Philippine Management Review 2017, Vol. 24, 83-98.

Graduate Business Program Admission Criteria and Student Graduate Academic Performance

Regina M. Lizares*, Leila C. Rahnema, Mia Pang-Rey, Ivy D. Suan, Carlos C. Bautista
University of the Philippines, Cesar E.A. Virata School of Business, Diliman, Quezon City 1101, Philippines

The study evaluated a graduate business program by examining the student's graduate academic performance and its admission procedure using several econometric procedures. The study shows that successful student's graduate academic performance in the University of the Philippines' graduate business program, both the Master in Business Administration (MBA) and MS Finance (MSF) degrees, can be consistently explained by the student's past undergraduate academic performance and the quantitative aptitude test score. Reading and logic aptitude test scores, the two other measures of individual ability, did not seem to have a bearing on the student's graduate academic performance. Hence, it is possible that altering the relative weights of the three test scores may change the profile of successful applicants and, at the same time, improve the overall efficacy of the admission procedure.

Keywords: Graduate admission, Academic performance, Sample selection bias, Philippines

1 Introduction

Graduate business programs seek to improve the business profession, as well as to add value to graduates and—ultimately—to society through education. They do so through proper selection, education, and placement policies and processes (Shavelson, Short, Muthen, & Muthen, 1998). A graduate business program's success depends not only on the quality and level of instruction but also on the quality of the students selected by a particular screening mechanism. A program's admission policy reflects both the school's mission and the standards it upholds.

This study examined student's graduate academic performance and admission policy effectiveness in the University of the Philippines-Virata School of Business' (UP-VSB) MBA and MS Finance programs. Based on the findings, areas for future research and policy changes are suggested. This study is of significance to graduate business program directors and administrators who aim to increase the efficacy of their admission procedure and to improve the retention and graduation rates of its students. Through better understanding of the likely predictors of student's graduate academic performance, more quality admission choices can be made.

The study differs from other academic performance studies done in the Philippines[1] and internationally in its use of Heckman's (1979) sample selection model to examine the sample selection problem inherent in this type of studies. The observations used in this study were not randomly drawn from the population since they comprise of applicants admitted to the graduate business program.

This paper is divided as follows. The next section provides a literature review of the extensive research done in the same field of interest, breaking down the relevant variables used and summarizing the significant findings of these studies. Then, the section that discusses the data and econometric methodology used follows. The fourth section presents the estimation results, while the fifth recommends and concludes the research.

2 Literature Review

Identifying the most appropriate selection criteria for graduate business school admission has been the focus of many studies since the 1970s. A vast literature on the effectiveness of certain predetermined variables has surfaced and contributed to the buildup of graduate business programs worldwide. The underlying assumption is that student's graduate academic performance, usually

*Correspondence: Tel: +63 2 928 4571; Fax: +63 2 929 7991. Email: rmlizares@up.edu.ph

[1] For studies on undergraduate economics performance, see Sicat and Panganiban (2009) and Sicat and Briones (2009). For a previous analysis of the UP-VSB MBA program see Supangco (2000).

defined and measured by the cumulative graduate grade point average (GPA), can be explained by a vector of variables. However, there are likely other non-conventional criteria that could be just as important as the traditional variables in predicting success in graduate business programs.

Many variables have been explored ranging from: *undergraduate factors* (undergraduate GPA, undergraduate degree/major, undergraduate institution, academic performance in prerequisite subjects); to *standardized tests results* (Graduate Management Admission Test- GMAT total and/or its components GMAT verbal- GMATV, GMAT quantitative- GMATQ, and analytical writing assessment- AWA); to *demographic factors* (age, gender, marital status, ethnicity); to other *qualitative factors* (work experience, leadership experience, managerial competencies, practical intelligence, language with a focus on fluency in English, personality); and to *interaction of these variables*. Many studies have been conducted to examine the explanatory and predictive power of these variables. Appendix 1 summarizes a few of these studies.

2.1 GMAT and Undergraduate GPA

Mostly using correlation and regression techniques, different permutations of the student's graduate academic performance and admission criteria have been empirically tested. Applicant's GMAT and undergraduate GPA are the two most heavily used admission criteria and student's graduate academic performance predictor across graduate business schools and across time, as seen in Appendix 1. Combined, these two variables explain on average 20-25% of the variance of the student's graduate academic performance. The GMAT/standardized test provides a meaningful comparison of individuals across undergraduate institutions and majors, while undergraduate GPA offers a view of individuals' motivation and discipline.

The value of these two predictor variables were further solidified by the meta-analysis[2] conducted by Kuncel, Credé, and Thomas (2007) and Oh, Schmidt, Shaffer, and Le (2008). Utilizing a meta-analytic method to estimate the amount of variance attributable to sampling error, range restriction, and unreliability, Kuncel et al. (2007) examined the existing literature on the validity of GMAT and undergraduate GPA. Results based on over 402 independent samples across 64,583 students indicate that the GMAT is a superior predictor to undergraduate GPA and that the two combined yield a high level of validity for predicting student's graduate academic performance. The year after, Oh et al. (2008) recalibrated the GMAT validity reported by Kuncel et al. (2007) and discover that the GMAT's validity estimates have been underestimated by 7% due to the application of sub-optimal range-restrictions correction. These results imply that GMAT scores are even more valid for predicting business school grades than previously believed.

However, solely using GMAT as a selection tool may result in several biases. First, there are underlying factors that affect GMAT scores such as age and gender. Second, GMAT biases admission towards those who will excel as individual performers but may not provide indication on individual's group performance (Peiperl & Trevelyan, 1997).

For UP-VSB graduate school programs, the GMAT, the Graduate Records Examination (GRE) or the GPAT are accepted. However, the majority, if not all applicants take the GPAT primarily due to its affordability; the GMAT costs US$250, the GRE US$195 and the GPAT less than US$20, a tenth of the price.

2.2 Other Variables

Other variables for graduate business school admission and performance have been explored, in conjunction with GMAT and undergraduate GPA. However, they have shown mixed and much lower predictive and explanatory power.

Work experience. Work experience is an admission requirement in many graduate business programs. However, its inclusion as an antecedent variable poses a measurement challenge. It is more often measured quantitatively than qualitatively (type or value of the experience), despite the fact that not all work experiences are neither equivalent in substance nor equal in quality. However,

[2] Meta-analysis, a method for quantitatively combining and summarizing results reported from individual studies, has radically changed how researchers analyze and interpret their research findings (Hunter & Schmidt, 2004).

even quantitatively, the measure of work experience varies by the years since undergraduate degree (Adams & Hancock, 2000; McClure, Wells, & Bowerman, 1986; Hoefer & Gould, 2000; Braunstein, 2002), months of work experience (Carver & King, 1994; Pattie, 2011), or age (Truit, 2002). These quantitative measures also vary in its representation as either continuous or categorical variables. For UP-VSB, work experience is quantitatively counted and indicated as a continuous variable; given work experience must be supported by employment certificate, it is likely imprecisely measured and understated given the exigent validation demand.

As a predictor of student's graduate academic performance, work experience has shown mixed results. Some studies have shown that it is a significant determinant of graduate GPA (Adams & Hancock, 2000; McClure et al., 1986; Carver & King, 1994; Braunstein, 2002; Pattie, 2011; Truit, 2002), while some have not (Peiperl & Trevelyan, 1997; Hoefer & Gould, 2000).

Gender and age. Student's graduate academic performance was minimally affected by gender and age, if at all. However, GMAT—a selection criteria for graduate business program admission—is somewhat affected by these two variables. The mean GMAT scores were lower for females (Hancock, 1999; Braunstein, 2002; Truit, 2002; Deis & Kheirandish, 2010) and for older individuals (Deis & Kheirandish, 2010). The same gender and age bias was seen with the GPAT. The mean GPAT scores were lower for females as seen in Appendix 2, and the mean GPAT scores decreased as the applicants' age increases as seen in Appendix 3. All these imply that deciding on graduate business school admission strictly by GMAT/GPAT score may disadvantage female and older candidates who are qualified.

Others. Aside from the traditional independent variables, many other non-conventional factors to explain graduate academic performance variance have shown statistical significance: native language (Yang & Diaopin, 2001), ethnicity (Dogan, 2011; Sulaiman & Mohezar, 2006), competitiveness of undergraduate institution (Braunstein, 2002), work and leadership experience (Deis & Kheirandish, 2010), marital status (Peiperl & Trevelyan, 1997), business degree backgrounds (Braunstein, 2002), managerial competencies (Kass, Grandzol, & Bommer, 2012), personality variables such as need for achievement and locus of control (Marks, Watts, & Yetton, 2001).

Undergraduate business prerequisites as an explanation of student's graduate academic performance have been previously explored. Bieker's (1996) sample comprised of individuals who have completed the eleven courses that are prerequisite common body of knowledge (CBK) courses for admission to MBA program; he showed that GPA, limited to these eleven CBK, explained variation in student's graduate academic performance. Meanwhile, Christensen and Nance (2012) showed that, with a mixed sample of individuals with and without the undergraduate prerequisites, the completion of the prerequisites did not guarantee success in the MBA program any different than that of students who have not completed them.

The consideration of non-cognitive predictors in conjunction with the GMAT and undergraduate GPA may enhance the overall quality of admission decisions (Wright & Palmer, 1994; Christensen & Nance, 2012; Dogan, 2011). Non-cognitive aspects such as professional work experience, leadership skills, communication skills, interpersonal skills, intrinsic and extrinsic motivations, and personality, to name a few, are factors that can affect the student's graduate academic performance. Resumes, letters of recommendation, writing samples, and personal interviews offer ways to gauge these non-cognitive attributes. Unfortunately, most of these items are difficult to quantify and receive limited weight in admission decisions.

Lastly, Hedlund, Wilt, Nobel, Ashford, and Sternberg (2001) added measures of practical intelligence (PI) to the MBA admission process. The preliminary findings showed that the addition of PI measures predicted success inside and outside the classroom and provided small (2-6%) yet significant increments in the prediction of variance in MBA performance beyond GMAT scores and undergraduate GPA. Furthermore, these measures exhibited less disparity across gender and racial/ethnic groups than does the GMAT. However, the process of developing and testing for PI is rather cumbersome and the added (small) benefit should be weighed against the cost.

3 Methodology and Data

This study is similar to other academic performance studies in its use of ordinary least square (OLS) to explain the variance in academic performance. However, this study pushed the analysis further in its use of Heckman's (1979) sample selection model to examine the sample selection problem inherent in this type of studies. The observations used in this study were not randomly drawn from the population; they were comprised of applicants admitted to the graduate business program.

3.1 Data

This study used four years of admission data from 2009[3] to 2012. This four-year data set contained 1,462 observations. After excluding records with missing data, 1,444 were usable observations. Of these applicants, 545 were accepted to the program. A breakdown of the admission data per program type and gender is seen in Appendix 4.

The data set contained the following details for each applicant: 1) academic credentials (undergraduate GPA and undergraduate honors if any, undergraduate field, undergraduate institution, and the number of accounting and mathematics course taken[4]); 2) socio-demographic variables (gender, civil status, and age); and 3) entrance examination results (GPAT total, and its component breakdown- logic, quantitative and reading); and 4) years of work experience, validated by an employment certificate. Appendix 5 lists the categorical variables used in this data set.

A majority of applicants were rank and file employees and a few middle management personnel from the private business sector. These applicants were required to take the GMAT, GRE or GPAT to test their reading, quantitative and logical reasoning abilities[5]. In the history of the UP-VSB graduate business program, only a very few have taken the GMAT or the GRE because of its prohibitive cost. All students in the data set took the GPAT.

There are three types of graduate business degree programs in the University of the Philippines, the part time MBA program (Evening), the full time MBA program (Day) and the MS Finance program.

3.2 Methodology

The assumption was that a student's graduate academic performance y_i, can be measured by his/her overall graduate grade point average ($GGPA_i$). Graduate GPA was assumed to be influenced by a vector of variables $\boldsymbol{x}_i$, such as undergraduate GPA, GPAT scores, individual personal characteristics and other exogenous variables. Hence, the regression function can be written in the form:

$$GGPA_i = \boldsymbol{x}_i'\boldsymbol{\beta} + \varepsilon_i \;\; ; \;\; i = 1, \dots, n \tag{1}$$

Meanwhile, the admission decision was specified as a probit equation. The decision to admit an applicant, represented by a binary variable ($Admit_i$), is a function of a vector of variables $\boldsymbol{z}_i$, such as academic credentials, entrance examination results, and other individual characteristics represented by categorical variables listed in Appendix 5, considered by the admission committee. A discussion of the use of this econometric method in evaluating student's graduate academic performance can be found in Cushing and McGarvey (2004). This probit equation can be expressed by an equation of the following form:

$$Admit_i = 1(\boldsymbol{z}_i'\boldsymbol{\gamma} + v_i > 0) \tag{2}$$

---

[3] The admission procedure was revised in 2009 and the application procedure itself was shifted to a fully online process.

[4] The variables Accounting Background and Math Background crudely measures the number of accounting and mathematics courses, respectively, taken by the applicant during his/her undergraduate studies.

[5] The examination takes four hours including breaks, and it has 200 questions that cover these three components.

Initially, the assumption was that the admission and the performance equations were independent and were estimated separately via the probit and OLS methods, respectively.

However, the results of the student's performance equation depended on who was admitted using a particular admission policy. Participants were chosen by an admission policy and, hence, the dependent variable, graduate GPA of admitted students, did not arise from random sampling. The sample selection bias that arose from the missing data may be treated as a specification error, much like an omitted variable problem. This also meant that the admission and performance were not independent of each other. Hence, there was a need to use the sample selection model, an econometric methodology developed by Heckman (1979) and discussed extensively in Greene (2012).

Taking the expectation of $GGPA_i$ conditional on the student's acceptance to the program, one gets:

$$\begin{aligned} E(GGPA_i|i \text{ is in the sample}) &= E(y_i|Admit_i = 1) = E[y_i|(v_i > -\boldsymbol{z}_i'\boldsymbol{\gamma})] \\ &= \boldsymbol{x}_i'\boldsymbol{\beta} + E[\varepsilon_i|(v_i > -\boldsymbol{z}_i'\boldsymbol{\gamma})] \\ &= \boldsymbol{x}_i'\boldsymbol{\beta} + \beta_\lambda \lambda_i \end{aligned} \tag{3}$$

With the specification of the admission criteria (3), the performance equation (1) can be rewritten as:

$$\begin{aligned} y_i|(Admit_i = 1) &= E(y_i|Admit_i = 1) + u_i \\ &= \boldsymbol{x}_i'\boldsymbol{\beta} + \beta_\lambda \lambda_i + u_i \end{aligned} \tag{4}$$

Equation (2) is the admission equation and (4) is the performance equation. $\boldsymbol{x}_i$ and $\boldsymbol{z}_i$ are vectors of variables that seek to explain academic success and admission to the program respectively. Equations (2) and (4) were estimated simultaneously by maximum likelihood[6].

4 Results

The results of parameter estimates of equations (2) and (4) using probit, OLS and sample selection methods are shown in Tables 1 to 3. Each Table includes estimates for the full sample labeled All and for sub-samples labeled by type of program: MSF, Evening and Day. Categorical variables were included in the estimates to control for various factors: applicant's year of entry (Batch Year), undergraduate school (School Classification), Undergraduate Background (e.g., economics, engineering, etc.). The significance of these categorical variables was determined through the Wald and F-tests shown in the last few rows of the Tables. Two measures of graduate academic performance, first trimester graduate GPA and exit graduate GPA (–1T and –X suffixes in the Tables respectively) were used for robustness check. For the latter, exit meant either completion or dropping out of the program. Results for some sub-samples were not available due to insufficient number of observations that had depended on the performance measure used.

4.1 Probit and OLS Estimates

The performance equation was estimated using OLS with the second term, $\beta_\lambda \lambda_{i_i}$, omitted in (4) if it is assumed that the admission policy has no bearing on the collective performance of students. Moreover, maintaining this assumption of independence, one can simply estimate the admission equation (2) using probit. The probit estimates of the admission equation are shown in Table 1 while the OLS estimates of performance are shown in Tables 1, 2-A and 2-B.

Admission equation using probit. In column 1 of Table 1 where all observations are included, all three GPAT scores (Logic, Quantitative and Reading) were statistically significant. All other variables were statistically insignificant. Estimating the admission equation by program provided very different results in terms of significance and magnitude of coefficients. For the MSF estimates, only the Quantitative and Reading scores were statistically significant; for the Day estimates, only Work Experience had been statistically significant but was incorrectly signed since this was expected

[6] The original Heckman procedure is a two-step procedure where a selection equation is estimated first and used in the performance equation.

to have a positive coefficient, indicating the desirability of work experience. The Evening sub-sample skewed more closely to the full sample results where all three GPAT scores were statistically significant; in addition, Work Experience was statistically significant. Surprisingly, Undergraduate GPA was not statistically significant as an admission variable. The Wald tests of the four categorical variables included (Program Type, Batch Year, School Classification and Undergraduate Background) showed that only Undergraduate Background did not help explain admission decisions.

Performance equation using OLS. As mentioned earlier, for robustness check, this study used two measures of student's graduate academic performance: first trimester (1T) GPA and the exit (X) GPA. Columns 1 and 2 of Table 2-A and 2-B show full sample results of OLS estimates using 1T and X performance variables. The Math Background and Work Experience variables in Table 2-A were statistically insignificant and incorrectly signed. Hence, these are excluded in Table 2–B. Exclusion of the two variables appeared to yield a reasonable specification since Math Background may have exhibited possible multi-collinearity with the Quantitative score. Meanwhile, Work Experience was likely imprecisely measured and understated given the exigent demand of an employment certification to validate the work experience; furthermore, Work Experience exhibited a strong correlation at 70% with Age. Despite these specification changes, the estimates did not improve significantly. In both Tables 2–A and 2–B, the Undergraduate GPA and the Quantitative score were statistically significant, except in the MSF sub-sample. The MS Finance program, known for its quantitative demands, oddly only has the Reading score as a statistically significant variable.

4.2 Sample Selection Estimates

The above results are satisfactory and a lot of insights can be gained but these may still be improved by attempting to account for the dependence of performance on admission policy. For completeness, this study reports the sample selection estimates of performance and admission that includes math background and work experience in Table 3-A. Table 3-B, which can be compared with the probit and OLS estimates of Tables 1 and 2-B, excludes these two variables.

Admission equation. Compared to the probit results, the sample selection estimates in Table 3-B provide more consistent results overall and across programs. All three GPAT scores are statistically significant with the exception of Logic score for the MSF program where it is not statistically significant. As in the probit estimates of Table 1, none of the socio-demographic variables are statistically significant. The Program Type variable, which serves to differentiate the level of rigor and program content among programs, is statistically significant. The choice of program by the applicant appears to be factors in the admission procedure. The latter reflects the effects of the quota for each program. This is in consonance with the admission policy followed by the admission committee.

Performance equation. The Undergraduate GPA and the Quantitative score are consistently statistically significant in the full and sub-sample estimates. Note that Logic and Reading scores are either incorrectly signed or statistically insignificant as in the OLS estimates. Results from both Tables 3-A and 3-B show that the other variables—Accounting Background, Math Background and socio-demographic variables—are not statistically significant. The significance of the correlation coefficient, ρ, shows that admission and performance are linked. Ignoring this leads to an overestimation of the magnitude of the coefficient of the Undergraduate GPA. This can be seen for example by comparing column 1 of Tables 2-B and 3-B where the values are 0.2809 and 0.1882, respectively. This difference can be crucial especially when attempting to predict the applicant's or potential student's graduate academic performance which is then used as an input to the admission decision.

Table 1. Probit Estimates of Admission Equation

	(1) All	(2) MSF	(3) Eve	(4) Day
Undergraduate GPA	0.131	–0.325	0.135	0.401
	(0.126)	(0.387)	(0.157)	(0.330)
Work Experience	0.034	0.015	**0.068	*–0.114
	(0.019)	(0.052)	(0.024)	(0.047)
Logic	**0.017	0.019	**0.019	0.016
	(0.004)	(0.012)	(0.004)	(0.010)
Quantitative	**0.017	**0.023	**0.018	0.015
	(0.003)	(0.009)	(0.004)	(0.009)
Reading	**0.018	**0.043	**0.017	0.017
	(0.003)	(0.011)	(0.004)	(0.009)
Accounting Background	0.075	0.117	0.071	0.066
	(0.039)	(0.117)	(0.048)	(0.118)
Math Background	0.001	–0.051	–0.011	0.040
	(0.033)	(0.107)	(0.040)	(0.092)
Gender	0.012	0.154	–0.089	0.445
	(0.092)	(0.287)	(0.116)	(0.239)
Age	–0.006	0.025	–0.017	0.030
	(0.014)	(0.032)	(0.018)	(0.038)
Civil Status	–0.014	0.250	–0.012	–0.097
	(0.067)	(0.206)	(0.080)	(0.209)
Pseudo–R^2	0.253	0.356	0.272	0.342
No. of Observations	1269	175	898	191
Wald Tests:				
Program Type(df)	21.48 (2)			
(p–value)	(0.00)			
Batch Year (df)	6.76 (3)	7.22 (2)	4.66 (3)	17.39 (3)
(p–value)	(0.08)	(0.03)	(0.20)	(0.00)
School Classification (df)	17.87 (8)	13.57 (8)	15.40 (8)	13.30 (8)
(p–value)	(0.02)	(0.09)	(0.05)	(0.10)
Undergraduate Background (df)	6.87 (8)	4.81 (6)	6.54 (8)	11.61 (8)
(p–value)	(0.55)	(0.57)	(0.59)	(0.17)

Note: standard errors in parenthesis except for the Wald tests;
df = degrees of freedom; * p < 0.05, ** p < 0.01

Table 2-A. OLS estimates of Academic Performance Equation (with math background and work experience variables)

	(1) All–1T	(2) All–X	(3) MSF–X	(4) Eve–1T	(5) Eve–X
Undergraduate GPA	**0.2831	**0.2289	0.4486	**0.2146	**0.1903
	(0.05)	(0.04)	(0.23)	(0.06)	(0.05)
Accounting Background	0.0074	0.0057	0.0285	0.0178	0.0082
	(0.01)	(0.01)	(0.07)	(0.02)	(0.02)
Math Background	0.0039	–0.0055	–0.0770	–0.0022	–0.0083
	(0.01)	(0.01)	(0.08)	(0.02)	(0.01)
Logic	0.0026	0.0015	0.0009	0.0005	0.0001
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Quantitative	**0.0069	**0.0064	0.0050	**0.0067	**0.0062
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Reading	0.0024	**0.0037	*0.0269	0.0027	*0.0028
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Work Experience	–0.0087	–0.0084	–0.0892	–0.0082	–0.0043
	(0.01)	(0.01)	(0.07)	(0.01)	(0.01)
Gender	–0.0312	–0.0546	0.0405	–0.0367	–0.0355
	(0.03)	(0.03)	(0.13)	(0.04)	(0.04)
Age	0.0016	0.0059	*0.0826	–0.0027	–0.0004
	(0.00)	(0.00)	(0.04)	(0.01)	(0.01)

Table 2-A cont'd

	(1) All–1T	(2) All–X	(3) MSF–X	(4) Eve–1T	(5) Eve–X
Civil Status	*–0.0540	–0.0113	0.2564	–0.0601	–0.0341
	(0.03)	(0.03)	(0.20)	(0.03)	(0.03)
Adjusted–R^2	0.378	0.248	0.193	0.296	0.243
F statistic	11.56	9.71	.	6.32	4.93
S.E. of regression	0.312	0.328	0.544	0.324	0.277
No. of Observations	485	485	70	316	316
F–Tests					
Program Type (df)	16.48 (2)	12.89 (2)			
(p–value)	(0.00)	(0.00)			
Batch Year (df)	6.35 (3)	1.46 (3)	0.43 (2)	2.84 (3)	0.23 (3)
(p–value)	(0.00)	(0.23)	(0.65)	(0.04)	(0.87)
School Classification (df)	2.19 (8)	1.19 (8)	0.66 (8)	1.09 (8)	0.87 (8)
(p–value)	(0.03)	(0.31)	(0.72)	(0.37)	(0.54)
Undergraduate Background (df)	4.68 (8)	2.36 (8)	1.09 (7)	3.29 (8)	2.12 (8)
(p–value)	(0.00)	(0.02)	(0.39)	(0.00)	(0.03)

Note: standard errors in parenthesis except for the F tests; df = degrees of freedom; * p < 0.05, ** p < 0.01

Table 2-B. OLS Estimates of Academic Performance Equation

	(1) All–1T	(2) All–X	(3) MSF–X	(4) Eve–1T	(5) Eve–X
Undergraduate GPA	**0.2809	**0.2321	0.4439	**0.2025	**0.1861
	(0.05)	(0.04)	(0.22)	(0.06)	(0.05)
Accounting Background	0.0040	0.0026	0.0321	0.0105	0.0025
	(0.01)	(0.01)	(0.06)	(0.02)	(0.01)
Logic	*0.0026	0.0015	0.0002	0.0007	0.0003
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Quantitative	**0.0068	**0.0063	0.0043	**0.0066	**0.0061
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Reading	0.0024	**0.0036	*0.0217	0.0023	0.0025
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Gender	–0.0272	–0.0533	0.0811	–0.0320	–0.0345
	(0.03)	(0.03)	(0.11)	(0.04)	(0.04)
Age	–0.0027	0.0014	0.0282	–0.0059	–0.0021
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Civil Status	*–0.0546	–0.0142	0.1607	–0.0535	–0.0311
	(0.03)	(0.03)	(0.17)	(0.03)	(0.03)
Adjusted–R^2	0.369	0.251	0.152	0.286	0.245
F statistic	11.98	11.05	.	6.39	5.35
S.E. of regression	0.311	0.324	0.544	0.323	0.274
No. of Observations	511	511	75	334	334
F–Tests					
Program Type (df)	16.65 (2)	15.40 (2)			
(p–value)	(0.00)	(0.00)			
Batch Year (df)	8.17 (3)	2.43 (3)	1.16 (2)	3.53 (3)	0.30 (3)
(p–value)	(0.00)	(0.06)	(0.32)	(0.02)	(0.83)
School Classification (df)	2.16 (8)	0.95 (8)	0.45 (8)	0.92 (8)	0.67 (8)
(p–value)	(0.03)	(0.48)	(0.88)	(0.50)	(0.72)
Undergraduate Background (df)	4.99 (8)	2.41 (8)	4.09 (7)	3.31 (8)	2.19 (8)
(p–value)	(0.00)	(0.01)	(0.00)	(0.00)	(0.03)

Note: standard errors in parenthesis except for the F tests; df = degrees of freedom; * p < 0.05, ** p < 0.01

Table 3-A. Heckman Estimates of Performance and Admission Equations (with math background and work experience variables)

	All–1T	**All–X**	**MFS–X**	**Eve-1T**	**Eve–X**
Undergraduate GPA	**0.2159	**0.2202	**0.5653	**0.1607	**0.1469
	(0.05)	(0.04)	(0.15)	(0.06)	(0.05)
Accounting Background	0.0100	0.0120	–0.0415	0.0149	0.0107
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)
Math Background	0.0278	0.0126	–0.0607	0.0213	0.0105
	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)
Logic	–0.0012	0.0013	0.0053	–0.0035	–0.0044
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Quantitative	**0.0064	**0.0078	**0.0075	**0.0059	**0.0041
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Reading	0.0000	**0.0042	*0.0212	–0.0015	–0.0016
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Work Experience	–0.0126	–0.0052	–0.0779	–0.0201	–0.0158
	(0.01)	(0.01)	(0.05)	(0.01)	(0.01)
Gender	–0.0562	**–0.0772	–0.1157	–0.0483	–0.0410
	(0.03)	(0.03)	(0.11)	(0.04)	(0.04)
Age	0.0029	0.0037	0.0550	0.0025	0.0031
	(0.01)	(0.00)	(0.02)	(0.01)	(0.01)
Civil Status	–0.0331	–0.0030	0.0467	–0.0351	–0.0174
	(0.03)	(0.03)	(0.18)	(0.04)	(0.03)
Admission equation					
Undergraduate GPA	0.1955	0.1365	–0.1553	0.1814	0.1462
	(0.12)	(0.13)	(0.38)	(0.15)	(0.14)
Logic	**0.0171	**0.0171	0.0178	**0.0187	**0.0184
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Quantitative	**0.0149	**0.0182	*0.0179	**0.0142	**0.0144
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Reading	**0.0140	**0.0163	**0.0417	**0.0161	**0.0161
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Gender	0.0259	–0.0030	0.2452	–0.0668	–0.0902
	(0.09)	(0.09)	(0.27)	(0.11)	(0.10)
Age	–0.0048	–0.0047	0.0008	–0.0120	–0.0138
	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
Civil Status	–0.0229	–0.0171	0.1421	–0.0129	–0.0216
	(0.07)	(0.07)	(0.21)	(0.08)	(0.08)
Work Experience	0.0265	0.0297	0.0667	*0.0523	**0.0548
	(0.02)	(0.02)	(0.05)	(0.02)	(0.02)
λ	–0.289	0.028	0.165	–0.324	–0.347
σ	0.386	0.326	0.506	0.408	0.379
ρ	–0.748	0.087	0.326	–0.795	–0.917
Independent equations test ($\rho = 0$)	7.79	0.26	0.94	14.31	51.19
(p–value)	(0.01)	(0.61)	(0.33)	(0.00)	(0.00)
Program type (df)	50.00 (4)	41.86 (4)			
(p–value)	(0.00)	(0.00)			
Batch Year (df)	20.49 (3)	5.62 (3)	3.29 (2)	10.09 (3)	1.10 (3)
(p–value)	(0.00)	(0.13)	(0.19)	(0.02)	(0.78)
School Classification (df)	17.30 (8)	16.84 (8)	13.23 (8)	10.96 (8)	8.71 (8)
(p–value)	(0.03)	(0.03)	(0.10)	(0.20)	(0.37)
Undergraduate Background (df)	8.70 (8)	8.07 (8)	267.21 (8)	15.64 (8)	14.04 (8)
(p–value)	(0.37)	(0.43)	(0.00)	(0.05)	(0.08)

Table 3-B. Heckman Estimates of Performance and Admission Equations

	(1) All–1T	(2) All–X	(3) MSF–X	(4) Eve–1T	(5) Eve–X
Undergraduate GPA	**0.1882	**0.1438	**0.5392	*0.1281	*0.1213
	(0.05)	(0.05)	(0.14)	(0.06)	(0.05)
Accounting Background	0.0102	0.0059	–0.0234	0.0149	0.0107
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)
Logic	–0.0014	**–0.0046	0.0050	–0.0037	**–0.0046
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Quantitative	**0.0067	**0.0035	*0.0066	**0.0061	**0.0043
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Reading	–0.0002	–0.0017	*0.0183	–0.0015	–0.0016
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Gender	–0.0498	–0.0617	–0.1036	–0.0481	–0.0441
	(0.03)	(0.03)	(0.11)	(0.04)	(0.04)
Age	–0.0037	–0.0013	0.0117	–0.0067	–0.0043
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Civil Status	–0.0321	–0.0037	0.0077	–0.0257	–0.0140
	(0.03)	(0.03)	(0.14)	(0.03)	(0.03)
Admission equation					
Undergraduate GPA	*0.2721	0.1690	–0.1656	0.2711	0.2247
	(0.12)	(0.11)	(0.38)	(0.14)	(0.13)
Logic	**0.0178	**0.0164	0.0179	**0.0197	**0.0193
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Quantitative	**0.0140	**0.0133	*0.0192	**0.0131	**0.0135
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Reading	**0.0133	**0.0127	**0.0442	**0.0155	**0.0155
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Gender	0.0249	0.0064	0.1365	–0.0332	–0.0599
	(0.09)	(0.08)	(0.27)	(0.10)	(0.10)
Age	0.0101	0.0081	0.0324	0.0135	0.0132
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)
Civil Status	–0.0290	–0.0314	0.0954	–0.0166	–0.0229
	(0.06)	(0.06)	(0.19)	(0.07)	(0.07)
λ	–0.306	–0.440	0.117	–0.331	–0.351
σ	0.395	0.456	0.501	0.412	0.381
ρ	–0.775	–0.964	0.233	–0.803	–0.922
Independent equations test(ρ = 0)	15.31	68.85	0.64	23.70	58.53
(p–value)	(0.00)	(0.00)	(0.42)	(0.00)	(0.00)
Program type (df)	49.39 (4)	61.01 (4)			
(p–value)	(0.00)	(0.00)			
Batch Year (df)	23.88 (3)	7.22 (3)	5.01 (2)	11.53 (3)	1.09 (3)
(p–value)	(0.00)	(0.07)	(0.08)	(0.01)	(0.78)
School Classification (df)	19.28 (8)	13.96 (8)	14.03 (8)	11.11 (8)	9.51 (8)
(p–value)	(0.01)	(0.08)	(0.08)	(0.20)	(0.30)
Undergraduate Background (df)	10.12 (8)	14.68 (8)	310.66 (8)	17.07 (8)	15.63 (8)
(p–value)	(0.26)	(0.07)	(0.00)	(0.03)	(0.05)

Note: standard errors in parenthesis except for the Wald tests; df = degrees of freedom; * p < 0.05, ** p < 0.01

5 Conclusion

This study shows that graduate business program admission and graduate academic performance are linked, hence, a more effective admission policy will result in better student graduate academic performance. From this study's findings, the admission equation using sample selection estimates (vs. probit) shows more consistent results overall and across programs. All three GPAT scores were statistically significant, while none of the socio-demographic variables were statistically significant. Meanwhile, the performance equation using both sample selection estimates and OLS shows that successful graduate academic performance in the University of the Philippines' graduate business

programs can be consistently explained by the student's past undergraduate academic performance and the quantitative aptitude test score.

This study has implications for graduate business program directors and administrators who aim to improve the quality of graduate business programs and students. First, the admission decision can be enhanced by altering the relative weights of the three GPAT test scores; the relative weighing can also differ per graduate business program (i.e. bigger Quantitative weight for MSF given the program's quantitative demands). This may change the profile of successful applicants and at the same time improve the overall efficacy of the graduate admission procedure. Second, the admission procedure must have a means of knowing the skills of applicants with significant work experience and weighing this in along with GPAT scores and undergraduate GPA. Lastly, to expand predictability, other test variables such as critical thinking and analytical essays may be weighed in.

This study has several limitations. First, this study was restricted to UP-VSB data for the period 2009 to 2012, limiting the generalizability of the results. Second, given the data collected from each applicant during graduate school admission, only a few variables were considered for graduate academic performance, limiting the predictability. Third, the process of data collection may have restricted the variable's validity; there is a high possibility that work experience is underestimated given the exigent demand of an employment certificate for validation.

This study can then be extended to include data from later years. In addition, further data on each applicant for graduate school admission can be collected and these variables influence on graduate school performance can be explored. This is especially powerful given that the review of literature showed undergraduate GPA and GMAT (proxy of GPAT) explain on average only 20-25% of the variance of the student's graduate academic performance; GPAT analysis shows a gender and age bias, with female and older applicants scoring lower. Lastly, other measures can be used to measure work experience, such as years since undergraduate degree or age given its high correlation to work experience.

The reliance on GPAT and undergraduate GPA as the graduate admission criteria may seem too simplistic. Clearly, there are other aspects of the applicant's full range of abilities and experiences important for graduate academic performance success and beyond that are not captured by these two measures. However, despite its simplicity, these two measures have been validated. Until data on other variables have been collected, and its influence on graduate school performance explored, the trust placed on GPAT and undergraduate GPA as the major graduate admissions criteria holds.

References

Adams, A. J., & Hancock, T. (2000). Work experience as a predictor of MBA performance. *College Student Journal, 34*(2), 211-216.

Bieker, R. F. (1996). Factors affecting academic achievement in graduate management education. *Journal of Education for Business*, *72*(1), 42-46.

Braunstein, A. W. 2002. Factors determining success in a graduate business program. *College Student Journal, 36*(3), 471-477.

Carver, M. R., Jr., & King, T. E. (1994). An empirical investigation of the MBA admission criteria for nontraditional programs. *Journal of Education for Business*, *70*(2), 95-98.

Christensen, D. G., & Nance, W. R. (2012). Academic performance in MBA programs: Do prerequisites really matter? *Journal of Education for Business*, *87*, 42-47.

Cushing, M., & McGarvey, M. (2004). Sample selection in models of academic performance. *Economic Inquiry*, *42*(2), 319-322.

Deis, M. H., & Kheirandish, R. (2010). What is a better predictor of success in an MBA program: Work experience or the GMAT? *Academy of Educational Leadership Journal*, *14*(3), 91-98.

Dogan, R. (2011). *Antecedents to students' performance in MBA programs*. From the selected works of Riza Dogan, University of Texas at El Paso.

Greene, W. (2012). *Econometric analysis* (12th ed.). Prentice Hall.

Hancock, T. (1999). The gender difference: Validity of standardized admission tests in predicting MBA performance. *Journal of Education for Business*, *75*(2), 91-93.

Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica, 47*, 153-161.

Hedlund, J., Wilt, J. M., Nobel, K. L., Ashford, S. J., & Sternberg, R. J. (2006). Assessing practical intelligence in business school admissions: A supplement to the graduate management admissions test. *Learning and Individual Differences*, *16*, 101-127.

Hoefer, P., & Gould, J. (2000). Assessment of admission criteria for predicting students' academic performance in graduate business programs. *Journal of Education for Business*, *75*(4), 225-229.

Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings* (2nd ed.). Sage.

Kass, D., Grandzol, C., & Bommer W. 2012. The GMAT as a predictor of MBA performance: Less success than meets the eye. *Journal of Education for Business*, *87*, 290-295.

Koys, D. J. (2005). The validity of the Graduate Management Admissions Test for non-U.S. students. *Journal of Education for Business*, *80*(4), 236-239.

Kuncel, N. R., Credé, M., & Thomas, L. L. (2007). A meta-analysis of the predictive validity of the Graduate Management Admission Test (GMAT) and Undergraduate grade point average (UGPA) for graduate student academic performance. *Academy of Management Learning and Education*, *6*(1), 51-68.

Marks R., Watt P., & Yetton P. (1981). GMAT scores and performance: Selecting students into a graduate management school. *Australian Journal of Management*, *25*(2), 81-102.

McClure, R. H., Wells, C. E., & Bowerman, B. L. 1986. A model of MBA student performance. *Research in Higher Education*, *25*(2), 182-189.

Oh, I-S., Schmidt, F. L., Shaffer, J. A., & Le, H. (2008). The Graduate Management Admission Test (GMAT) is even more valid than we thought: A new development in meta-analysis and its implications for the validity of the GMAT. *Academy of Management Learning and Education, 7*(4), 563-570.

Paolillo, J. G. P. (1982). The predictive validity of selected admissions variables relative to grade point average earned in a Masters of Business Administration program. *Educational and Psychological Measurement*, *42*(4), 1163-1167.

Pattie, J. M. 2011. *Work experience as a predictor of academic performance in graduate business school* (Unpublished doctoral dissertation). University of Virginia, VA.

Peiperl, M. A, & Trevelyan, R. (1997). Predictors of performance at business school and beyond: Demographic factors and the contrast between individual and group outcomes. *Journal of Management Development*, *16*(5), 354-367.

Shavelson, R., Short, L., Muthen, B., Li, W., Muthen, L. 1998. Relationship between applicant characteristics, MBA program attributes and student performance. *Graduate Management Admission Council*.

Sicat, G., & Panganiban, M. (2009). *High school background and academic performance* (UPSE Discussion Paper 0906).

Sicat, G., & Briones, K. J. (2009). *Determinants of student performance in the introductory economics course in UP* (UPSE Discussion Paper 0906).

Sulaiman, A., & Mohezar, S. (2006). Student success factors: Identifying key predictors. *Journal of Education for Business*, *81*(6), 328-333.

Supangco, V. (2000). *Factors affecting performance in the MBA program* (UPVSB Discussion Paper 0006).

Truit, T. C. (2002). *Validity of selection criteria in predicting MBA success*. Christian Business Faculty Association Conference.

Wright, R. E., & Palmer, J. C. (1994). GMAT scores and undergraduate GPAs as predictors of performance in graduate business programs. *Journal of Education for Business*, *69*(6), 344-349.

Yang, B., & Diaopin, R. L. (2001). Predicting academic performance in management education: An empirical investigation of MBA success. *Journal of Education for Business*, *77*(1), 15-20.

Appendix 1

Factors Affecting Academic Performance in Graduate Management Education: Summary of A Few Previous Studies

Article	Year	GMAT	Under-graduate GPA	Other significant variables	R^2	Other variables explored but are not significant
Paolillo	1982	Sig	Sig (Limited to Junior and Senior GPA)	Full vs. part-time attendance in the MBA program	0.21	Number of credit hours required in the MBA program, undergraduate major, age, pursuance of the MBA at the same institution where the student received the undergraduate degree
McClure, Wells and Bowerman	1986	Sig	Sig	Age, undergraduate institution, interaction of undergraduate GPA with undergraduate institution and major, undergraduate major, work experience (measured as year since undergraduate degree)	0.51	
Carver and King	1994	Sig	Sig	Months of work experience	0.21	Age, gender, undergraduate major, duration of formal education, competitiveness of undergraduate institution
Wright and Palmer	1994	Sig	Sig		0.18	
Bieker	1996	Sig	Sig (Measured by CBK GPA[7])	Race, GMAT and race	0.53	Gender, Age, and 5 other interaction variables: GMAT and gender, GMAT and age, CBKGPA and race, CBKGPA and gender, CBK and age
Peiperl and Trevelyan	1997	Sig (broken down as GMATV and GMATQ)	Not included	English proficiency, age, marital status	0.27	Work experience, gender

[7] Student's GPA in eleven courses that are prerequisites common body of knowledge (CBK) courses for admission to MBA program- accounting, economics, applied calculus, statistical methods, computer info systems, management, marketing, environments of administration, and finance

Article	Year	GMAT	Under-graduate GPA	Other significant variables	R^2	Other variables explored but are not significant
Hoefer and Gould	2000	Sig (broken down as GMATV and GMATQ)	Sig		0.20	Gender, age, competitiveness of undergraduate institutions, TOEFL, year of graduation from undergraduate institution
Yang and Diaopin	2001	Sig (broken down as GMATV and GMATQ)	Sig	Language	0.26	Age, gender
Braunstein	2002	Sig	Sig	Work experience (measured as years since undergraduate degree)	0.24	Type of undergraduate degree, undergraduate institution, gender
Truit	2002	Sig	Not Sig	Marital status, (Note: work experience, measured by age, is sig for younger students when sample is split)	0.26	Undergraduate GPA, age, gender, undergraduate degree/major
Koys	2005	Sig	Sig		0.42	
Kass, Grandzol and Bommer	2012	Sig (broken down as GMATV, GMATQ and AWA)	Sig		0.32	

Note: Sig- Denotes that the variable is statistically significant

Appendix 2

Comparison of Mean GPAT by Gender and Program Type

	Female	Male	Total
Day	58	52	110
Logic	58.00	63.35	60.53
Quantitative	38.69	43.77	41.09
Reading	55.93	58.42	57.11
Total	50.81	55.17	52.87
Evening	189	166	355
Logic	59.02	62.25	60.53
Quantitative	39.10	45.67	42.17
Reading	59.43	60.45	59.91
Total	52.47	56.15	54.19
MS Finance	41	39	80
Logic	62.98	69.56	66.18
Quantitative	47.88	57.92	52.77
Reading	67.00	66.71	66.86
Total	59.32	64.81	62.00
Total	288	257	545
Logic	59.38	63.58	61.36
Quantitative	40.26	47.15	43.51
Reading	59.81	60.99	60.36
Total	53.11	57.27	55.07

Appendix 3

Comparison of Mean GPAT by Age

Age Range (in years)	GPAT Logic	GPAT Quantitative	GPAT Reading	GPAT Total
21-25	61	46	65	57
26-30	63	44	64	57
31-35	60	43	62	55
36- above	57	40	58	52
Total	61	44	63	56

Appendix 4

Breakdown of Admission Data

Program Type	Female			Male			Total		
	Reject	Admit	Total	Reject	Admit	Total	Reject	Admit	Total
Day	69	58	127	40	52	92	109	110	219
Undergraduate GPA	2.91	3.10	3.00	2.97	2.90	2.93	2.93	3.00	2.97
Evening	399	189	588	267	166	433	666	355	1,021
Undergraduate GPA	2.96	3.05	2.99	2.82	2.84	2.83	2.90	2.95	2.92
MS Finance	77	41	118	47	39	86	124	80	204
Undergraduate GPA	2.96	3.13	3.02	3.01	3.02	3.01	2.98	3.08	3.02
Total	545	288	833	354	257	611	899	545	1,444
	2.95	3.07	2.99	2.86	2.88	2.87	2.92	2.98	2.94

Appendix 5

List of Categorical Variables

	Undergraduate Institution
1	UP Diliman
2	UP Los Baños
3	UP Others
4	Ateneo de Manila University
5	De La Salle University
6	University of Santo Tomas
7	Public Universities
8	Private Universities in Manila and Foreign
9	Private Universities outside Manila

	Undergraduate Field
1	Accounting
2	Arts, Humanities, Communication
3	Business Administration, Management
4	Economics
5	Engineering
6	Mathematics, Statistics, Computer Science
7	Science
8	Social Science
9	Others: Tourism, Education, Lib Science, IT, NEC

	Program Type
1	Full-time MBA
2	Part-time MBA
3	MS Finance