no significant gender differences on vocabulary, foreign language ability and general knowledge of culture. Based on the responses of 275 students, Adigun, Onihunwa, Irunokhai, Sada, and Adesina (2015) showed that the male students scored slightly better in examinations than the female students but the difference was not statistically significant. This research made a recommendation for the parents to educate their children the way they can, ignoring the gender concern.

Erdem et al. (2007) opined that socio-economic and demographic factors have impact on students' cumulative GPA. Factors such as the type of high school graduates, gender, the number of siblings in school, education level of parents, and expression of family expectations about the school and study time were found impacting academic test scores. Tessema, Ready, and Malone (2012) replicated and extended their research on the effect of gender on different college outcomes such as students' satisfaction, ACT scores, and GPA at a midsized Midwestern State University. They found gender having a significant effect on students' satisfaction and academic results. Braddock (1981) discovered significant impact of race on students' academic performance. The study observed better

performance of white males than black males although the result turned opposite while the athletic consideration was brought into consideration.

Ahmad, Pervaiz, and Aleem (2015) carried out a survey to investigate the possible differences in gender-wise academic performances in higher education. The Levenes' test suggested that the variance of both male and female students' performance were equal but the average score of female students was significantly higher than male students. The major factor including parental educations, participation in debates, better income support, use of internet in studies, better performance in earlier classes, time spent in studies other than class hours are contributors for better performance. Unity and Igbudu (2015) assessed the influence of gender on academic skill and noticed the significance of gender. The research remarked that female tends to work more conscientiously and have a stronger work ethic than male. Sparks-Wallace (2007) analyzed differences in academic performance measures of males and females in Northeast Tennessee. Findings revealed that females performed better than males in every subject. When males are commonly viewed as possessing superior characteristics over female in most aspects of performance, especially physically and intellectually, females' earning above the level of males in academic setting is quite noteworthy. Studies have shown that females have better memory in general than males. Khan, Nawaz, Chaudhry, Hyder, and Butt (2012) evaluated the comparative academic performance of male and female students, day scholars and boarders and of rural and urban area students at undergraduate level in the University of Agriculture Faisalabad in Pakistan. Better performances of females than their male counterparts have been discovered on the basis of response from 265 students. Houtte (2004) concentrated on the underperformance of boys in comparison with girls. In this study he used a data of 3,760 pupils in the third and the fourth year of secondary education in a sample of 34 schools in Belgium. The paper viewed that boys are less studious than the girls and thereby the former ending up with poorer grades.

Islam (2014) examined the influence of some selected socioeconomic, demographic, familial, individual student's scholastic and institutional factors on the academic achievement of undergraduate students of Sultan Qaboos University in Oman. The study identified many factors that have significant influence on achieving higher GPA. A host of factors including pre-admission qualification, level of attendance, probation status, and time spent in study, father's education, parental support and involvement, major subjects of study and gender of the students have been identified as significant determinants of academic success of students. Student's motivation and effort has been considered to be the element that initiates students own involvement in learning and scholastic activities. They observed that students having better score in their high school exams are four times more likely to achieve a higher grade at undergraduate level.

Dania (2014) investigated the effect of gender on students' academic achievement in secondary school Social Studies. The result showed that gender had no significant effect on students' achievement but there was a significant interaction effect of treatment and gender on academic performance. Jabor, Machtmes, Kungu, Buntat, and Nordin (2011) carried out a research to determine if age and gender influence the achievement in high school mathematics. The study described the graduating high school students in the US by age, gender and academic achievement in mathematics. Comparing the mathematics achievement between age groups and gender, they observed the significant differences in mathematics GPA scores between age groups and gender. Iji and Abah (2017) focused that female graduates of mathematics education are as proficient as their male counterparts in driving value added services in and beyond the education sub-sector of the Nigerian economy. This study attempted to explore the dynamism of difference in academic achievement of male and female graduating students of mathematics education. A discrete-time Markov chain model has been employed to derive the results. Eshetu (2015) investigated the impact of gender and age on academic performance. This study has important bearing since the age was found inversely impacting academic results, and gender caused a differential in degree achievement. The number of studies focusing the relation between academic achievement and age is scanty. Our current research is designed to examine the discernable effect of age on academic progress.

Okonna, Ushie, and Okworo (2014) investigated the effect of gender on the academic performance of maritime trainees in Nigeria, where web-based resources are used for instruction. Findings showed no significant difference between the academic performances of male and female maritime security trainees. Similar conclusion has been drawn by Goni (2015). Dania. and Daniel (2015) examined the influence of subject combination and gender on the achievement of scores. They found neither subject combination nor gender as the influencer of examination results. Orabi (2007) examines the gender differences in student academic performance and attitudes in an introductory engineering course. Students' academic performance was evaluated by comparing coursework scores between the two genders using assignments, projects, exams and class participation. The results of this study showed that there were no significant differences between mean scores in the academic performance in terms of gender. The result also indicated that academic performance in the course was also affected by several factors such as student ability, motivation, quality of secondary education obtained. Female students had a slightly higher overall course grade average than men and outperformed the male students in all class assignments except the final design projects. This survey showed that men reported higher gains than women in the technical skills including confidence on engineering knowledge while women indicated higher gains in teamwork and design skills.

Jayanthi, Balakrishnan, Ching, Latiff, and Nasirudeen (2014) examined the different factors influencing academic performance of students in tertiary institutions in Singapore. The specific objectives of this study were to determine if factors such as gender, age, and nationality of student, part-time employment, extracurricular activities and interest in pursuing higher studies affected academic success. GPA was used as a measure of academic performance. The result showed that gender, nationality of student, co-curricular activities and interest in pursuing higher degrees influenced students' academic course. Ghazvini and Khajehpour (2011) proved the existence performance differential with respect to gender. The study used a sample of 363 students from the high school students in the first, second and third academic years. Results suggested that differences exist in the academic environment, with the girls having a more adaptive approach to learning tasks. Qian, Buchmann, and Zhang (2018) found that among whites and Asians, girls and boys exhibit similar patterns of educational adaptation as measured by high school grade point average, but there are significant gender differences in patterns of educational adaptation among blacks and Hispanics. Second-generation Hispanic boys, but not girls, have lower grades than their ethnic native counterparts, and first-generation black boys, but not girls, earn higher grades than their native peers.

Quadlin (2018) found very different consequences of men and women's academic performance in the labor market. One striking finding of the research is that employers penalize women but not men for signaling strong academic performance on their resumes. Using mostly Scandinavian and North American data from 1914 to 2011, the survey carried out by Voyer and Voyer (2014) established the existence of a generalized female advantage over the male in school achievement. This research conducted a meta-analysis to answer the questions pertaining to the existence of gender differences in academic achievement as measured by the instructor-assigned task and the factors that moderate them. The results of the survey robustly favored the females in all fields of study. Although the differences between academic scores of males and females were small in magnitude, they were greatly consistent and significant. Falch and Naper (2013) investigated whether gender gaps in student achievement are related to evaluation scheme. They found no evidence of why boys do relatively better in the exam.

Extant literatures regarding the link between gender and educational achievement are contradictory. Seemingly, most of the surveys end up concluding that females perform better than males by dint of the inner qualities, attitude, motivation, time management, capacity of suppressing anxiety and other inherent characteristics. However, impact of age on grade achievement has been examined with lesser focus. More importantly, several papers argue that students' performances mark a downward trend over time, which requires further investigation. None of the studies used information from Bangladeshi students studying at the universities. Our current research is carried out to bridge this research gap. We design our research plan with the dual objectives of investigating the

impacts of age and gender on academic results obtained by the tertiary level students in Bangladesh. The research is significant in a number of ways. The study of Asadullah (2006) estimated the labor market returns to education where he found higher estimates of returns to education for the females but the reason behind this remained unexplored. Our current study is able to shed some lights on this. Another general perception of better academic attainment by the females has been supplemented by implanting the idea of heteroskedastic partition. We perform statistical test in order to look into the difference between the variations in results of two groups, which is arguably imperative.

3. DATA AND METHODOLOGY

This section deals with the description of data and methodology of the study. The research is basically empirical in nature. Primary data have been collected from five private universities around Chittagong zone in Bangladesh. Sample universities are Premier University (PU), International Islamic University of Chittagong (IIUC), Port City International University (PCIU), Southern University (SU) and University of Science and Technology Chittagong (USTC). Since a good variety of subjects are offered by the universities in Bangladesh, we focused on students' performances on five selective subjects, namely Bachelor of Business Administration (BBA), Computer Science and Engineering (CSE), Economics, Bachelor of Laws (LLB) and English. Final examination grades obtained by the students of first semester to eight semester of a sample comprising 8,985 students have been compiled. Table 1 presents the decomposition of entire data set in terms of university and gender.

Table-1. Decomposition of the Sample.

University	Total Students	Gender	
		Male	Female
PU	2685	1730	955
IIUC	3562	2007	1555
PCIU	702	520	182
SU	1843	1151	692
USTC	193	130	63
Total	**8985**	**5538**	**3447**

Table 2, 3, 4, 5 and 6 provide subject-wise information of male and female students of the five sample universities.

Table-2. Premier university (PU) information.

Courses	Total Students	Male	Female
BBA	1812	1203	609
CSE	716	462	254
Economics	157	92	65
Total	2685	1757	928

Table-3. International Islamic University Chittagong (IIUC) Information.

Courses	Total Students	Male	Female
BBA	1461	828	633
CSE	1186	731	455
Economics and Banking (EB)	915	448	467
Total	3562	2007	1555

Table-4. Port City International University (PCIU) Information.

Courses	Total Students	Male	Female
BBA	268	194	74
CSE	327	267	60
LLB	39	26	13
English	68	33	35
Total	702	520	182

Table-5. Southern University (SU) Information.

Courses	Total Students	Male	Female
BBA	473	347	126
CSE	487	341	146
LLB	393	263	130
English	490	200	290
Total	1843	1151	692

Table-6. University of science and technology Chittagong (USTC) information.

Courses	Total Students	Male	Female
BBA	193	130	63
Total	193	130	63

Data have been collected by visiting the controller offices of the respective universities, which happen to be the most reliable source of academic results.

In the first step we will be examining the impact of age on academic results. For this purpose a simple regression model of the following form would be estimated.

$$y_i = \beta_1 + \beta_2 x_i + e_i \qquad (1)$$

Here, y represents GPA and x semester. Equation 1 regresses the academic results (GPA) of a typical student on his or her age measured by the semester currently s(he) is enrolled in. The authors will examine whether the academic results of the students improve significantly over their ages.

Most of the private universities in Bangladesh set their curriculum to finish undergraduate studies within eight to twelve semesters. Variation in GPA may be attributable to other factors than semester alone. Influence of all omitted factors is accommodated in the error term e. Our primary assumptions of zero mean and constant variance of the error term hold true. The intercept term β_1 might represent the GPA of a newly admitted student, perhaps his or her higher secondary GPA. The slope term β_2 represents the average change in GPA when the student completes one marginal semester. Magnitude of β_2 has important bearing in our research because it directly matches with one of the objectives of our research- whether age influences academic results. Significant positive β_2 would imply the improvement in academic results with respect to semester completed.

The constancy of the variance of error term is popularly known as homoscedasticity. But it is intuitively plausible to suspect any difference in the variance of grades of male and female students. In such case, violation of homoscedasticity would occur and thereby creating heteroscedasticity. If we find any statistical difference between the variances of errors of two groups by separating data for male and female, it would be featured as heteroskedastic partition. Our research goal includes examining the existence of heteroskedastic partition in the scores of male and female students.

Reconsidering the regression model above: $y_i = \beta_1 + \beta_2 x_i + e_i$

Let the variance of e_i for male is $\sigma_i^2 = \sigma_M^2$ and for female $\sigma_i^2 = \sigma_F^2$. If it so happens that $\sigma_M^2 = \sigma_F^2$ then the data is homoscedastic. Contrary to this, if $\sigma_M^2 \neq \sigma_F^2$ then the data is heteroskedastic. The latter version is known as heteroskedastic partition because the heteroscedasticity is attributable to the partitioned data of male and female. In order to examine the impact of gender on academic proficiency, we would base on the econometric test for heteroscedasticity.

The null and alternative hypotheses for this test are $H_0 : \sigma_M^2 = \sigma_F^2$

$$H_A : \sigma_M^2 \neq \sigma_F^2$$

Appropriate test statistic: $F = \dfrac{\hat{\sigma}_M^2 / \sigma_M^2}{\hat{\sigma}_F^2 / \sigma_F^2}$

The rejection of null hypothesis would justify the influence of gender on educational attainment.

The research has been extended by incorporating gender dummy as an interaction dummy with the semester. The dummy-augmented model turns out to be

$$y_i = \beta_1 + \beta_2 x_i + \gamma(x_i \times M) + e_i \qquad (2)$$

Here, M = 1 refers to male student, and M = 0 female.

Primarily we rely on the ordinary least-squares (OLS) approach to estimate the impact of age on semester grade. Such estimators are expected to be best linear and unbiased given the usual assumptions about the error term remaining valid. The presence of heteroscedasticity causes the loss of goodness of the estimator, which is corrected by applying the generalized least-squares (GLS) approach. We have estimated the model by the application of both the OLS and the GLS approaches.

4. EMPIRICAL FINDINGS

The specific forms of the regression model used in our analysis are

$$GPA = \beta_1 + \beta_2 SEMESTER + e \qquad (3)$$

and

$$GPA = \beta_1 + \beta_2 SEMESTER + \gamma(SEMESTER \times M) + e \qquad (4)$$

4.1. Estimation Output for Premier University (PU)

Subject: BBA;   Category: All students;   Number of observation: 1,812

$$\hat{GPA} = 2.58 + 0.06\ SEMESTER \qquad (5)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: BBA;   Category: Male students;   Number of observation: 1,203

$$\hat{GPA} = 2.58 + 0.05\ SEMESTER \qquad (6)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: BBA;   Category: Female students;   Number of observation: 609

$$\hat{GPA} = 2.58 + 0.09\ SEMESTER \qquad (7)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Using 1,812 observations, we find the evidence of semester influencing grade point average. More specifically, a typical student's GPA increases by 0.06 points when he or she is promoted to the next semester. Equation 6 and 7 help predicting the comparative performance of male and female students. Apparently, girls seem to outperform the boys, which is evident in the estimated results. Average increase in GPA of the boys is 0.05 per semester whereas of the girls it is 0.09. The interaction dummy is found to be significant. However, we have ignored the inclusion of intercept dummy because the concern about higher secondary GPA is devoid of our research goals. These results are specific to the students of BBA at Premier University. Below we present the estimated values of the students of CSE.

Subject: CSE;   Category: All students;   Number of observations: 715

$$\hat{GPA} = 2.66 + 0.04 \ SEMESTER \qquad (8)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: CSE;   Category: Male students;   Number of observations: 462

$$\hat{GPA} = 2.66 + 0.02 \ SEMESTER \qquad (9)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: CSE;   Category: Female students;   Number of observation: 253

$$\hat{GPA} = 2.66 + 0.06 \ SEMESTER \qquad (10)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

An interesting feature of the above findings is that the rate of improvement in academic scores is somewhat smaller when the subject under consideration is Computer Science and Engineering. Other findings are similar. Here also female students' estimated increase in grades is better than the male students. This finding provides valuable information regarding the impact of subject heterogeneity on academic performance. In general, science subjects are trickier than other disciplines and therefore improving grades is thought to be harder. Our results here support this proviso. Another salient feature evolves when the subject Economics is taken into account. Estimated result using 157 observations is presented as Equation 11 which signifies that semester does not alter the estimated GPA.

$$\hat{GPA} = 3.04 - 0.00 \ SEMESTER \qquad (11)$$
$$(p-value) \quad (0.00) \quad (0.86)$$

Several reasons, including the course curriculum, degree of difficulty, quality of intake and smaller sample might cause such neutral effect of semester on academic progress. Above results pertain to a large size private university in Chittagong city. We now turn to another large university the International Islamic University Chittagong (IIUC), from which we have collected highest number of observations.

4.2. Estimation Output for International Islamic University Chittagong (IIUC)

Subject: BBA;   Category: All students;   Number of observation: 1461

$$\hat{GPA} = 2.17 + 0.13 \ SEMESTER \qquad (12)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Estimates in Equation 12 are consistent with the earlier findings of overall increase in marginal grades. However, we did not examine whether the linearity would prevail throughout. But the distinguishing feature of this sample university is captured by Equation 13 where gender dummy as an interaction dummy seems to be insignificant owing to high probability value.

$$\hat{GPA} = 2.17 + 0.12 \ SEMESTER + 0.01 \ (SEMESTER \times M) \qquad (13)$$
$$(p-value) \quad (0.00) \quad (0.00) \qquad\qquad (0.37)$$

This follows, irrespective of gender, students do better as they become senior and estimated marginal increase in GPA is 0.13. Results of Computer Science and Engineering (CSE) are presented below.

Subject: CSE;   Category: All students;   Number of observations: 1,186

$$\hat{GPA} = 2.37 + 0.09 \ SEMESTER \qquad (14)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: CSE;   Category: Male students;   Number of observations: 731

$$\hat{GPA} = 2.36 + 0.08 \ SEMESTER \qquad (15)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: CSE;   Category: Female students;   Number of observation: 455

$$\hat{GPA} = 2.36 + 0.11 \ SEMESTER \qquad (16)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

These findings support the previous conclusion that improvement in grades by the Science students is harder than the commerce students. Estimated increase in overall GPA per semester of Science students seems to be 0.09 whereas for commerce students it was 0.13. Although grades of commerce students are not affected by gender, grades of science students are gender-influenced. Again the better performances of females are apparent. The behavior of grade improvement by the students of Economics & Banking (EB) at IIUC has a distinct feature. Estimation output based on total 915 observations shows a general improvement in grades per semester by 0.11 points, which is 0.13 for male but 0.10 for female. Presumably, this result may be considered to be reliable and there is a little chance of sampling bias since the number of male and female students are 448 and 467 respectively, not very different from one another. Equations 17, 18 and 19 represent the predicted behavior of EB students at IIUC.

Subject: EB; Category: All students;   Number of observations: 915

$$\hat{GPA} = 2.14 + 0.11 \ SEMESTER \qquad (17)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: EB;   Category: Male students;   Number of observations: 448

$$\hat{GPA} = 2.13 + 0.13 \ SEMESTER \qquad (18)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: EB;   Category: Female students;   Number of observation: 467

$$\hat{GPA} = 2.13 + 0.10 \ SEMESTER \qquad (19)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

These findings question the nature of impact of gender on academic achievement because in most cases we found the better performance of female students but here the opposite. However, it should not be viewed peculiar since literature supports similar evidence, at least to a limited extent. Moreover, unlike other universities, IIUC maintains separate campuses for male and female students where male students are taught and graded by male teachers alone but female students are mostly nurtured by the female teachers. This observation necessitates further research about the comparative grading attitudes of male and female teachers.

We next turn to the estimated results of another average sized university- the Port City International University.

4.3. Estimation Output for Port City International University (PCIU)

Equations from 20 to 26 demonstrate the estimated relations between academic scores and age (proxied by semester) of the students of four departments at PCIU.

Subject: BBA; Category: All students;   Number of observations: 268

$$\hat{GPA} = 2.96 + 0.06 \ SEMESTER \qquad (20)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: BBA;   Category: Male students;   Number of observations: 194

$$\hat{GPA} = 2.97 + 0.05 \ SEMESTER \qquad (21)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Subject: BBA;   Category: Female students;   Number of observation: 74

$$\hat{GPA} = 2.97 + 0.11\ SEMESTER \qquad (22)$$
$$(p-value) \quad (0.00)\ (0.00)$$

Equations 20, 21 and 22 justify the evidence of positive relation between GPA and age of the students of BBA at PCIU. Like other instances, here also the females outperform the males. But results of CSE and English students are neither age nor gender dependent, which is reflected in the estimated Equations 23, 24 and 26.

Subject: CSE;   Category: All students;   Number of observation: 327

$$\hat{GPA} = 2.99 + 0.02\ SEMESTER \qquad (23)$$
$$(p-value) \quad (0.00)\ (0.14)$$

Subject: CSE;   Category: All students;   Number of observation: 327

$$\hat{GPA} = 2.99 + 0.03\ SEMESTER - 0.01\ (SEMESTER \times M) \qquad (24)$$
$$(p-value) \quad (0.00)\ (0.17) \qquad\qquad (0.63)$$

GPA of LLB students have been estimated using only 39 observations, and age is observed significant here. Students, on average, are capable of increasing their marginal score by 0.11 points every semester. Gender, as the determinant of grades, could not be examined due to insufficient observations.

Subject: LLB; Category: All students;   Number of observations: 39

$$\hat{GPA} = 2.40 + 0.11\ SEMESTER \qquad (25)$$
$$(p-value) \quad (0.00)\ (0.00)$$

Subject: English; Category: All students;   Number of observations: 68

$$\hat{GPA} = 3.14 + 0.02\ SEMESTER \qquad (26)$$
$$(p-value) \quad (0.00)\ (0.52)$$

4.4. Estimation Output for Southern University (SU)

We have used total 1,843 observations from SU in order to examine the determinants of students' performance. Subject-wise estimation results are presented below.

Subject: BBA; Category: All students;   Number of observations: 473

$$\hat{GPA} = 2.69 + 0.04\ SEMESTER \qquad (27)$$
$$(p-value) \quad (0.00)\ (0.01)$$

The result suggests an overall increase in GPA per semester by 0.04 points. However, when we conducted another regression by introducing gender as an interaction dummy, we found it insignificant. This suggests, male and female do not account for any difference in terms of academic achievement. Empirical investigations carried out for three other subjects – CSE, LLB and English- do not support any relation between academic achievement and biological and demographic factors.

4.5. Estimation Output for University of Science and Technology Chittagong (USTC)

USTC is the first private university in Chittagong specialized mainly in medical sciences. We collected data on the results of 193 students studying BBA at USTC. Estimated outputs are as below.

Subject: BBA; Category: All students;   Number of observations: 193

$$\hat{GPA} = 2.94 + 0.08\ SEMESTER \qquad (28)$$
$$(p-value) \quad (0.00)\ (0.00)$$

Subject: BBA;   Category: Male students;   Number of observations: 130

$$\hat{GPA} = 2.94 + 0.06\ SEMESTER \qquad (29)$$
$$(p-value) \quad (0.00)\ (0.00)$$

Subject: BBA;   Category: Female students;   Number of observation: 63

$$\hat{GPA} = 2.94 + 0.11\ SEMESTER \qquad (30)$$
$$(p-value) \quad (0.00) \quad (0.00)$$

Equation 28, 29 and 30 reveal the similar statistical information regarding the relation between GPA obtained, age and gender. Female students' overall GPA increase by 0.11 points, male students by 0.06 points, indicating the females' attentiveness towards textbook learning. This might be a general conclusion in relation to academic results and gender. But another objective is to check the consistency in results of these two groups. In order to accomplish this, we test whether the variances of the results of male students are equal to their female counterparts.

Consistency in academic results is reflected in the degree of variation in individual GPA from overall GPA. We examine whether the GPA variances of male and female are statistically different or not. In order to test the hypothesis of equal variance against the heteroskedastic variance, values of F-statistic have been computed. Table 7 presents the computed values of F-, where N_M and N_F stand for the number of male and female students respectively.

Table-7. Computed Values of F-statistic.

Male		Female		F-statistic	Department
σ_M^2	N_M	σ_F^2	N_F		
Premier University					
0.262	1203	0.291	609	1.11	BBA
0.171	462	0.217	254	1.27	CSE
0.180	65	0.371	92	2.06	Economics
International Islamic University Chittagong					
0.697	828	0.806	633	1.16	BBA
0.760	731	0.664	455	0.87	CSE
0.934	448	0.991	467	1.06	EB
Port City International University					
0.232	194	0.266	74	1.15	BBA
0.320	267	0.343	60	1.07	CSE
0.180	26	0.459	13	2.55	LLB
0.229	33	0.138	35	0.60	English
Southern University					
0.493	347	0.557	126	1.13	BBA
0.563	341	0.551	146	0.98	CSE
0.427	263	0.294	130	0.69	LLB
0.951	200	0.508	290	0.53	English
University of Science & Technology of Chittagong (USTC)					
0.324	130	0.382	63	1.18	BBA
All Courses Together					
0.445	2702	0.590	1505	1.33	BBA
0.534	1802	0.512	914	0.96	CSE
0.852	513	0.911	559	1.07	Economics
0.416	289	0.317	143	0.76	LLB
0.948	233	0.473	325	0.50	English
All Universities Together					
Male		Female		F-statistic	University
σ_M^2	N_M	σ_F^2	N_F		
0.778	2007	0.836	1555	1.07	IIUC
0.236	1730	0.282	954	1.19	PU
0.286	520	0.327	182	1.14	PCIU
0.609	1151	0.511	692	1.19	SU
0.324	130	0.382	63	1.18	USTC
TOTAL (All Universities and Courses together)					
0.543	5538	0.608	3446	1.12	University & Courses

We have computed a total twenty-six values of F-statistic. Of them, only eight values are less than 1 for which we cannot reject the null hypothesis $H_0 : \sigma_F^2 = \sigma_M^2$ against the one-tailed alternative $H_A : \sigma_F^2 > \sigma_M^2$. Rejection of null is possible in eighteen other cases. Evidence of heteroscedasticity is apparent here. Such result lends support in favors of higher variability in the grades of female students than the males though the average score of the former is higher. Arguably, greater variance of females' grade refers to the lack of consistency in academic achievement of the female students.

Table 8 reveals some measures of descriptive statistics that can help reach any conclusion regarding the comparative performance of male and female students in terms of average score and variability in scores. Gender-wise average grades and variances have been presented for each of the sample universities. With few exceptions, the average scores of females are found higher than males. This observation justifies the general conclusion of females' seriousness and eagerness towards academic programs. However, the higher variances of females' scores question their behavioral consistency in the knack of learning and succeeding. Another source of variability might lie in the nature of student intake by the private universities in Bangladesh. For pursuing higher studies in the country, female students are more likely to opt for private institutions than males. As a consequence, students of both extremes, in terms of academic caliber, are admitted by the private universities. Some extraordinary students attain almost full points in the examination and low caliber students score poor, thereby increasing the variance of grade distribution.

Table-8. Descriptive Statistics of Grades.

Department	Male				Female			
	Mean	Maximum	Minimum	Variance	Mean	Maximum	Minimum	Variance
Premier University								
BBA	2.79	4.0	2.0	0.277	3.02	4.0	2.0	0.301
CSE	2.75	4.0	2.0	0.173	2.93	4.0	2.0	0.230
Economics	2.89	3.81	2.0	0.179	3.11	4.0	1.8	0.368
International Islamic University of Chittagong(IIUC)								
BBA	2.74	4.0	0.0	0.776	2.77	4.0	0.0	0.895
CSE	2.70	4.0	0.0	0.832	2.90	4.0	0.0	0.676
EB	2.70	4.0	0.0	1.114	2.73	4.0	0.0	0.999
Port City International University								
BBA	3.11	4.0	2.0	0.258	3.53	4.0	2.0	0.270
CSE	3.07	4.0	2.0	0.321	3.10	3.89	2.07	0.341
LLB	2.87	3.94	2.0	0.335	3.02	3.94	2.08	0.539
English	3.38	4.0	2.42	0.226	3.04	3.63	2.31	0.135
Southern University								
BBA	2.84	4.0	0.0	0.501	3.00	3.91	0.0	0.560
CSE	2.88	3.88	0.0	0.564	3.06	4.0	0.0	0.567
LLB	2.52	3.77	0.0	0.426	2.69	3.75	0.0	0.319
English	2.47	3.88	0.0	0.946	2.79	3.91	0.0	0.507
University of Science & Technology of Chittagong(USTC)								
BBA	3.17	4.0	1.20	0.353	3.46	4.0	1.0	0.407
All Courses Together								
BBA	2.82	4.0	0.0	0.475	2.95	4.0	0.0	0.618
CSE	2.80	4.0	0.0	0.552	2.95	4.0	0.0	0.516
Economics	2.72	4.0	0.0	0.999	2.79	4.0	0.0	0.956
LLB	2.54	3.77	0.0	0.414	2.72	3.94	0.0	0.344
English	2.60	4.0	0.0	0.944	2.82	3.91	0.0	0.472

Presence of heteroscedasticity causes a loss of efficiency in the OLS estimators that we derived so far. This happens because the OLS estimators do not have minimum variance. We tried to get around the problem by applying the generalized least squares (GLS) approach. Surprisingly, no difference between OLS and GLS estimates

as well as standard errors has been noticed. Such results might be due to large sample size. We have relied on sufficiently large samples almost in all cases and thus the estimates are reliable.

5. CONCLUSION AND POLICY IMPLICATIONS

This research studied, in the first step, the relationship between university students' age and academic performance. Using a fairly large sample of 8,985 students from five private universities in Bangladesh, the research finds the evidence of a positive relationship between age (semester) and academic achievement (GPA). Both OLS and GLS techniques yield some estimates of GPA per semester ranging from 0.02 to 0.13. Substantial heterogeneity is observed in the estimates. Source of heterogeneity in the estimates lies in the degree of difficulty of the subject considered. Estimates obtained for the students of science appear to be smaller than the estimates for commerce, humanities or social sciences. It has been noticed that average grades of computer science students increase by 0.05 points per semester which is around 0.07 points for the students of commerce. Course curriculum and the nature of the sample university also cause the diversity in marginal grades.

The paper also examines the gender differences in academic achievement of university students. Gender, as an interaction dummy, has been introduced to substantiate the influence of gender on learning skill. Basing on the empirical findings of current study, we can conclude that gender has a significant effect on GPA in almost all the academic disciplines of selected universities. Apparently, the performance of the female students is found significantly better than the male students. If, for example, the course BBA is singled out, we observe that the male students' average increase in GPA per semester is 0.05 points but for female students it happens to be 0.11. Such gender difference favored females in other fields of study with rare exception.

The existence of heteroskedastic partition among male and female GPA investigated by the paper may be viewed as a vital contribution of the research, which obviously is likely to enrich the literatures on education economics. To the best of our knowledge, statistical difference between the variances of grades of male and female students has not been exclusively examined earlier, especially analyzing the grades of students pursuing higher studies in Bangladesh.

Findings of the study may be useful to the students, parents, university administrations, policymakers and employers. Several papers examined the returns to education in Bangladesh and found substantial heterogeneity in returns to education with respect to gender. Asadullah (2006) for example, found higher estimates of returns to education of the females compared to the males. Our current research is able to pinpoint the reason why returns of the females are relatively higher. While getting the same education and training from the same educators, females obtain better scores than the males, indicating their knack and dedication. Higher returns of the females from education might accrue due to their similar devotedness towards work in the labor market. However, the findings about greater variability in academic scores of females might have a carryover on the returns, which requires further research.

One of the limitations of the study is that the research findings are based on the samples collected from private universities alone. There are as many as 46 public and 105 private universities in Bangladesh. Separate study conducted by examining the scores of public universities might help check the validity of our current research. Estimated linear relationship between semester passed and GPA obtained may be viewed as another limitation of the study. Further research may be initiated allowing for any nonlinearity.

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