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Article

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Does Student Performance in Introductory Economics and Business Courses Impact ETS Scores?

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Abstract

This study examines the impact of economics education on student performance on the Educational Testing Service Major Field Test in Business. We demonstrate that grades in introductory microeconomics and macroeconomics courses have a positive relationship with overall exam performance as well as sub-scores in most content areas of the test. Furthermore, we use a measure of “extranormal” ability in economics and demonstrate its positive relationship to test performance. “Extranormal” ability represents the portion of course grades that cannot be explained by prior academic achievement. Finally, we show that the relationship between “extranormal” ability and exam performance is much more limited for female students than for male students.

Keywords: Major Field Test in Business, MFT-B, standardized test performance, economics, gender

Does Student Performance in Introductory Economics and Business Courses Impact ETS Scores?

In this paper, we demonstrate the impact of performance in introductory microeconomics and macroeconomics courses on subsequent learning in business disciplines, as measured by the Educational Testing Service Major Field Test in Business (ETS). While previous studies have examined how the number of economics courses taken relates to ETS exam performance, we instead examine the impact of grades earned in these courses on overall test performance as well as scores in each content area. Furthermore, we examine whether Islam and Islam's (2013) "extranormal" ability measure in individual courses partially explains ETS performance. "Extranormal" ability is defined as the portion of the introductory course grade not explained by previously demonstrated academic ability. Results provide evidence of the importance of economics and the economist's mindset in comprehending various business content areas.

Most undergraduate business schools require students to develop an understanding of economic principles. Indeed, the Association to Advance Collegiate Schools of Business (AACSB International) Proposed 2020 Standards indicate in Accrediting Standard 4.1 (Curriculum Content) that economics constitutes one of the core disciplines that should be addressed in all bachelor's level business degree programs. Jesswein (1982) finds that over 95% of AACSB accredited business schools require at least two semesters of introductory economics. Similarly, Mang and Brown (2013) examine degree requirements from 61 Canadian university business degree programs and find that almost all require at least one full academic year of economics. Prenshaw and Taylor (2007) conduct a survey of 146 non-economics business faculty about the importance of economics to introductory business courses. In all functional areas of business, microeconomics was regarded as more important than macroeconomics, though faculty in the finance discipline regarded macroeconomics nearly as important.

Empirical evidence also suggests that economics knowledge contributes to student success in business courses. In a study of 164 students, Grimes and Niss (1991) find that economic understanding improved student performance in business disciplines, and that students with mathematical aptitude and good grades in economics are more likely to stay in the business program. Morgan, Tallman, and Williams (2003) find that lower division performance in microeconomics and macroeconomics is positively and significantly related to success in upper division business core courses. Pomykalski, Dion, and Brock (2008) find that macroeconomics (but not microeconomic) grades are significant predictors of overall GPA. Brown, McCormick, and Abraham (2002) discover a similar connection. Islam and Islam (2013) study "extranormal" ability in economics, defined as that portion of the economics grade not explained by prior demonstrated academic ability (as measured by GPA in general studies courses). They find that "extranormal" ability in both microeconomics and macroeconomics courses is positively and significantly related to performance in upper division finance, accounting, marketing, and management courses. Ritchie, Rodriguez, Harrison, and Wates (2014) found that completion of a macroeconomics course prerequisite impacted MFT-B scores, though prerequisites in many other disciplines did not. Fairchild and Hahn (2019) demonstrate that finance and accounting majors perform better than other majors on the ETS exam. They speculate that these students have more exposure during their coursework to key content on the exam, including economics concepts and theories.

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Many business schools have been measuring and assessing student learning through administration of the Educational Testing Service Major Field Test in Business. This test is a 120 question, multiple choice exam assessing student knowledge in nine functional areas: accounting, economics, management, quantitative business analysis, finance, marketing, legal and social environment, information systems and international issues. A stream of studies has examined the factors that affect student performance on the exam (Black and Duhon, 2003; Bycio and Allen, 2007; Settlage and Settlage, 2011; Chowdhury and Wheeling, 2013; Ritchie, Rodriguez, Harrison, and Wates, 2014; Ling, Bochenek, and Burkander, 2015; Bisalski, Helms, and Whitesell, 2017; Fairchild and Hahn, 2019).

In a meta-analysis of 30 studies published across two decades, Ling, Bochenek, and Burkander (2015) find that college GPA is significantly correlated with ETS exam performance. However, they do not examine academic performance by specific college subject or course. Several studies have examined whether the number of courses taken in specific subject areas impacts ETS exam performance. For instance, Settlage and Wollscheid (2015) find that the number of content area courses taken is positively related to some sub-scores. Students who take more finance courses do better on the finance subsection, but interestingly, the number of economics courses is unrelated to content area sub-scores.

Our research does not simply examine the *number and type of courses* taken by students. Instead, we explore the relationship between *grades* in introductory courses and ETS exam scores. Moreover, we extend the literature in several other important ways. We examine how “extranormal” ability in the various subject areas impact ETS scores. In doing so, we explore the relationship between a student’s foundational economic knowledge and success in business-related exams much later in their undergraduate careers. In addition, we further explore the gender test performance puzzle and provide additional evidence for differences between males in females in ETS test performance.

We hypothesize that strong performance in core economics courses may be correlated with ETS exam scores for reasons beyond the accumulation of important foundational knowledge regarding the laws of supply and demand, the functioning of markets, and similar concepts. Some evidence suggests that economics concentrators tend to exhibit very strong critical thinking skills and can apply these skills effectively across domains outside of economics. In one study, students in various majors at a top university took a critical and conceptual thinking test. Most students performed quite poorly on questions outside of their field of expertise. However, economics majors performed better than all other students on questions beyond their field (Flynn, 2012). Reviewing the findings, Epstein (2019, p.48) argues that, “[e]conomics is a broad field by nature, and econ professors have been shown to apply the reasoning principles they’ve learned to problems outside their area.”

Some scholars claim that the ETS exam measures general intellectual/cognitive ability more so than the learning taking place in particular business courses. They have pointed to the fact that SAT or ACT scores are highly correlated with ETS exam performance. For this reason, they have been critical of the use of the exam as an assessment tool for business curricula (Bielinska-Kwapisz, Brown, and Semenik, 2012; Green, Stone, and Zegeye, 2014). Therefore, if students who excel at economics tend to exhibit stronger critical thinking skills, then we would

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expect course grades in the introductory economic theory courses to be correlated with ETS exam performance. If economics training helps students apply reasoning principles across multiple domains, then we hypothesize that course grades as well as “extranormal” ability in economics courses will be correlated with ETS sub-scores in each field, as well as with the overall ETS exam score.

Data and Methodology

The data for this study comes from an AACSB-accredited university located in the northeastern United States. The school has an average yearly enrollment of nearly 3,500 undergraduates, and approximately 75% of the students major in business fields. All business degree candidates take the ETS Major Field Test in Business. We obtained data on 3,185 students who took the exam between 2011 and 2016. To our knowledge, this information on student ETS scores constitutes the largest and longest dataset currently used to explore the determinants of success on the exam.

At the university, every student must take both Principles of Macroeconomics and Principles of Microeconomics to fulfill core requirements¹. Most students take both classes in their first year. Business majors also must take the core foundational courses in various business disciplines. Table 1 provides descriptive statistics. Male students represent 60% of our sample. The average ETS score is 160.1, with males scoring significantly higher, according to a Student’s t-test, than their female counterparts (162.1 vs. 157.2). This gender gap between ETS scores is consistent with prior research, despite evidence that women tend to have a higher GPA than males at universities (e.g. Bielinska-Kwapisz and Brown, 2013).

¹ We only include students who have grades for both Micro and Macro classes. This excludes students who placed out of either class to ensure these students did not bias the results.

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Table 1: Descriptive Statistics

Variable	Full Sample		Male Sample		Female Sample		Gender Difference	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Coeff.	Significance
ETS Scores								
<i>Total</i>	160.165	10.890	162.092	11.140	157.225	9.797	4.8668	***
Subject Area								
Accounting	52.341	15.856	54.016	15.971	49.786	15.337	4.2297	***
CIS	59.327	14.980	59.937	15.285	58.396	14.459	1.5414	***
Economics	49.571	15.880	52.530	16.186	45.056	14.270	7.4738	***
Finance	54.333	17.334	57.709	17.560	49.182	15.642	8.5271	***
Management	64.448	12.180	64.804	11.978	63.906	12.468	0.8979	**
Marketing	67.186	13.468	67.705	13.324	66.393	13.653	1.3114	***
Legal [‡]	60.169	15.912	61.803	15.896	57.675	15.615	4.1282	***
International Issues [‡]	56.790	17.494	58.418	17.679	54.305	16.914	4.1131	***
Quantitative Business [‡]	46.927	15.115	48.235	15.219	44.930	14.740	3.3047	***
Test Version 1	0.380	0.485	0.381	0.485	0.379	0.485	0.0020	
Academic Quality								
College GPA	3.145	0.388	3.089	0.394	3.231	0.363	-0.142	***
SAT(V)	546.358	60.250	546.653	60.199	545.908	60.350	0.745	
SAT(M)	585.531	59.351	593.498	58.967	573.374	57.878	20.124	***
Academic Index	185.683	12.583	184.669	12.422	187.229	12.675	-2.560	***
Intro Course Grades								
Accounting	3.052	0.723	3.036	0.737	3.076	0.707	-0.040	
CIS	3.285	0.676	3.222	0.700	3.381	0.625	-0.160	***
Finance	2.935	0.789	2.919	0.787	2.959	0.791	-0.040	
Management	3.179	0.630	3.111	0.643	3.285	0.596	-0.174	***
Marketing	3.130	0.541	3.071	0.540	3.220	0.530	-0.149	***
Microeconomics	2.934	0.697	2.956	0.690	2.899	0.707	0.057	***
Macroeconomics	2.918	0.707	2.934	0.709	2.892	0.703	0.042	**
Major								
Accounting	0.247	0.432	0.248	0.432	0.247	0.431	0.001	
CIS	0.021	0.145	0.027	0.162	0.017	0.112	0.010	
Entrepreneurship	0.017	0.129	0.021	0.143	0.011	0.105	0.010	
Finance	0.238	0.426	0.315	0.465	0.120	0.325	0.196	*
Intl. Business	0.099	0.299	0.078	0.268	0.132	0.334	-0.054	
Management	0.146	0.353	0.137	0.344	0.159	0.366	-0.022	
Marketing	0.231	0.422	0.174	0.379	0.319	0.466	-0.145	

Significance is calculated using Student t-tests. Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

‡ We do not examine sub-scores in international business, quantitative analysis, and business law, as the university has no single introductory course dedicated to international business and no major in either quantitative analysis or business law.

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To examine the relationship between economics training and ETS exam performance, we estimate a series of regression models. The base model, Model 1, is presented below in Equation (1).

$$ETSSubScore_{ij} = \beta_{0j} + \beta_{1j}Female_i + \beta_{2j}Athlete_i + \beta_{3j}Honors_i + \sum_{k=4}^9 \beta_{kj} Major_{ik} + \beta_{10j}Test1_i + \beta_{11j}SAT\ Math_i + \beta_{12j}SAT\ Verbal_i + \sum_{m=13}^{19} \beta_{mj} Grades_{im} + \varepsilon_{ij} \quad (1)$$

Here, $ETSSubScore_{ij}$ represents the score that individual student, i earned on the ETS exam sub-field, j .² We also run this same model for the total ETS score. This study includes sub-score data for accounting, finance, marketing, management, computer information systems (CIS), and economics content areas. We do not examine sub-scores in international business, quantitative analysis, and business law, as the university has no single introductory course dedicated to international business and no major in either quantitative analysis or business law.

In the model, each of the first three explanatory variables are dummy variables given a value of 1 if the student is female, a division 1 athlete, or an honors student, respectively. $Grades_{ik}$, represents the grade that student, i earned in their introductory business or economics course, k . Note that there are seven introductory courses; Principles of Macroeconomics (*Macroeconomics*), Principles of Microeconomics (*Microeconomics*), Financial Management (*Finance*), Principles of Financial Accounting (*Accounting*), Foundations of Marketing Management (*Marketing*), Management Principles and Practice (*Management*) and Computer Information Systems (*CIS*). During the period of study, there were two versions of the exam since the Educational Testing Service revises the exam periodically. Although the level of difficulty is intended to be stable over time, we include a control for potential differences in test difficulty, $Test1_i$.³ $Major_{im}$, represents a series of indicator variables identifying the student's major area of study. The management major constitutes the default (when the indicator variables are all equal to zero). Finally, ε_{ij} represents the error term.

While grades are often used to proxy for general knowledge in a subject field, using prior grades to predict performance in later situations may not fully capture the true effect of a student's ability to perform. Factors such as effort, grit, persistence, and work ethic are ignored in simple grade calculations. Therefore, we adapt Model 1 and estimate Model 2 following the two-step modeling procedure of Islam and Islam (2013). In the first stage, we estimate an expected grade for each student, i in each introductory course, k ($Grade_{ik}$), based on their academic accomplishments in high school ($AcademicIndex_i$), gender ($Female_i$), and

² According the ETS, sub-scores represent large subdomains of the discipline and are based on enough test questions to be statistically reliable for both groups and individual students. See, <https://www.ets.org/mft/faq/>.

³ According to the ETS, total scores from different editions of the same test are made comparable through a statistical process called common item equating. See <https://www.ets.org/mft/faq/>.

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admittance to the Honors program ($Honors_i$). Stage 1 of Model 2 is presented below in Equation (2a).

$$Grade_{ik} = \gamma_{0k} + \gamma_{1k}AcademicIndex_i + \gamma_{2k}Female_i + \gamma_{3k}Honors_i + \sum_{m=4}^{10} \gamma_{mj} Year_{im} + \mu_{ik} \quad (2a)$$

In Equation (2), k continues to represent one of the seven foundational courses. $Year_{im}$, represents dummy variables to control for factors such as grade inflation over the time of the sample. Academic Index is an amalgam of High School GPA and SAT scores used in the admissions process.

Then, we use the predicted grades and residuals from Stage 1 as independent variables in the second stage that predicts ETS exam performance. The predicted grades are calculated using Equation (2b) below and the residuals are calculated using Equation (2c).

$$\widehat{Grade}_{ik} = \hat{\gamma}_{0k} + \hat{\gamma}_{1k}AcademicIndex_i + \hat{\gamma}_{2k}Female_i + \hat{\gamma}_{3k}Honors_i + \sum_{m=4}^{10} \hat{\gamma}_{mj} Year_{im} \quad (2b)$$

$$\hat{\mu}_{ik} = Grade_{ik} - (\hat{\gamma}_{0k} + \hat{\gamma}_{1k}AcademicIndex_i + \hat{\gamma}_{2k}Female_i + \hat{\gamma}_{3k}Honors_i + \sum_{m=4}^{10} \hat{\gamma}_{mj} Year_{im}) \quad (2c)$$

The predicted grade, \widehat{Grade}_{ik} , represents the student's expected intellectual ability in each course, while the residual, $\hat{\mu}_{ik}$, represents the grade earned above or below that expected based on academic ability. Islam and Islam (2013) call this "extranormal" ability, while Ketcham, Nigro, and Roberto (2018) refer to it as "persistence." If the student scores higher than predicted by the model in Equation (2b), we suggest, as Islam and Islam (2013) do, that the student has a positive academic ability which is likely related to effort, persistence, or some other unobservable characteristics. Therefore, the residuals of the first stage equations serve as the estimate of the student's "extranormal" ability in each core business or economics field.

For each of the seven core classes, Equation (2) is estimated separately, and the predicted values and residuals are used to estimate the second stage of Model 2, show below in Equation (3).

$$ETSSubScore_{ij} = \beta_0 + \beta_{1j}Female_i + \beta_{2j}Athlete_i + \beta_{3j}Honors_i + \sum_{m=4}^9 \beta_{mj} Major_{im} + \beta_{10j}Test1_i + \beta_{11j}SAT\ Math_i + \beta_{12j}SAT\ Verbal_i + \sum_{k=13}^{19} \beta_{kj} \hat{\mu}_{ik} + \beta_{20j}\widehat{Grades}_{ij} + \varepsilon_{ij} \quad (3)$$

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Note that while predicted grade is only included for the specific subject area, “extranormal” ability or “persistence” is included for all subject areas in each specification of Model 2. For the full ETS score specification of the model, we use the predicted and “extranormal” overall GPA, which is calculated using Equations (2a), (2b), and (2c) with GPS instead of grades. All other aspects of the second stage of Model 2 are identical to those of Model 1.

Due to the consistent results found in previous literature related to differences in male and female performance on ETS exams, we also estimate each model separately by gender. These serve as robustness checks as well as provide further insight into the gender test-taking and performance puzzle. All models are estimated using OLS.

Results

Results of Model 1 are presented in Table 2. Column (1) presents the results for full ETS score. Grades that students earn in their introductory classes are highly significant for all but grades in CIS classes. Both the Principles of Macroeconomics and Principles of Microeconomics grades significantly and positively impact the overall test scores, despite the fact that many students take these courses in their first year, while they complete the ETS exam in their fourth year.

Consistent with past studies, women continue to score significantly lower (-4.44 pts) on the overall test, even after controlling for numerous academic and demographic factors. This result is consistent with past studies which highlight the differences in performance across men’s and women’s cohorts on ETS exams (e.g. Bean and Bernardi, 2002; Black and Duhon, 2003; Bielinska-Kwapisz and Brown, 2013; Ketcham, Nigro, and Roberto, 2018).

Columns (2) through (7) present the results for the students’ scores in the accounting, computer information systems, finance, marketing, management, and economics sections of the ETS exam, respectively. Most results are similar across the different sub-fields of the test. Women continue to perform worse than men on all sections of the test, with the largest discrepancies in finance and economics. These findings are consistent with past studies which suggest that women perform worse on quantitative portions of these types of standardized tests (e.g. Hedges and Nowell, 1995; Xie and Shauman, 2003; Niederle and Vesterlund, 2010; College Board, 2016). Major fixed effects are now significant in systematic ways. For example, accounting majors do best in the accounting and finance sub-fields but worse comparatively in the management sub-field; management majors naturally perform well in this portion of the exam. Finally, grades in both Principles of Macroeconomics and Principles of Microeconomics introductory courses continue to significantly and positively impact the scores of students in every sub-field with the exception of microeconomics for information systems.

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Table 2: Examining the Effects of Introductory Grades on ETS Total and Sub-field Scores, Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total Score	Accounting	CIS	Finance	Marketing	Management	Economics
Female	-4.4448*** [0.3010]	-3.8045*** [0.4823]	-2.0376*** [0.5383]	-6.6565*** [0.5613]	-1.8853*** [0.4600]	-1.5905*** [0.4254]	-5.9090*** [0.5254]
Athlete	-1.9917*** [0.3708]	-2.5219*** [0.5941]	-1.3139** [0.6631]	-0.5412 [0.6914]	-2.3410*** [0.5667]	-1.7073*** [0.5241]	-1.4009** [0.6472]
Honor	0.8924 [0.5859]	1.3404 [0.9389]	-0.4639 [1.0479]	-1.4639 [1.0926]	0.4527 [0.8956]	-1.2942 [0.8283]	-0.2486 [1.0228]
ETS Version/Test Scores							
Test1	-0.5860** [0.2903]	-0.1704 [0.4651]	-3.2799*** [0.5191]	-5.4941*** [0.5413]	3.7724*** [0.4436]	0.5244 [0.4103]	0.5342 [0.5067]
Sat Math	0.0199*** [0.0026]	0.0296*** [0.0042]	-0.0022 [0.0047]	0.0344*** [0.0049]	0.0130*** [0.0040]	0.0085** [0.0037]	0.0169*** [0.0046]
Sat Verbal	0.0587*** [0.0025]	0.0391*** [0.0041]	0.0478*** [0.0046]	0.0350*** [0.0048]	0.0641*** [0.0039]	0.0566*** [0.0036]	0.0457*** [0.0045]
Intro Course Grades							
Accounting	1.3158*** [0.2390]	1.3823*** [0.3830]	0.9108** [0.4275]	1.5160*** [0.4457]	1.1369*** [0.3653]	0.2794 [0.3379]	1.2430*** [0.4173]
CIS	0.3737 [0.2421]	0.2426 [0.3880]	1.3721*** [0.4330]	0.3301 [0.4515]	0.5733 [0.3701]	0.2241 [0.3422]	-0.3545 [0.4226]
Finance	1.0262*** [0.2191]	0.8228** [0.3512]	-0.6934* [0.3919]	1.5710*** [0.4087]	0.7378** [0.3349]	0.6772** [0.3098]	1.0119*** [0.3825]
Management	1.3814*** [0.2650]	1.7510*** [0.4247]	2.3890*** [0.4740]	1.7198*** [0.4942]	0.7291* [0.4051]	1.7637*** [0.3746]	1.0666** [0.4626]
Marketing	1.5414*** [0.3173]	2.2792*** [0.5084]	2.0770*** [0.5674]	1.5803*** [0.5917]	1.6581*** [0.4849]	1.2674*** [0.4485]	0.7039 [0.5539]
Microeconomics	1.4106*** [0.2481]	1.4680*** [0.3976]	0.2493 [0.4437]	2.2187*** [0.4626]	1.0859*** [0.3792]	1.0030*** [0.3507]	2.4296*** [0.4331]
Macroeconomics	1.7467*** [0.2457]	1.6422*** [0.3938]	0.9353** [0.4395]	1.3945*** [0.4582]	0.8042** [0.3756]	1.0606*** [0.3473]	3.1740*** [0.4289]
Major							
Accounting	3.3805*** [0.4722]	14.5102*** [0.7567]	3.6225*** [0.8445]	3.9471*** [0.8805]	-0.9292 [0.7217]	-4.9647*** [0.6675]	1.3546 [0.8243]
CIS	1.4849 [1.0092]	0.8157 [1.6172]	8.3780*** [1.8049]	1.5696 [1.8820]	-1.0409 [1.5425]	-4.3452*** [1.4266]	2.4711 [1.7617]
Entrepreneurship	1.4819 [1.1156]	3.3351* [1.7877]	-0.9914 [1.9951]	-3.7890* [2.0803]	2.2072 [1.7051]	-3.1979** [1.5769]	2.5108 [1.9474]
Finance	2.1517*** [0.4668]	2.2118*** [0.7480]	-0.9287 [0.8348]	10.4475*** [0.8704]	0.1359 [0.7134]	-6.0299*** [0.6598]	6.3358*** [0.8148]
Intl. Business	1.6877*** [0.5740]	-1.1487 [0.9198]	-2.4122** [1.0265]	6.8999*** [1.0704]	3.8628*** [0.8773]	-3.4042*** [0.8114]	5.3392*** [1.0020]
Marketing	-0.7794* [0.4619]	0.6032 [0.7401]	-2.3712*** [0.8260]	0.1624 [0.8613]	1.5473** [0.7059]	-4.4699*** [0.6529]	-1.6281** [0.8063]
Constant	90.6158*** [1.8842]	-17.9300*** [3.0193]	13.9404*** [3.3696]	-15.4716*** [3.5135]	3.0899 [2.8798]	14.3875*** [2.6633]	-12.5618*** [3.2890]
Observations	3185	3185	3185	3185	3185	3185	3185
Adjusted R ²	0.498	0.392	0.152	0.311	0.233	0.198	0.281

Standard errors in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Given the significance of gender in the models and as a robustness check, we estimate Model 1 separately for males and females. Panel A of Table 3 presents ETS results for males, while Panel B examines female scores. Column 1 which reports results for the total score shows some apparent differences by gender. The ETS benefits of major choice vary by gender. For males, statistically significant positive relationships exist between choice of major and ETS

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exam performance (positive for most majors, though negative for marketing). Other than accounting, major choice has no statistically significant impact on female scores. The impact of math and verbal SAT scores, however, are greater for females. It should be noted that these variables can also proxy for test taking ability. Finally, in terms of introductory grades, the impact on male scores are greater for every course except for computer information systems, which is insignificant for both genders.

Columns 2-7 of Table 3 present the gender-specific ETS sub-score results. Students of both genders score higher in their chosen discipline. Male students' microeconomics and macroeconomics grades positively impact all subject areas except for management. The impact for females of microeconomic and macroeconomics grades, however, is minimal on the business discipline sub-scores. In fact, besides the economics score, microeconomics grades only positively impact marketing sub-scores for female students, while macroeconomics grades only positively impact accounting sub-scores.

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Table 3: Examining the Effects of Introductory Grades on ETS Total and Sub-field Scores, by Gender

Table 3: Panel A. Males

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total Score	Accounting	CIS	Finance	Marketing	Management	Economics
Athlete	-2.4142*** [0.4928]	-2.7077*** [0.7674]	-2.1375** [0.8615]	-1.0904 [0.8943]	-2.6571*** [0.7273]	-2.0672*** [0.6651]	-1.2099 [0.8463]
Honor	0.7582 [0.8194]	1.8222 [1.2761]	-1.5745 [1.4326]	-1.0983 [1.4870]	0.8905 [1.2094]	-2.0205* [1.1060]	-0.4241 [1.4073]
ETS Version/Test Scores							
Test1	-0.9252** [0.3926]	0.2950 [0.6114]	-4.1388*** [0.6864]	-6.0483*** [0.7125]	3.5438*** [0.5794]	-0.7508 [0.5299]	1.1562* [0.6742]
SAT Math	0.0180*** [0.0035]	0.0307*** [0.0054]	-0.0055 [0.0061]	0.0380*** [0.0063]	0.0078 [0.0051]	0.0034 [0.0047]	0.0179*** [0.0060]
SAT Verbal	0.0584*** [0.0034]	0.0373*** [0.0052]	0.0481*** [0.0059]	0.0308*** [0.0061]	0.0582*** [0.0050]	0.0574*** [0.0045]	0.0486*** [0.0058]
Intro Course Grades							
Accounting	1.7290*** [0.3174]	1.6844*** [0.4943]	0.8107 [0.5549]	1.6775*** [0.5759]	1.3553*** [0.4684]	0.6314 [0.4284]	1.5484*** [0.5450]
CIS	0.0973 [0.3144]	0.0917 [0.4896]	1.0749* [0.5496]	-0.0045 [0.5705]	0.6829 [0.4640]	0.2259 [0.4243]	-0.7841 [0.5399]
Finance	1.1899*** [0.2989]	1.2582*** [0.4655]	-0.6463 [0.5225]	1.5844*** [0.5424]	0.4826 [0.4411]	0.7518* [0.4034]	1.2372** [0.5133]
Management	1.1825*** [0.3497]	0.9514* [0.5446]	2.3787*** [0.6114]	1.7599*** [0.6346]	0.8632* [0.5161]	1.5639*** [0.4720]	0.8238 [0.6005]
Marketing	1.9462*** [0.4200]	2.5852*** [0.6541]	2.4779*** [0.7343]	2.5178*** [0.7622]	1.2952** [0.6199]	1.3988** [0.5669]	1.4901** [0.7213]
Microeconomics	1.7648*** [0.3336]	2.1267*** [0.5196]	1.1666** [0.5833]	2.9971*** [0.6054]	1.1069** [0.4924]	0.4931 [0.4503]	2.7579*** [0.5730]
Macroeconomics	2.0269*** [0.3307]	1.8447*** [0.5151]	0.9648* [0.5782]	1.7842*** [0.6002]	1.0330** [0.4881]	1.0834** [0.4464]	3.7681*** [0.5680]
Major							
Accounting	3.2673*** [0.6458]	13.8062*** [1.0057]	3.8797*** [1.1290]	2.5006** [1.1719]	-0.2848 [0.9531]	-4.5894*** [0.8716]	0.7694 [1.1091]
CIS	2.5672** [1.2282]	1.0503 [1.9127]	8.7180*** [2.1472]	2.5385 [2.2288]	0.1470 [1.8126]	-3.1430* [1.6577]	2.8469 [2.1092]
Entrepreneurship	1.4926 [1.3677]	2.7861 [2.1300]	0.9129 [2.3912]	-4.9048** [2.4820]	2.2680 [2.0186]	-4.2390** [1.8461]	2.2994 [2.3489]
Finance	2.5864*** [0.6041]	2.0411** [0.9409]	-0.2147 [1.0562]	10.4444*** [1.0964]	0.7839 [0.8916]	-5.5650*** [0.8154]	6.1575*** [1.0375]
Intl. Business	2.1509** [0.8387]	-0.7228 [1.3061]	-1.8301 [1.4663]	7.0120*** [1.5220]	4.8678*** [1.2378]	-3.0479*** [1.1320]	4.8599*** [1.4403]
Marketing	-1.2876* [0.6678]	0.1466 [1.0400]	-1.4303 [1.1675]	-1.3257 [1.2118]	1.1588 [0.9856]	-4.6091*** [0.9013]	-2.8686** [1.1468]
Constant	88.6772*** [2.5239]	-20.1806*** [3.9306]	12.8556*** [4.4125]	-20.2924*** [4.5802]	8.8123** [3.7249]	17.6639*** [3.4066]	-19.1250*** [4.3344]
Observations	1924	1924	1924	1924	1924	1924	1924
Adjusted R ²	0.481	0.387	0.157	0.312	0.209	0.182	0.275

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Table 3: Panel B. Females

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total Score	Accounting	CIS	Finance	Marketing	Management	Economics
Athlete	-1.2801** [0.5495]	-2.1618** [0.9385]	-0.0040 [1.0399]	0.4212 [1.0822]	-1.9816** [0.9086]	-1.2001 [0.8510]	-1.5313 [0.9990]
Honors	1.2833 [0.8147]	0.9439 [1.3915]	1.2873 [1.5419]	-1.6479 [1.6046]	-0.3587 [1.3471]	-0.5761 [1.2619]	0.3775 [1.4812]
ETS Version/Test Scores							
Test1	-0.2504 [0.4213]	-1.0876 [0.7196]	-2.0883*** [0.7973]	-4.7823*** [0.8298]	4.0673*** [0.6966]	2.3556*** [0.6525]	-0.5433 [0.7660]
SAT Math	0.0236*** [0.0040]	0.0296*** [0.0069]	0.0044 [0.0076]	0.0296*** [0.0079]	0.0206*** [0.0067]	0.0156** [0.0062]	0.0171** [0.0073]
SAT Verbal	0.0593*** [0.0039]	0.0416*** [0.0066]	0.0456*** [0.0073]	0.0432*** [0.0076]	0.0739*** [0.0064]	0.0565*** [0.0060]	0.0409*** [0.0070]
Intro Course Grades							
Accounting	0.5756 [0.3549]	0.7599 [0.6061]	1.1549* [0.6716]	1.0769 [0.6989]	0.7461 [0.5868]	-0.2289 [0.5496]	0.6049 [0.6452]
CIS	0.7668** [0.3748]	0.4771 [0.6401]	1.8641*** [0.7093]	0.8707 [0.7381]	0.3308 [0.6197]	0.2528 [0.5805]	0.2093 [0.6814]
Finance	0.7088** [0.3122]	0.1281 [0.5333]	-0.7549 [0.5909]	1.4902** [0.6149]	0.9919* [0.5163]	0.5284 [0.4836]	0.5995 [0.5676]
Management	1.5915*** [0.4008]	3.1668*** [0.6846]	2.3360*** [0.7585]	1.3195* [0.7894]	0.4193 [0.6627]	1.8450*** [0.6208]	1.4993** [0.7287]
Marketing	1.0094** [0.4746]	1.9634** [0.8106]	1.5076* [0.8981]	0.2958 [0.9347]	2.0914*** [0.7847]	0.9640 [0.7350]	-0.3122 [0.8628]
Microeconomics	0.8355** [0.3638]	0.4112 [0.6213]	-1.1564* [0.6884]	1.1704 [0.7164]	1.0321* [0.6015]	1.7130*** [0.5634]	1.8927*** [0.6614]
Macroeconomics	1.3614*** [0.3570]	1.3360** [0.6097]	0.7729 [0.6756]	0.8496 [0.7030]	0.5559 [0.5902]	1.1144** [0.5529]	2.3293*** [0.6490]
Major							
Accounting	3.6350*** [0.6721]	15.2645*** [1.1480]	3.3510*** [1.2720]	6.1540*** [1.3237]	-1.4968 [1.1113]	-5.1255*** [1.0410]	1.9030 [1.2220]
CIS	-1.9034 [1.8565]	-0.9776 [3.1707]	8.1374** [3.5133]	-2.6969 [3.6562]	-3.7730 [3.0696]	-7.0209** [2.8753]	0.0200 [3.3751]
Entrepreneurship	1.6778 [1.9729]	4.5100 [3.3696]	-5.9344 [3.7336]	-1.2728 [3.8855]	2.6760 [3.2621]	0.3777 [3.0556]	2.4384 [3.5868]
Finance	0.4944 [0.7729]	1.5311 [1.3201]	-2.3964 [1.4627]	8.4645*** [1.5222]	-0.7905 [1.2780]	-6.5298*** [1.1971]	5.1010*** [1.4052]
Intl. Business	1.2674* [0.7601]	-1.7471 [1.2983]	-3.1467** [1.4385]	7.2278*** [1.4970]	3.0039** [1.2568]	-3.4608*** [1.1773]	5.6401*** [1.3820]
Marketing	-0.4998 [0.6189]	0.8305 [1.0570]	-3.4532*** [1.1712]	1.4901 [1.2188]	1.8212* [1.0232]	-4.1046*** [0.9585]	-0.7935 [1.1251]
Constant	89.2648*** [2.7437]	-19.3318*** [4.6860]	13.5735*** [5.1923]	-15.1891*** [5.4035]	-6.4949 [4.5365]	8.2965* [4.2493]	-8.7508* [4.9881]
Observations	1261	1261	1261	1261	1261	1261	1261
Adjusted R ²	0.478	0.378	0.141	0.205	0.265	0.227	0.186

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Islam and Islam (2013) show that “extranormal” ability in economics courses is related to performance in upper division business courses. We examine whether or not this “extranormal” ability in all subject areas also relates to performance on the ETS exam and sub-scores in each content area of the test. Table 4 presents the results of the first stage of the regression from which we can calculate “extranormal” ability using the residuals. Predicted values and residuals from this stage are then used as explanatory variables in the second stage.

Table 5 presents the results of the second stage of Model 2. Results are similar to those of Model 1. Positive and significant coefficients on all predicted grades continue to suggest that success in introductory courses lead to higher scores on each sub-field of the ETS exam, and higher predicted overall GPAs lead to higher total ETS scores.

The ability measures in all fields continue to positively and significantly impact the overall tests scores, except for the information systems measure. Moreover, Principles of Macroeconomics and Principles of Microeconomics grades hold the largest coefficients for all “extranormal” ability measures in the total ETS score regression. Once again, both Principles of Macroeconomics and Principles of Microeconomics “extranormal” ability measures positively and significantly impact the student scores in every sub-field but one (the exception is the relationship between microeconomics “extranormal” ability and sub-score in computer information systems).

Table 4: Examining the Effects of “Extranormal” Ability on ETS Total and Sub-field Scores, Stage 1, Full Sample

	(1) GPA	(2) Accounting grade	(3) CIS grade	(4) Finance grade	(5) Marketing grade	(6) Management grade	(7) Microeconomics grade	(8) Macroeconomics grade
Female	0.1021*** [0.0118]	-0.0123 [0.0247]	0.1183*** [0.0233]	-0.0135 [0.0269]	0.1099*** [0.0182]	0.1362*** [0.0216]	-0.1151*** [0.0231]	-0.0966*** [0.0238]
Honors	0.1139*** [0.0251]	-0.0020 [0.0525]	0.0838* [0.0497]	0.1585*** [0.0572]	0.1270*** [0.0388]	0.1727*** [0.0461]	0.1233** [0.0492]	0.1543*** [0.0508]
Academic Index	0.0151*** [0.0005]	0.0204*** [0.0011]	0.0153*** [0.0010]	0.0200*** [0.0011]	0.0143*** [0.0008]	0.0133*** [0.0009]	0.0213*** [0.0010]	0.0194*** [0.0010]
Cohort 2012	0.0127 [0.0180]	0.0984*** [0.0376]	-0.0823** [0.0356]	0.1555*** [0.0410]	-0.0324 [0.0278]	-0.1576*** [0.0330]	-0.0487 [0.0353]	-0.1681*** [0.0364]
Cohort 2013	0.0166 [0.0196]	-0.0448 [0.0410]	-0.0665* [0.0388]	0.1508*** [0.0447]	-0.0546* [0.0302]	-0.0636* [0.0359]	-0.0734* [0.0384]	-0.1622*** [0.0396]
Cohort 2014	0.0454** [0.0189]	-0.0421 [0.0395]	0.0513 [0.0374]	0.1154*** [0.0431]	-0.0569* [0.0292]	-0.0511 [0.0347]	-0.2291*** [0.0370]	-0.1008*** [0.0382]
Cohort 2015	0.0822*** [0.0186]	-0.0006 [0.0390]	0.0026 [0.0369]	0.0922** [0.0424]	0.0705** [0.0287]	-0.0745** [0.0342]	0.0308 [0.0365]	0.0595 [0.0377]
Cohort 2016	0.0852*** [0.0201]	-0.0619 [0.0420]	-0.0590 [0.0397]	0.0121 [0.0457]	0.0084 [0.0309]	0.0757** [0.0368]	-0.0448 [0.0393]	-0.0794* [0.0405]
Constant	0.2710*** [0.0934]	-0.7214*** [0.1953]	0.4120** [0.1849]	-0.8555*** [0.2128]	0.4340*** [0.1441]	0.6798*** [0.1713]	-0.9337*** [0.1830]	-0.5989*** [0.1888]
Observations	3185	3185	3185	3185	3185	3185	3185	3185
Adjusted R^2	0.304	0.129	0.101	0.124	0.147	0.112	0.172	0.141

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Table 5: Examining the Effects of “Extrnormal” Ability on ETS total and ETS Sub-Field Scores, Stage 2, Full Sample

	(1) Total Score	(2) Accounting	(3) CIS	(4) Finance	(5) Marketing	(6) Management	(7) Economics
Female	-5.5293*** [0.3436]	-3.8239*** [0.4810]	-2.9061*** [0.6350]	-6.0720*** [0.5636]	-2.7950*** [0.5425]	-2.6204*** [0.5180]	-5.3449*** [0.5141]
Athlete	-1.4493*** [0.3880]	-0.9199 [0.6208]	0.4795 [0.7467]	-0.5463 [0.6988]	-1.5918*** [0.5908]	-0.5484 [0.5737]	-1.1787* [0.7073]
Honors	-0.0810 [0.6354]	1.0671 [0.9447]	-1.5974 [1.1019]	-1.4183 [1.2067]	-0.6823 [0.9741]	-2.7209*** [0.9221]	-0.8995 [1.0936]
ETS Version/Test Scores							
Test1	-0.6234** [0.2884]	-0.8199* [0.4737]	-2.8385*** [0.5217]	-5.5661*** [0.5615]	4.0547*** [0.4448]	1.0411** [0.4163]	0.3268 [0.6821]
SAT Math	0.0213*** [0.0030]	0.0223*** [0.0048]	-0.0063 [0.0053]	0.0443*** [0.0056]	0.0124*** [0.0046]	0.0081* [0.0041]	0.0176*** [0.0052]
SAT Verbal	0.0552*** [0.0028]	0.0327*** [0.0046]	0.0438*** [0.0051]	0.0442*** [0.0053]	0.0634*** [0.0044]	0.0561*** [0.0040]	0.0465*** [0.0049]
Extrnormal Ability							
GPA Extrnormal	8.7468*** [0.8207]						
Accounting Extrnormal	0.6037** [0.2438]	1.2958*** [0.3825]	0.8404** [0.4281]	1.4409*** [0.4496]	1.1033*** [0.3663]	0.2252 [0.3392]	1.2941*** [0.4175]
CIS Extrnormal	-0.5012** [0.2522]	0.1683 [0.3880]	1.2732*** [0.4345]	0.3687 [0.4560]	0.5717 [0.3714]	0.1856 [0.3439]	-0.2856 [0.4237]
Finance Extrnormal	-0.0015 [0.2344]	0.7864** [0.3504]	-0.7068* [0.3922]	1.4614*** [0.4118]	0.7544** [0.3357]	0.7150** [0.3112]	1.1185*** [0.3827]
Marketing Extrnormal	0.6345** [0.2545]	1.3502*** [0.3981]	0.1969 [0.4457]	2.1585*** [0.4683]	0.9987*** [0.3812]	0.8803** [0.3529]	2.3475*** [0.4349]
Management Extrnormal	0.9743*** [0.2520]	1.6004*** [0.3932]	0.8418* [0.4401]	1.3916*** [0.4622]	0.7489** [0.3766]	0.9829*** [0.3486]	3.1637*** [0.4300]
Microeconomics Extrnormal	0.2932 [0.2810]	1.6994*** [0.4244]	2.3691*** [0.4748]	1.7750*** [0.4986]	0.7447* [0.4063]	1.6542*** [0.3767]	1.0604** [0.4642]
Macroeconomics Extrnormal	0.4227 [0.3285]	2.1359*** [0.5085]	2.0405*** [0.5689]	1.5626*** [0.5976]	1.6012*** [0.4869]	1.2290*** [0.4507]	0.6666 [0.5555]
Predicted Values							
GPA Predicted values	11.7433*** [1.1104]						
Accounting Predicted values		12.4132*** [1.2928]					
CIS Predicted values			10.7989*** [1.9285]				
Finance Predicted values				4.2981*** [1.5226]			
Marketing Predicted values					9.2346*** [1.7567]		
Management Predicted values						8.8674*** [1.5921]	
Microeconomics Pred. values							9.8310** [4.4345]
Macroeconomics Pred. values							-1.6982 [4.8873]
Majors							
Accounting	3.8986*** [0.4684]	14.4630*** [0.7538]	3.6474*** [0.8431]	4.2952*** [0.8866]	-0.9264 [0.7226]	-4.8855*** [0.6682]	1.2904 [0.8227]
CIS	1.4824 [0.9937]	0.7058 [1.6125]	8.2902*** [1.8045]	1.5782 [1.8952]	-1.1009 [1.5441]	-4.2822*** [1.4294]	2.4914 [1.7587]
Entrepreneurship	0.9792 [1.0980]	3.5199** [1.7822]	-0.8340 [1.9946]	-4.1297** [2.0937]	2.2057 [1.7062]	-3.0643* [1.5804]	2.6988 [1.9446]
Finance	2.3946*** [0.4602]	2.1807*** [0.7456]	-0.8738 [0.8339]	10.6133*** [0.8761]	0.1293 [0.7141]	-5.9881*** [0.6609]	6.2548*** [0.8139]
Intl Business	1.5944*** [0.5657]	-1.1065 [0.9166]	-2.3164** [1.0255]	7.0259*** [1.0781]	3.8368*** [0.8782]	-3.3398*** [0.8126]	5.3266*** [1.0000]
Marketing	-0.8588* [0.4546]	0.5991 [0.7378]	-2.3566*** [0.8256]	0.1555 [0.8670]	1.5078** [0.7065]	-4.4979*** [0.6540]	-1.6809** [0.8047]
Constant	81.6922***	-18.8039***	5.7812	-7.9671**	-4.3123	5.9098	-9.8349***

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	[2.4983]	[3.0957]	[4.6406]	[3.5829]	[3.9694]	[3.8478]	[3.6291]
Observations	3185	3185	3185	3185	3185	3185	3185
Adjusted R^2	0.514	0.396	0.153	0.302	0.232	0.196	0.284

Standard errors in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, Model 2 is estimated for men and women separately. Table 6 displays the results of the first stage of the model. Panel A presents the results for males and Panel B for females. Table 7 presents the second stage for the male and female specifications of Model 2. Once again Panel A displays the results for men, and Panel B provides the results for women. Similar to Model 1, results suggest significant differences across the determinants of male and female ETS score success. Column (1) presents the results for the full ETS score specification.

Turning to the variables of interest, women benefit more on the overall ETS exam from higher estimated GPA (13.07) than men (10.20). The “extranormal” ability measure from the first stage GPA equation is also positive and significant for both genders suggesting that grit, persistence, study habits, and other factors likely impact the scores as well. Similar to the results of Model 1, for the gender specific full ETS score specifications, no “extranormal” ability measure in any introductory course subject field has a significant impact for women on their overall ETS score. For male students, “extranormal” ability in accounting, marketing, microeconomics and macroeconomics each positively and significantly impact their total ETS scores.

The remaining columns in each Panel of Table 7 present the results for each ETS sub-score. Here we find a very interesting result with regard to how “extranormal” ability in economics relates to ETS exam performance in a much more pronounced way for male students than for females. Male students’ macroeconomics “extranormal” ability positively impacts all subject areas except for computer information systems. Microeconomic “extranormal” ability positively and significantly impacts all but computer information systems and management. For female students, microeconomics “extranormal” ability only impacts marketing, management, and economics sub-scores in a positive way. Macroeconomics “extranormal” ability only impacts accounting, management, and economics sub-scores.

While the results and returns to academic performance and personal characteristics vary across men and women in the sample, we consistently find evidence of a positive and significant relationship between success, expected, and “extranormal” ability in introductory economics courses and performance on overall and field-specific ETS exams.

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Table 6. Examining the Effects of “Extranormal” Ability on ETS Total and Sub-field Scores, Stage 1, by Gender

Table 6: Panel A. Male Sample

	(1) GPA	(2) Accounting grade	(3) CIS grade	(4) Finance grade	(5) Marketing grade	(6) Management grade	(7) Microeconomics grade	(8) Macroeconomics grade
Honor	0.1413*** [0.0351]	0.0153 [0.0720]	0.0974 [0.0698]	0.1285* [0.0773]	0.1634*** [0.0532]	0.2214*** [0.0641]	0.0762 [0.0657]	0.1472** [0.0685]
Athlete	-0.0900*** [0.0204]	-0.1075** [0.0418]	-0.1476*** [0.0405]	-0.0236 [0.0449]	-0.0844*** [0.0309]	-0.1372*** [0.0372]	-0.0239 [0.0381]	-0.0943** [0.0398]
Academic Index	0.0151*** [0.0007]	0.0209*** [0.0014]	0.0155*** [0.0013]	0.0212*** [0.0015]	0.0131*** [0.0010]	0.0123*** [0.0012]	0.0219*** [0.0013]	0.0199*** [0.0013]
Cohort 2012	-0.0168 [0.0239]	0.0957* [0.0490]	-0.1307*** [0.0475]	0.1197** [0.0527]	-0.0480 [0.0362]	-0.1982*** [0.0437]	-0.0998** [0.0447]	-0.2416*** [0.0467]
Cohort 2013	-0.0047 [0.0261]	-0.0540 [0.0536]	-0.0838 [0.0519]	0.0929 [0.0575]	-0.0837** [0.0396]	-0.1120** [0.0477]	-0.0821* [0.0489]	-0.1838*** [0.0510]
Cohort 2014	0.0237 [0.0252]	-0.0272 [0.0515]	0.0694 [0.0500]	0.0732 [0.0554]	-0.0872** [0.0381]	-0.0623 [0.0459]	-0.2689*** [0.0470]	-0.1108** [0.0490]
Cohort 2015	0.0875*** [0.0249]	0.0470 [0.0509]	-0.0401 [0.0494]	0.1194*** [0.0547]	0.0540 [0.0376]	-0.0200 [0.0453]	0.0491 [0.0465]	0.0486 [0.0485]
Cohort2016	0.0811*** [0.0263]	-0.0524 [0.0539]	-0.1139** [0.0522]	0.0443 [0.0579]	-0.0022 [0.0398]	0.1116** [0.0480]	-0.0672 [0.0492]	-0.1089** [0.0513]
Constant	0.2948** [0.1259]	-0.8085*** [0.2579]	0.4122* [0.2499]	-1.0493*** [0.2770]	0.6795*** [0.1905]	0.8881*** [0.2297]	-1.0394*** [0.2353]	-0.6518*** [0.2454]
Observations	1924	1924	1924	1924	1924	1924	1924	1924
Adjusted R ²	0.276	0.134	0.098	0.123	0.118	0.097	0.177	0.151

Standard errors in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Panel B. Female Sample

	(1) GPA	(2) Accounting grade	(3) CIS grade	(4) Finance grade	(5) Marketing grade	(6) Management grade	(7) Microeconomic s grade	(8) Macroeconomics grade
Honors	0.0846** [0.0349]	-0.0168 [0.0765]	0.0562 [0.0689]	0.2134** [0.0857]	0.0779 [0.0564]	0.1218* [0.0647]	0.1835** [0.0750]	0.1646** [0.0760]
Athlete	-0.0926*** [0.0230]	-0.1513*** [0.0505]	-0.1879*** [0.0454]	-0.0086 [0.0565]	-0.0856** [0.0372]	-0.1448*** [0.0427]	-0.0661 [0.0495]	-0.0832* [0.0501]
Academic Index	0.0145*** [0.0007]	0.0190*** [0.0016]	0.0138*** [0.0015]	0.0182*** [0.0018]	0.0155*** [0.0012]	0.0141*** [0.0014]	0.0201*** [0.0016]	0.0180*** [0.0016]
Cohort 2012	0.0549** [0.0267]	0.0990* [0.0584]	-0.0132 [0.0526]	0.2108*** [0.0654]	-0.0136 [0.0431]	-0.1019** [0.0494]	0.0279 [0.0572]	-0.0575 [0.0580]
Cohort 2013	0.0443 [0.0289]	-0.0338 [0.0634]	-0.0454 [0.0571]	0.2397*** [0.0710]	-0.0186 [0.0467]	-0.0007 [0.0536]	-0.0601 [0.0621]	-0.1331** [0.0629]
Cohort 2014	0.0651** [0.0289]	-0.0823 [0.0634]	-0.0005 [0.0571]	0.1789*** [0.0710]	-0.0235 [0.0467]	-0.0551 [0.0536]	-0.1714*** [0.0621]	-0.0986 [0.0629]

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	[0.0280]	[0.0615]	[0.0553]	[0.0688]	[0.0453]	[0.0520]	[0.0602]	[0.0610]
Cohort 2015	0.0666**	-0.0796	0.0572	0.0504	0.0825*	-0.1758***	-0.0007	0.0684
	[0.0276]	[0.0605]	[0.0544]	[0.0677]	[0.0446]	[0.0512]	[0.0593]	[0.0601]
Cohort 2016	0.0931***	-0.0723	0.0346	-0.0429	0.0226	0.0150	-0.0112	-0.0305
	[0.0304]	[0.0666]	[0.0600]	[0.0746]	[0.0491]	[0.0564]	[0.0653]	[0.0661]
Constant	0.4841***	-0.4355	0.8204***	-0.5440	0.3175	0.6973***	-0.8393***	-0.4485
	[0.1391]	[0.3049]	[0.2744]	[0.3412]	[0.2246]	[0.2579]	[0.2987]	[0.3026]
Observations	1261	1261	1261	1261	1261	1261	1261	1261
Adjusted R ²	0.312	0.127	0.096	0.126	0.156	0.121	0.162	0.130

Standard errors in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Panel A. Male Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total Score	Accounting	CIS	Finance	Marketing	Management	Economics
Athlete	-2.2973***	-2.1310***	-1.1162	-2.1502**	-2.9446***	-1.4489**	-2.1889**
	[0.5097]	[0.8018]	[0.9705]	[0.9018]	[0.7566]	[0.7255]	[0.9227]
Honors	0.4731	2.8214**	-2.0168	0.6977	1.2941	-2.8062**	1.0055
	[0.8811]	[1.2846]	[1.5105]	[1.6478]	[1.3070]	[1.2225]	[1.5001]
ETS Version/Test Score							
Test1	-0.9259**	-0.3585	-4.0231***	-6.2309***	3.6698***	-0.3855	0.3576
	[0.3814]	[0.6128]	[0.6788]	[0.7281]	[0.5694]	[0.5285]	[0.8963]
SAT Math	0.0237***	0.0277***	-0.0093	0.0497***	0.0121**	0.0023	0.0231***
	[0.0039]	[0.0061]	[0.0068]	[0.0072]	[0.0058]	[0.0052]	[0.0067]
SAT verbal	0.0586***	0.0350***	0.0455***	0.0429***	0.0614***	0.0562***	0.0538***
	[0.0037]	[0.0058]	[0.0065]	[0.0068]	[0.0055]	[0.0049]	[0.0063]
Extrnormal Ability							
GPA Extrnormal	8.7253***						
	[1.0648]						
Accounting Extrnormal	1.0049***	1.5811***	0.6813	1.4322**	1.4725***	0.5615	1.5302***
	[0.3236]	[0.4945]	[0.5565]	[0.5823]	[0.4684]	[0.4293]	[0.5458]
CIS Extrnormal	-0.7664**	0.0063	0.9789*	0.0714	0.7409	0.1187	-0.7119
	[0.3293]	[0.4928]	[0.5551]	[0.5802]	[0.4668]	[0.4279]	[0.5430]
Finance Extrnormal	0.1918	1.3920***	-0.3878	2.1704***	0.2832	0.7735*	1.6094***
	[0.3212]	[0.4683]	[0.5273]	[0.5513]	[0.4439]	[0.4068]	[0.5161]
Marketing Extrnormal	0.9754**	2.6363***	2.4309***	2.7215***	1.3409**	1.4162**	1.6963**
	[0.4338]	[0.6554]	[0.7378]	[0.7717]	[0.6210]	[0.5691]	[0.7231]
Management Extrnormal	0.1514	0.9520*	2.2580***	1.5285**	0.9701*	1.5736***	0.7717
	[0.3691]	[0.5449]	[0.6133]	[0.6416]	[0.5162]	[0.4731]	[0.6026]
Microeconomics Extrnormal	1.0858***	1.9845***	0.8807	2.5865***	1.4198***	0.4519	2.7792***
	[0.3469]	[0.5271]	[0.5935]	[0.6207]	[0.4995]	[0.4578]	[0.5808]
Macroeconomics Extrnormal	1.2898***	1.8251***	0.8077	1.7286***	1.1388**	0.9685**	3.8345***
	[0.3409]	[0.5186]	[0.5839]	[0.6106]	[0.4914]	[0.4504]	[0.5718]
Predicted Values							
GPA Predicted values	10.1953***						
	[1.4574]						
Accounting Predicted values		10.9924***					
		[1.6434]					
CIS Predicted values			11.3153***				
			[2.4417]				
Finance Predicted values				4.0867**			
				[1.9586]			
Marketing Predicted values					5.3991**		
					[2.2218]		
Management Predicted value						8.8106***	
						[1.9696]	
Microeconomics Pred. value							12.9700**
							[5.8443]
Macroeconomics Pred. value							-6.7332
							[6.3861]
Major							
Accounting	3.6868***	13.8374***	3.9053***	2.8855**	-0.2916	-4.5217***	0.7546
	[0.6398]	[1.0035]	[1.1297]	[1.1843]	[0.9523]	[0.8710]	[1.1062]

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CIS	2.4552** [1.2103]	1.0863 [1.9102]	8.6004*** [2.1510]	2.7072 [2.2502]	0.1752 [1.8106]	-3.0444* [1.6587]	3.1308 [2.1054]
Entrepreneurship	1.0926 [1.3467]	2.8619 [2.1264]	0.9565 [2.3948]	-5.2728** [2.5036]	2.1271 [2.0150]	-4.1091** [1.8478]	2.2805 [2.3446]
Finance	2.7291*** [0.5957]	2.0178** [0.9389]	-0.1903 [1.0566]	10.5777*** [1.1065]	0.7987 [0.8901]	-5.5252*** [0.8151]	6.0505*** [1.0354]
Intl. Business	1.8363** [0.8270]	-0.6366 [1.3035]	-1.6824 [1.4677]	7.1885*** [1.5358]	4.7767*** [1.2359]	-3.0562*** [1.1328]	4.7748*** [1.4366]
Marketing	-1.3903** [0.6577]	0.2094 [1.0381]	-1.3807 [1.1689]	-1.3193 [1.2223]	1.1696 [0.9839]	-4.6044*** [0.9016]	-2.8940** [1.1444]
Constant	83.4331*** [3.3603]	-18.7213*** [4.0469]	5.1901 [6.0761]	-8.8465* [4.7024]	8.6351* [5.1384]	9.9329** [4.8830]	-11.0993** [4.7868]
Observations	1924	1924	1924	1924	1924	1924	1924
Adjusted R ²	0.496	0.389	0.155	0.300	0.212	0.181	0.278

Table 7: Examining the Effects of “Extranormal” Ability on ETS Total and Sub-field Scores, Stage 2, by Gender

Table 7: Panel B. Female Sample

	(1) Total Score	(2) Accounting	(3) CIS	(4) Finance	(5) Marketing	(6) Management	(7) Economics
Athlete	-0.6931 [0.5592]	-1.2757 [0.9711]	0.6396 [1.1679]	-0.2165 [1.0818]	-1.2425 [0.9319]	-0.5385 [0.9262]	-1.4430 [1.0787]
Honors	0.1077 [0.8702]	1.4259 [1.3879]	0.8236 [1.6046]	-0.6794 [1.7541]	-2.0449 [1.4558]	-1.1425 [1.4034]	-0.7920 [1.5684]
Test Version/Scores							
Test1	-0.4567 [0.4107]	-2.1922*** [0.7225]	-2.0696*** [0.7937]	-4.8095*** [0.8499]	4.3098*** [0.6876]	2.6447*** [0.6568]	-0.6356 [1.0295]
SAT Math	0.0187*** [0.0046]	0.0153* [0.0079]	-0.0016 [0.0087]	0.0381*** [0.0091]	0.0116 [0.0075]	0.0154** [0.0069]	0.0063 [0.0082]
SAT Verbal	0.0501*** [0.0043]	0.0290*** [0.0075]	0.0402*** [0.0084]	0.0512*** [0.0086]	0.0642*** [0.0073]	0.0555*** [0.0067]	0.0302*** [0.0080]
Extranormal Ability							
GPA Extranormal	8.2245*** [1.2725]						
Accounting Extranormal	-0.1658 [0.3618]	0.6203 [0.6042]	1.0597 [0.6721]	0.6942 [0.7040]	0.6370 [0.5857]	-0.4020 [0.5508]	0.3973 [0.6443]
CIS Extranormal	-0.1723 [0.3860]	0.2591 [0.6370]	1.7976** [0.7092]	0.7835 [0.7418]	0.1093 [0.6180]	0.0916 [0.5813]	-0.0083 [0.6803]
Finance Extranormal	-0.1236 [0.3377]	0.3756 [0.5387]	-0.4745 [0.5996]	1.9377*** [0.6269]	0.7879 [0.5229]	0.4465 [0.4919]	0.9919* [0.5745]
Marketing Extranormal	-0.1608 [0.4931]	1.8850** [0.8099]	1.5056* [0.9015]	0.4829 [0.9437]	1.9116** [0.7855]	0.9526 [0.7389]	-0.3207 [0.8637]
Management Extranormal	0.4875 [0.4266]	2.6956*** [0.6898]	2.0564*** [0.7664]	1.1851 [0.8031]	0.4855 [0.6672]	1.9140*** [0.6276]	1.1952 [0.7354]
Microeconomics Extranormal	0.0819 [0.3732]	0.0765 [0.6212]	-1.3898** [0.6914]	0.5233 [0.7234]	1.1213* [0.6026]	1.7359*** [0.5668]	1.6577** [0.6624]
Macroeconomics Extranormal	0.5080 [0.3680]	1.1187* [0.6097]	0.6376 [0.6788]	0.6593 [0.7100]	0.4372 [0.5914]	1.0135* [0.5564]	2.1194*** [0.6500]
Predicted Values							
GPA Predicted values	13.0692*** [1.6775]						
Accounting Predicted values		13.3200*** [2.1230]					
CIS Predicted values			9.1841*** [3.1966]				
Finance Predicted values				1.7844 [2.4301]			
Marketing Predicted values					14.6479*** [2.8798]		
Management Predicted value						8.5603*** [2.6802]	

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Microeconomics Predicted value							7.8385
							[6.7328]
Macroeconomics Predicted value							3.8605
							[7.5333]
Majors							
Accounting	4.2715*** [0.6681]	15.0928*** [1.1436]	3.3358*** [1.2703]	6.5530*** [1.3301]	-1.5674 [1.1091]	-4.9806*** [1.0415]	1.7426 [1.2196]
CIS	-1.4776 [1.8235]	-1.1850 [3.1566]	8.0506** [3.5142]	-2.8250 [3.6761]	-3.8345 [3.0619]	-6.9158** [2.8807]	-0.2060 [3.3648]
Entrepreneurship	0.5153 [1.9391]	4.5514 [3.3541]	-5.9661 [3.7342]	-1.5484 [3.9052]	2.6642 [3.2529]	0.4011 [3.0617]	2.6342 [3.5763]
Finance	0.9477 [0.7610]	1.5084 [1.3150]	-2.4053 [1.4637]	8.4837*** [1.5311]	-0.7089 [1.2756]	-6.4248*** [1.1999]	5.0035*** [1.4022]
Intl. Business	1.3349* [0.7484]	-1.7545 [1.2933]	-3.0824** [1.4391]	7.4421*** [1.5070]	2.8912** [1.2552]	-3.3870*** [1.1799]	5.6270*** [1.3787]
Marketing	-0.4868 [0.6075]	0.7311 [1.0523]	-3.4839*** [1.1714]	1.4073 [1.2254]	1.8085* [1.0207]	-4.1046*** [0.9602]	-0.8755 [1.1216]
Constant	76.0222*** [3.7780]	-18.7713*** [4.7776]	7.8445 [7.6112]	-7.9857 [5.4527]	-24.2117*** [6.5467]	-0.3178 [6.5705]	-9.9016* [5.4276]
Observations	1261	1261	1261	1261	1261	1261	1261
Adjusted R ²	0.497	0.384	0.141	0.197	0.269	0.224	0.192

Standard errors in brackets * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

This study explores the impact of economic knowledge and ability on ETS exam success. We find that both Principles of Macroeconomics and Principles of Microeconomics grades and “extranormal” ability measures positively and significant impact overall exam performance and most sub-field scores. These findings support the argument that economics education is essential for an undergraduate business school curriculum and conducive to effective learning by business students.

These findings are also consistent with research demonstrating that economics majors tend to perform better than other students on tests of critical and conceptual thinking (Flynn, 2012; Epstein, 2019). Scholars have noted that the ETS exam may be a measure of general intellectual ability more so than a useful tool for assessing the learning taking place within a particular business curriculum. Our results may bolster the argument that strong training in economics provides a solid foundation for learning effectively in future business discipline courses. However, it also may be the case that excellent work in economics courses may indicate strong critical thinking skills, which turns out to be highly beneficial when taking the ETS exam.

Our results continue to suggest that women do worse on all sub-fields of the ETS exam, even after controlling for a variety of academic and demographic factors. Why do women perform better than men in college business courses, but worse on the ETS exam? This question has perplexed scholars for years, but research has not been able to determine the root causes of the discrepancies (Bagamery, Lasik, and Nixon, 2005; Settlege and Settlege, 2011; Bielinska-Kwapisz and Brown, 2013; Ketcham, Nigro, and Roberto, 2018).

While this study does not explain why women perform worse than men on the ETS exam, it does provide findings that may inform and stimulate future research in this area. We determine that “extranormal” ability in introductory economics courses seems to have a significant positive effect

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on ETS exam performance for male students across nearly all content areas of the test. For female students, however, the impact of “extranormal” economics ability seems to be much more limited. Perhaps this differential impact of economics education between males and females may help explain the gender difference in ETS exam performance. No prior research has explored this aspect of the gender difference in test performance.

One limitation of this study is that we do not have data that could help explain *why* males and females do not benefit in a similar way from “extranormal” ability in economics. Our study, however, is the first to document this differential impact of achievement in economics courses on ETS performance. Future research should build on the analysis in this study, drawing upon the two-stage modeling procedure employed here, to help understand the gender differences in performance on the ETS exam and other standardized tests.

Future studies could expand upon our work by controlling for additional factors – some measurable and some not - that may impact student performance on the ETS-B exam. For example, we have not controlled for potential grade inflation across professors since some maybe more lenient graders than others. Second, we do not control for teaching quality, gender or whether the professor is an adjunct, tenure track or term. These factors may impact student and faculty engagement and hence ETS performance. Third, we do not control for the number of economics or business classes that might impact overall exam success. More in-depth courses in non-major disciplines may enhance performance in certain topic areas. Lastly, future research should consider incorporating measures of how seriously students take the exam. Although the students examined received a grade boost for superior exam performance, measures of diligence are important measures of student performance.

References

- Bagamery, B., Lasik, J., & Nixon, D. (2005). Determinants of success on the ETS Business Major Field Exam for students in an undergraduate multisite regional university business program. *Journal of Education for Business, 81*, 55-63.
- Bean, D. and R. Bernardi (2002).” Performance on the Major Field Test in Business: The Explanatory Power of SAT Scores and Gender,” *Journal of Private Enterprise, 17(2)*, 172-180.
- Bielinska-Kwapisz, A., Brown, F.W. and Semenik, R., 2012. Is higher better? Determinants and comparisons of performance on the Major Field Test in Business. *Journal of Education for Business, 87(3)*, pp.159-169.
- Bielinska-Kwapisz and F. Brown. 2013. Differential Gender Performance on the Major Field Test-Business. *Journal of Education for Business, 88(3)*, pp. 159-166.
- Bisalski, H.C., Helms, M.M. and Whitesell, M. 2017. Preparing undergraduate students for the Major Field Test in Business. *Journal of Education for Business, 92(1)*, pp. 9-15.
- Black, H.T. and Duhon, D.L., 2003. Evaluating and improving student achievement in business programs: The effective use of standardized assessment tests. *Journal of Education for Business, 79(2)*, pp.90-98.
- Brown, K.H., McCormick, K. and Abraham, F., 2002. The principles of macroeconomics course as an early predictor of undergraduate business school performance. *Journal of the Academy of Business Education, 3(Fall)*, pp.61-69.
- Bycio, P. and Allen, J.S., 2007. Factors associated with performance on the educational testing service (ETS) major field achievement test in business (MFAT-B). *Journal of Education for Business, 82(4)*, pp.196-201.
- Chowdhury, M.I. and Wheeling, B., 2013. Determinants of Major Field Test (MFT) score for graduating seniors of a business school in a small mid-western university. *Academy of Educational Leadership Journal, 17(1)*, pp.59-71.
- College Board. 2016. “2016 College Bound Seniors Total Group Profile Report.” <https://secure-media.collegeboard.org/digitalServices/pdf/sat/total-group-2016.pdf>. Retrieved: July 2018.
- Epstein, David. 2019. *Range: Why Generalists Triumph in a Specialized World*. Riverhead Books.
- Fairchild, C. and Hahn, W. 2019. Accounting and finance majors outperform other majors on the major field test in business and the Comprehensive Business Exam: An analysis of exam performance drivers. *Journal of Education for Business, pp.1-6*.

IMPACT OF ECONOMICS EDUCATION ON STUDENT ETS SCORES

- Flynn, J.R., 2012. *How to Improve Your Mind: 20 Keys to Unlock the Modern World*. John Wiley & Sons.
- Green, J.J., Stone, C.C. and Zegeye, A., 2014. The Major Field Test in Business: A solution to the problem of assurance of learning assessment? *Journal of Education for Business*, 89(1), pp.20-26.
- Grimes, P.W. and Niss, J.F., 1991. Economic understanding and student success in a business curriculum. *Journal of Education for Business*, 66(5), pp.309-313.
- Hedges, Larry V., and Amy Nowell. 1995. "Sex Differences in Mental Test Scores, Variability, and Numbers of High-Scoring Individuals." *Science*, 269(5220): 41–45.
- Islam, Muhammad M., and Faridul Islam. 2013. "Economic education and student performance in the business discipline: implications for curriculum planning." *The Journal of Economic Education* 44(1): 17-31.
- Jesswein, W.A. 1982. A note on the economic component in the curriculum of contemporary schools of business. *Journal of Economic Education*, 13: 66–73.
- Ketcham, D., Nigro, P. and Roberto, M., 2018. Do persistence and passion matter: Evidence from the educational testing service major field test in business. *Journal of Education for Business*, 93(3), pp.112-118.
- Ling, G., Bochenek, J. and Burkander, K., 2015. Using the Major Field Test for a bachelor's degree in business as a learning outcomes assessment: Evidence from a review of 20 years of institution-based research. *Journal of Education for Business*, 90(8), pp.435-442.
- Mang, C.F. and Brown, N.R., 2013. The role of economics in Canadian undergraduate business education. *Journal of Education for Business*, 88(4), pp.187-193.
- Mirchandani, D., Lynch, R., & Hamilton, D. (2001). Using the ETS Major Field Test in Business: Implications for assessment. *Journal of Education for Business*, 77, 51-56.
- Morgan, J., Tallman, G. and Williams, R., 2003. Getting to the core: How does performance in lower division business courses affect performance in the upper division core. In *Allied Academies International Conference. Academy of Educational Leadership. Proceedings* (Vol. 8, No. 1, p. 97). Jordan Whitney Enterprises, Inc.
- National Center for Education Statistics. (2018). "The Condition of Education. Undergraduate Degree Fields." https://nces.ed.gov/programs/coe/indicator_cta.asp. Institute of Education Sciences. National Center for Education Statistics. Retrieved: July 2018.

IMPACT OF ECONOMICS EDUCATION ON STUDENT ETS SCORES

- Niederle, M., & Vesterlund, L. (2010). Explaining the gender gap in math test scores: The role of competition. *Journal of Economic Perspectives*, 24(2), 129-44.
- Perry, Mark (2013). 2013 SAT test results show that a huge math gender gap persists with a 32-point advantage for high school boys. AEI Ideas.
- Pomykalski, J.J., Dion, P. and Brock, J.L., 2008. A structural equation model for predicting business student performance. *Journal of Education for Business*, 83(3), pp.159-164.
- Prenshaw, P.J. and Taylor, S.W., 2007. Insights Into The Importance Of Economic Concepts To Other Introductory Business Courses. *Journal of College Teaching & Learning (TLC)*, 4(5).
- Ritchie, C. M., Rodriguez, L. C., Harrison, D. S. and Wates, K. W. 2014. The impact of prerequisite general education courses on the ETS Major Field Test for Business (MFT-B). *Journal of Education for Business*, 89(6), pp. 292-299.
- Settlage, D.M. and R. Wollscheid, J., 2015. Analyzing student performance in specific subject area indicators on the ETS major field test in business. *Journal of Education for Business*, 90(6), pp.322-327.
- Settlage, D.M. and Settlage, L.A., 2011. A statistical framework for assessment using the ETS Major Field Test in Business. *Journal of Education for Business*, 86(5), pp.274-278.
- Xie, Yu, and Kimberlee A. Shauman. 2003. *Women in Science: Career Processes and Outcomes*. Harvard University Press.