Differences in Academic Content, Placement, and Research Productivity among Doctoral Programs in Finance

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This study compares the academic content of doctoral programs in finance and examines its influence on the placement and research productivity of the programs' graduates. We find that there is a significant relationship between the academic content of a program and both the quality of the placements and the research contributions of its graduates. Doctoral programs requiring continuous time finance and/or stochastic calculus produce graduates who obtain better placements and publish more frequently in the top finance journals.

Introduction

Doctoral programs in finance have been a topic of interest for many years. Early studies include the investigation of admission, residency, and dissertation requirements of the programs (Shin and Hubbard, 1988), differences in research productivity and influence across academic institutions (Borokhovich et al., 1995, 1998), and an examination of the labor mobility of finance graduates (Chan et al., 2002). More recent studies have examined the requirements for promotion and tenure (Griffiths and Winters, 2005) and the research contributions of finance graduates (Heck and Cooley, 2005).

One of the last contributions in this area shows that the academic content of a program has a significant impact on the publication records of its graduates (Brusa et al., 2006). More specifically, their results indicate that the number of courses in investments, macroeconomics, microeconomics, continuous time finance, and stochastic calculus has a positive influence on measures of research productivity.

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Their results also reveal that while the majority of programs require courses in investments (94.64 percent of programs), microeconomics (94.64 percent of programs), and macroeconomics (82.14 percent of the programs), only a few require courses in continuous time finance (17.86 percent of programs) and stochastic calculus (35.71 percent of programs).

The significant influence of these courses and the different requirements of the programs trigger an interesting question: Could we observe differences in terms of placement and research productivity between graduates from more mathematically-oriented programs (those requesting classes in continuous time finance and/or stochastic calculus) and graduates from programs without these requirements? Perhaps students graduating from the more mathematically-oriented programs have a different level of knowledge that provides the basis for a different level of productivity. In other words, the more mathematically-oriented programs may provide students with additional knowledge and technical skills that establish the foundations for higher levels of research productivity and better opportunities in the job market. The main objective of this investigation is to examine this issue.

The goals of this study are to:

1) identify the courses required by doctoral programs that are mathematically-oriented (those programs requiring classes in continuous time finance and/or stochastic calculus) versus the courses required by doctoral programs without these mathematical demands,
2) examine the placement and publication records of the graduates from these two types of programs, and
3) investigate whether differences in the academic content of the programs explain differences in placements and publication records.

To attain these goals, we examine the courses required by 56 doctoral programs in finance. Among these programs, 25 require continuous time finance and/or stochastic calculus and 31 do not. We assume that programs requiring continuous time finance and/or stochastic calculus are more mathematically-oriented than programs without these requirements. We hypothesize that the more mathematically-oriented programs may provide students with additional knowledge and technical skills that contribute to a higher level of research productivity and better job opportunities. To test this hypothesis and assess the influence of program content on placement and research productivity, we examine the placement and publications of 993 individuals who graduated from doctoral programs in finance between 1990 and 2004. The results indicate that, when compared to their counterparts, the graduates from programs requiring more mathematically-oriented courses have greater access to more prestigious institutions and publish more frequently in the leading finance journals.

Academic Content

Our primary reference for identifying finance Ph.D. programs and graduates is *The 1999/2000 Prentice Hall Guide to Finance Faculty* (Hasselback, 1999). We examine information presented in the web pages of the doctoral programs listed in the guide and also web sites of newer programs not included in the guide. While all programs provide information about general topics such as entrance and graduation requirements, only 56 have web sites that provide complete information about their academic requirements.[1]

We divide these 56 programs into two sample groups. Group A includes 25 programs that require continuous time finance and/or stochastic calculus. Group B includes 31 programs without these requirements. We consider the programs in Group A to be more mathematically-oriented. Table 1 presents the list of doctoral programs included in each group.

Table 2 presents statistics on required courses in each subject area for the two groups. Panel A of Table 2 contains a summary of courses in finance. Both groups have the largest number of required courses in investment and portfolio, corporate finance, financial theory, and empirical research. The average number of courses in each topic is 1.38, 1.04, 1.20, and 1.18 for Group A and 1.35, 1.07, 1.18, and 1.27 for Group B. The t-statistics reveal no significant differences in the average number of finance courses required by the two groups.

Panel B of Table 2 presents statistics on economics courses. The average numbers of courses in macroeconomics, microeconomics, and econometrics are 1.57, 2.08, and 2.40 for Group A, and 1.24, 1.57, and 2.20 for Group B. The t-statistics indicate that the doctoral programs in Group A require a significantly greater number of courses in macroeconomics and microeconomics.

Panel C of Table 2 shows the main quantitative courses required by the two groups. The insignificant t-statistics indicate that there is little difference in the number of courses required by the two groups in the area of mathematics/statistics.

Panel D of Table 2 presents summary statistics by category for the two groups. The institutions in Group A require an average of 5.60 courses in finance, 6.20 courses in economics, and 3.44 quantitative courses. The institutions in Group B require an average of 5.84 courses in finance, 4.83 courses in economics, and 3.55 quantitative courses. A t-statistic of 4.71 indicates a statistically significant difference between the groups in the number of economics courses required.

Finally, the institutions in Group A require an average of 15.24 courses to complete a program while those in Group B require an average of 14.32 courses. A

[1]Because the selection and analysis criteria required complete program disclosure on the university's website, a number of well-known programs could not be selected and do not appear in the data. Of programs that satisfied selection criteria, program directors were randomly contacted to verify that the information on the website was complete.

Table 1—Doctoral Programs in Finance

Research institutions providing information about the academic content of their doctoral programs in finance. More mathematically-oriented programs requiring continuous time finance and/or stochastic calculus are listed as Group A. Programs without these requirements are listed as Group B

#	Group A	#	Group B
1	Baruch College (CUNY)	1	Alabama
2	Boston College	2	Arizona
3	California–Berkeley	3	Arizona State
4	California–Los Angeles	4	Arkansas
5	Carnegie Mellon	5	Connecticut
6	Chicago	6	Drexel
7	Columbia	7	Florida Atlantic
8	Duke	8	Florida International
9	Illinois	9	Florida State
10	Indiana	10	Georgia
11	Maryland	11	Houston
12	Massachusetts	12	Iowa
13	Michigan State	13	Kent State
14	Minnesota	14	Kentucky
15	New York	15	Memphis
16	North Carolina	16	Missouri
17	Northwestern	17	New Orleans
18	Pennsylvania	18	North Texas
19	Rutgers	19	Oklahoma
20	Rochester	20	Oklahoma State
21	Southern California	21	Old Dominion
22	Stanford	22	Penn State
23	Vanderbilt	23	Rhode Island
24	Wisconsin-Madison	24	South Florida
25	Yale	25	Tennessee
		26	Temple
		27	Texas – Arlington
		28	Texas A&M
		29	Texas Tech
		30	Virginia Tech
		31	Wisconsin–Milwaukee

t-statistic of 1.96 indicates that the difference in degree requirements between the groups is significant.

In summary, the results presented in this section indicate that programs in Group A not only demand more sophisticated courses, but also a larger number of courses. The difference is most notable in the area of economics.

Placement and Research Productivity

To assess if the differences in academic content between the groups influence the placement and research productivity of the graduates, we examine the placement

Table 2—Doctoral Courses Required by Doctoral Programs

Group A requires continuous time finance and/or stochastic calculus. Group B does not. t-statistics test the difference of means of programs offering classes (significance level: * 5 percent, ** 10 percent)

Panel A: Finance	Theory	Corporate	Investments & Portfolio	Financial Institutions	International	Continuous Time	Empirical Research	Options & Futures	Others
Group A (25 Programs)									
# Offering Classes	24	24	25	9	3	10	17	1	9
% of Total	0.96	0.96	1.00	0.36	0.12	0.40	0.68	0.04	0.36
Total # of Classes	33	25	30	9	3	10	20	1	9
Average # of Classes	1	1	1	1	1	1	1	1	1
Maximum # of Classes	3	2	3	1	1	1	2	1	1
Minimum # of Classes	1	1	1	1	1	1	1	1	1
Group B (31 Programs)									
# Offering Classes	26	28	28	14	10		15	10	19
% of Total	0.84	0.90	0.90	0.45	0.32		0.48	0.32	0.61
Total # of Classes	35	30	33	14	10		19	11	29
Average # of Classes	1	1	1	1	1		1	1	2
Maximum # of Classes	3	2	2	1	1		3	2	3
Minimum # of Classes	1	1	1	1	1		1	1	1
t-statistics	0.18	-0.46	0.17				-0.50		-2.97*

Panel B: Economics	Macroenomics	Microeconomics	Econometrics	Game Theory	Others
Group A (25 Programs)					
# Offering Classes	21	25	25	6	4
% of Total	0.84	1.00	1.00	0.24	0.16
Total # of Classes	33	52	60	6	4
Average # of Classes	2	2	2	1	1
Maximum # of Classes	2	4	4	1	1
Minimum # of Classes	1	1	2	1	1
Group B (31 Programs)					
# Offering Classes	25	28	30	2	5
% of Total	0.81	0.90	0.97	0.06	0.16
Total # of Classes	31	44	66	2	7
Average # of Classes	1	2	2	1	1
Maximum # of Classes	2	2	4	1	3
Minimum # of Classes	1	1	1	1	1
t-statistics	2.35*	3.19*	1.22		-1.00

and publication records of 993 graduates who obtained their degrees between 1990 and 2004. Of these graduates, 543 (54.68 percent) are from institutions in Group A and 450 (45.32 percent) from institutions in Group B.

Table 2 (cont.)—Doctoral Courses Required by Doctoral Programs

Panel C: Math/Statistics	Probability	Statistics	Math	Research Methods	Time Series	Stochastic Calculus	Others
Group A (25 Programs)							
# Offering Classes	10	11	12	5	9	20	7
% of Total	0.40	0.44	0.48	0.20	0.36	0.80	0.28
Total # of Classes	11	13	14	6	9	22	11
Average # of Classes	1	1	1	1	1	1	2
Maximum # of Classes	2	3	2	2	1	3	2
Minimum # of Classes	1	1	1	1	1	1	1
Group B (31 Programs)							
# Offering Classes	9	25	22	13	10		7
% of Total	0.29	0.81	0.71	0.42	0.32		0.23
Total # of Classes	10	38	26	16	10		10
Average # of Classes	1	2	1	1	1		1
Maximum # of Classes	2	4	3	2	1		2
Minimum # of Classes	1	1	1	1	1		1
t-statistics	-0.07	-1.38	-0.10	-0.13			0.50

Panel D: Total	Finance	Economics	Mathematics & Statistics	Others	Total
Group A (25 Programs)					
# Offering Classes	25	25	25	0	25
% of Total	1	1	1		1
Total # of Classes	140	155	86		381
Average # of Classes	6	6	3		15
Maximum # of Classes	8	9	5		20
Minimum # of Classes	4	5	2		12
Group B (31 Programs)					
# Offering Classes	31	31	31	1	31
% of Total	1	1	1	0.03	1
Total # of Classes	181	150	110	3	444
Average # of Classes	6	5	4	0	14
Maximum # of Classes	10	7	7	3	18
Minimum # of Classes	3	3	0	0	10
t-statistics	-0.63	4.71*	-0.31		1.96**

Placement

Of the 993 graduates with a doctoral degree in finance, we found placement information for 888 (89.43 percent). Among them, 496 (55.86 percent) obtained their degrees from programs in Group A and 392 (44.14 percent) obtained their degrees from programs in Group B. Table 3 presents statistics regarding the placement of these graduates.

Panel A of Table 3 shows that 792 graduates (89.19 percent) chose academic positions, while 96 graduates (10.81 percent) accepted non-academic jobs. The proportion of Group A graduates working at universities (84.27 percent) is smaller than the proportion of Group B graduates working at universities (95.41 percent). The difference in proportions (-11.14 percent) is statistically significant at the 1 percent level (z-statistic -5.30). Likewise, the difference in proportions of non-academic jobs taken by Ph.D.s from Group A and Group B is also statistically significant.

Table 3—Placement

Positions held by doctoral graduates in finance. Group A includes programs requiring continuous time finance and/or stochastic calculus. Group B does not. The *z*-statistics test for significant differences between proportion of graduates from Groups A and B (significance level: * 5 percent)

	Total		Group A		Group B			
	# Grads	%	# Grads	%	# Grads	%	% Diff.	Z-stat
Panel A: Placements								
Total Placements	888	100	496	100	392	100		
In Academia	792	89.19	418	84.27	374	95.41	| 11.14 |	| 5.30* |
Out of Academia	96	10.81	78	15.73	18	4.59		
Panel B: Academic Placements								
In Academia	792	89.19	418	84.27	374	95.41	-11.14	-5.30*
In US University	672	75.68	338	68.15	334	85.20	-17.05	-5.88*
In Foreign University	120	13.51	80	16.12	40	10.21	5.91	2.56*
Panel C: US University Placements								
In US University	672	75.68	338	68.15	334	85.20	-17.05	-5.88*
Doctoral University	269	30.29	207	41.73	62	15.82	25.91	8.34*
Non-Doc University	403	45.39	131	26.42	272	69.38	-42.96	-12.7*

Panel B of Table 3 shows that the majority of graduates choosing to work in academia stay in the United States. American universities were the destination for 68.15 percent of the graduates from programs in Group A and 85.20 percent of the graduates from programs in Group B. The difference between these proportions (-17.05 percent) is statistically significant at the 5 percent level (z-statistic -5.88). Meanwhile, 16.12 percent of the graduates from Group A and 10.21 percent of the graduates from Group B accepted positions with foreign universities. The difference between these proportions (5.91 percent) is also statistically significant at the 1 percent level (*z*-statistic 2.56).

Panel C of Table 3 shows that the proportion of graduates from Group A (41.73 percent) accepting positions at doctoral institutions is greater than the proportion of graduates from Group B (15.82 percent). The difference between these proportions (25.91 percent) is statistically significant at the 1 percent level (z-statistic 8.34). Meanwhile, the difference between the proportion of graduates from Group A and Group B finding jobs in non-doctoral universities is -42.96 percent and is also statistically significant at the 1 percent level (z-statistic -12.76).

The results in Table 3 show that the majority of graduates from both groups find jobs within academia, but there is a difference: the graduates from Group A tend to acquire positions in more prestigious (doctorate-granting) institutions. It appears that graduates of programs with more mathematical orientation have better placement opportunities than graduates from other programs.

To examine these results in more detail, we investigate three different models. The first model examines the probability that a graduate finds a position in academia. The second model evaluates the probability that a graduate takes a job in an American university, and the third model evaluates the probability that a graduate accepts a position in a doctoral institution. As a result of the binary characteristics of the dependent variable, we use a logistic methodology and estimate the following regression:

$$\ln\left(\frac{(\Pr(Y_i = 1)}{1 - \Pr(Y_i = 1)}\right) = \beta_0 + \beta_1 PROG + \beta_2 CLASS + \beta_3 PRESTIGE + \beta_4 YAG + \varepsilon_i (1)$$

In the first model, $Y_i = 1$ if the graduate finds a job in academia and $Y_i = 0$ if the graduate finds a job outside of academia. In the second model, $Y_i = 1$ if the position is in an American university and $Y_i = 0$ if the position is in a foreign university. In the third model, $Y_i = 1$ if the position is in a doctoral university in the US and $Y_i = 0$ if the position is in a non-doctoral US university. PROG is a dummy variable that equals 1 if the graduate is from a program in Group A and zero otherwise. The variable CLASS is the number of classes demanded by each doctoral program. The variable PRESTIGE is a dummy variable that equals 1 if the doctoral program is among the best 50 programs ranked by Chan, Chen, and Steiner (2002) and zero otherwise.[2] The variable YAG is the number of years after graduation of the graduates.

The main goal of these models is to verify the probability that graduates from more mathematically oriented programs find jobs in academia, in academia in the United States, and in doctoral institutions located in the US after controlling for the number of classes in the program, the prestige of the university granting the degree, and the years after graduation.[3]

Because the density function is nonnegative, the sign of the coefficient of the independent variables will indicate the direction of the effect of a change in the independent variable. Positive signs indicate that an increase in the independent variable will increase the probability of the response and negative signs will imply the opposite. The estimated coefficient of a binary model cannot be interpreted as the marginal effect on the dependent variable. Thus, to facilitate the interpretation of the coefficients we estimate the marginal effects as the change in probabilities with respect to the changes in the independent variables using the customary derivative

[2]Chan, Chen, and Steiner (2002) rank finance departments according to their number of publications.

[3]We test for endogeneity between the placement of the graduates and the prestige of their programs following the procedure described in Wooldridge (2003) chapter 15. The results show that prestige is an exogenous variable.

procedure as defined in Wooldridge (2003).[4] The z-statistics are estimated with robust standard errors that are determined following generalized linear model (GLM) methods.[5] The results of these estimations are presented in Table 4.

Panel A of Table 4 shows the coefficients, marginal effects, and z-statistics of the model examining the probability that a graduate from a doctoral program in Group A accepts a job in academia. Consistent with the results in Table 3, the coefficient of the PROG variable is negative (-1.238) and statistically significant (z-statistic = -3.54). The marginal effect is -0.100, and it is significantly different from zero (z-statistic = -3.78). These results indicate that an increase in the independent variable (from 0 to 1) decreases the probability of the event by 10 percentage points. In other words, if a graduate comes from Group A the probability that the graduate accepts a position in academia is reduced 10 percentage points.

Panel B of Table 4 presents the results of the model examining the probability that a graduate from a doctoral program in Group A will take a position in an American university. The variable PROG exhibits a coefficient of -0.793 and a marginal effect of -0.137. Both magnitudes are statistically significant at the 5 percent level (z-statistics -3.76 and -3.92, respectively). These results are also consistent with those presented in Table 3 and indicate that if the graduate comes from Group A the probability that the graduate accepts a position in an American university is reduced almost 14 percentage points.

Panel C of Table 4 shows the results of the model examining the probability that a graduate from a doctoral program in the Group A will accept a position in a doctoral university in the US. The coefficient of the PROG variable is positive (0.814) and statistically significant (z-statistic = 4.20). The marginal effect is 0.157 and it is significantly different from zero (z-statistic = 4.35). The variable PRESTIGE exhibits a significantly positive coefficient 1.162 (z-statistic = 3.85) and a significantly positive marginal effect 0.194 (z-statistic = 4.91). The variable YAG exhibits a significantly negative coefficient -0.0051 (z-statistic = -2.06) and a significantly negative marginal effect -0.010 (z-statistic = - 2.06). These results indicate that if the

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[4]Because the derivatives must be evaluated at some value for the independent variables, the conventional approach of evaluating the derivative at the mean of the independent variable is taken. This approach is not valid for binary independent variables. For the binary independent variables, the change in probability is computed with the cumulative distribution function (CDF) evaluated with the binary equal to 1 less the CDF with the binary evaluated at zero and all other independent variables set at their sample means. See J. Scott Long (1997) chapter 3 for further details.

[5]z-statistics also were estimated with robust standard errors using the quasi-maximum likelihood method (White, 1982), with results similar to those determined using GLM methods. The degree of multicollinearity among the independent variables estimating the condition indexes associated with these variables was examined. Condition indexes of 1, 1.76, 5.63, and 9.64 indicate the lack of multicollinearity. See Gujarati (1995) page 338 for further details.

Table 4—Logistic Regressions for Graduate Placements

To examine the impact of doctoral programs on the placement of graduates, this study evaluates three models. These models are based on the following regression:

$$\ln\left(\frac{(\Pr(Y_i = 1)}{1 - \Pr(Y_i = 1}\right) = \beta_0 + \beta_1 PROG + \beta_2 CLASS + \beta_3 PRESTIGE + \beta_4 YAG + \varepsilon_i \qquad (1)$$

In the first model, $Y_i = 1$ if the graduate find a job in Academia and $Y_i = 0$ if outside of Academia. In the second model, $Y_i = 1$ if the position is in an American university and $Y_i = 0$ if a foreign university. In the third model, $Y_i = 1$ if the position is in a doctoral university in the US and $Y_i = 0$ if in a non-doctoral US university. PROG is a dummy variable that equals 1 if the graduate is from a Group A program and 0 if not. The variable CLASS is the number of classes demanded by each doctoral program. The variable PRESTIGE is a dummy variable that equals 1 if the doctoral program is among the best 50 programs ranked by Chan, Chen, and Steiner (2002) and 0 if not. The variable YAG is the number of years after graduation.

We expect β_1 to be negative in models 1 and 2 and positive in model 3. The estimated coefficient cannot be interpreted as the marginal effect on the dependent variable; therefore, we estimate the marginal effects as the partial probabilities with respect to the vector of characteristics. The Z-statistics are estimated with robust standard errors that are determined following generalized linear model (GLM) methods. RSQ is the McFadden likelihood ratio index, an analog of the R^2 reported in OLS models. LR statistic tests the joint null hypothesis that all slope coefficients except the constant are zero and is an analog of the F-statistics in OLS models (significance level: * 5 percent)

Variables	Constant	PROG	CLASS	PRESTIGE	YAG	RSQ	LR
Panel A: Academia							
Coefficient	3.910*	-1.238*	-0.076	-0.066	0.024	0.054	287.73*
Z-statistic	3.56	-3.54	-1.20	-0.14	0.71		
Marginal Effect		-0.100*	-0.006	-0.005	0.002		
Z-statistic		-3.78	-1.20	-0.14	0.71		
Panel B: US University							
Coefficient	1.674*	-0.793*	0.006	-0.439	0.020	0.039	473.20*
Z-statistic	2.14	-3.76	0.13	-1.55	0.78		
Marginal Effect		-0.137*	0.001	-0.072	0.003		
Z-statistic		-3.92	0.13	-1.62	0.78		
Panel C: Doctoral University							
Coefficient	-2.733*	0.814*	0.063	1.162*	-0.051*	0.088	496.53*
Z-statistic	-3.51	4.20	1.38	3.85	-2.06		
Marginal Effect		0.157*	0.012	0.194*	-0.010*		
Z-statistic		4.35	1.38	4.91	-2.06		

graduate comes from Group A the probability that the graduate accepts a position in a doctoral university is increased 16 percentage points. Also the probability that a graduate will find a job in a doctoral university increases 19 percentage points when the student graduates from a prestigious program. On the other hand, the probability that a graduate will find a job in a doctoral university decreases 1 percentage point for each year after graduation.

It is important to note the results of the variables Prestige and YAG. These variables do not exhibit any significant influence on the probability that graduates find jobs in either academia or an American university, but they show significant influence on the probability that graduates find job with doctoral universities in the United States. In other words, graduates from more prestigious universities have a higher probability of accepting positions in doctoral institutions. On the other hand the longer the amount of time after graduation, the smaller the probability that a graduate will find a position in the same type of institution.

In summary, the results presented in Table 4 confirm the results exhibited in Table 3. For instance, the results in Table 3 indicate that the proportions of graduates from Group A programs going into Academia or finding jobs in US universities are smaller than the proportion of graduates from Group B programs. The results of the logistic regressions in Table 4 confirm these results. Also, the results in Table 4 confirm the conclusion that graduates from Group A programs have a larger probability of finding jobs in doctoral institutions than do graduates from Group B programs. It appears that graduates from more mathematically-oriented programs have more placement opportunities than do graduates from other programs, not only in academia in the US but also in foreign universities and outside of academia.

Research Productivity

Next, we examine if the programs that are more mathematically-oriented produce graduates with a different record of research productivity. We again look at the 993 students obtaining their doctoral degrees between 1990 and 2004, consisting of 543 (54.68 percent) Group A graduates and 450 (45.32 percent) Group B graduates. Of the 993, only 673 (67.77 percent) published at least one article in an academic journal during the last 15 years. From these 673 individuals, 369 (54.83 percent) are Group A graduates and 304 (45.17 percent) are Group B graduates. In other words, 67.95 percent of the graduates from Group A and 67.55 percent of the graduates from Group B published at least one academic article in the last 15 years. These authors produced 2,879 articles in publication venues covering 175 journals in accounting, advertising, business, economics, finance, marketing, management, and statistics.

Table 5 presents the variables that examine various dimensions of research productivity for the 673 graduates who published at least one article. These variables are the number of publications, the number of pages in the article, the number of publications adjusted by the number of authors, and the number of pages in the article adjusted by the number of authors.

Table 5 indicates that the 673 graduates produced 2,879 publications with 56,559 pages for an average of 4.28 publications per author and 84.04 pages per author. The number of publications and pages adjusted by the number of authors are 1,458 and 28,576, respectively.

Table 5 shows results for the Group A graduates. The 369 graduates from Group A published 1,656 publications with 37,156 pages for an average of 4.49 articles and

Table 5—Descriptive Statistics of Research Productivity

Group A includes the more mathematically-oriented programs requiring continuous time finance and/or stochastic calculus. Group B includes the programs without these requirements. The column Publications/author shows the number of publications adjusted by the number of authors. The column Pages/author presents the number of pages published adjusted by the number of authors. The t-statistics test the difference in the means of the two groups (significance level: * 5 percent)

	Publications	Pages	Publications/author	Pages/author
Total Graduates (673)				
Total Number	2,879	56,559	1,458	28,576
Average Number	4.28	84.04	2.16	42.46
Maximum Number	27	689	15.24	366.81
Minimum Number	1	3	0.20	1
Group A (369)				
Total Number	1,656	37,156	888	19,609
Average Number	4.49	100.70	2.41	53.14
Maximum Number	27	689	15.24	366.81
Minimum Number	1	3	0.20	1
Group B (304)				
Total Number	1,223	19,403	569	8,967
Average Number	4.02	63.83	1.87	29.49
Maximum Number	24	357	13.16	229
Minimum Number	1	5	0.25	1.66
T-statistics	1.65	6.36*	3.70*	7.80*

100.70 pages per author. The number of publications and pages adjusted by authors are 888 and 19,609, respectively.

Table 5 presents results for the Group B graduates. The 304 graduates in Group B published 1,223 publications with 19,403 pages for an average of 4.02 articles and 63.83 pages per author. The number of publications and pages adjusted by authors are 569 and 8,967, respectively.

The t-statistics show that there is not a significant difference in the average number of publications per graduate between the two groups. Statistically significant differences do exist in terms of the number of pages published, the number of publications adjusted by the number of authors, and the number of pages adjusted by the number of authors.

To provide more insight into publishing success of the graduates, we investigate their record of publications in the top finance journals. According to Alexander and Mabry (1994), Borokhovich, Bricker, Brunarski, and Simkins (1995), Borde, Cheney, and Madura (1999), Arnold, Butler, Crack, and Altintig (2003), Smith (2004), and Oltheten, Theoharakis, and Travlos (2005) the five most influential journals in the field are the *Journal of Finance (JF)*, the *Journal of Financial Economics (JFE),* the *Review of Financial Studies (RFS)*, the *Journal of Financial and Quantitative Analysis (JFQA)*, and the *Journal of Business (JB)*.

Table 6 presents a summary of the graduates' publications in the top journals. The table includes tallies of the total number of articles published and the number of articles adjusted by the number of authors for all graduates and for each of the two groups. The results show that graduates from Group A published, on average, significantly more articles in the *Journal of Finance*, the *Journal of Financial Economics,* and the *Review of Financial Studies* than graduates from Group B. This significant difference holds even after adjusting for number of articles by the number of authors.

Table 6 also presents the proportion of graduates publishing in top journals for the entire sample and for each of the groups. The percentages of graduates publishing in top journals in finance are relatively small. Only 6.24 percent of the graduates published in the *Journal of Business*, 27.64 percent in the *Journal of Finance,* 17.98 percent in the *Journal of Financial Economics*, 12.63 percent in the *Journal of Financial and Quantitative Analysis,* and 8.62 percent in the *Review of Financial Studies*. These percentages are largely influenced by the number of publications of Group A graduates, whose proportions of publication in top journals are 8.94 percent in the *JB*, 43.36 percent in the *JF*, 26.56 percent in the *JFE*, 19.24 percent in the *JFQA,* and 15.45 percent in the *RFS*. The share of publications in top journals by graduates from Group B are 2.69 percent in the *JB*, 8.55 percent in the *JF*, 7.56 percent in the *JFE*, 4.60 percent in the *JFQA,* and 0.32 percent in the *RFS*. The difference in the proportion of publications in top journal by the groups is statistically significant.

To test the robustness of these results, we utilize several regressions models. The basic regression model is

$$R = \beta_0 + \beta_1 \text{ PROG} + \beta_2 \text{ CLASS} + \beta_3 \text{ PRESTIGE} + \beta_4 \text{ YAG} + \varepsilon_t \qquad (2)$$

where R represents one of the measures of research productivity such as the number of publications, the number of pages in the article, the number of publications adjusted by the number of authors, the number of pages in the article adjusted by the number of authors, the number of publications in top journals, and the number of publications in top journals adjusted by the number of authors. PROG is a dummy variable that equals one for graduates in Group A and zero for graduates in Group B. The variable CLASS is the number of courses demanded by each doctoral program. PRESTIGE is a dummy variable that equals one if the doctoral program is among the best 50 programs ranked by Chan, Chen, and Steiner (2002) and zero if not. The variable YAG is the number of years after graduation of the graduates. The main goal of these models is to verify if more mathematically-oriented programs have a significant influence on the research productivity of the graduates after controlling for the number of courses in the program, the prestige of the university granting the degree, and the years after graduation. In other words, if the requirement of more difficult classes by the more mathematically-oriented doctoral programs has a significant influence on the research productivity of the graduates, we expect the coefficient β_1 to be positive and significantly different than zero in all the regressions.

Table 6—Descriptive Statistics of Research Productivity in Top Journals

Group A includes the more mathematically-oriented programs requiring continuous time finance and/or stochastic calculus. Group B includes the programs without these requirements. The rows articles/author shows the number of publications adjusted by the number of authors. The t- and z-statistics test the differences in means and proportions, respectively (significance level: * 5 percent)

	Journal of Business	Journal of Finance	Journal of Financial Economics	Journal of Financial and Quantitative Analysis	Review of Financial Studies
Panel A: Total Graduates (673)					
Total Number of Authors	42	186	121	85	58
% of Total	6.24	27.64	17.98	12.63	8.62
Total Number of Articles	54	339	179	96	64
Average Number of Articles	1.28	1.82	1.48	1.13	1.10
Maximum Number of Articles	4	8	6	3	2
Minimum Number of Articles	1	1	1	1	1
Total Number of Articles/Author	31.33	174.06	95.06	52.14	36.56
Average Number of Articles/Author	0.74	0.93	0.78	0.61	0.63
Maximum Number of Articles/Author	2.5	4.33	3	2	2
Minimum Number of Articles/Author	0.33	0.25	0.25	0.25	0.25
Panel B: Group A (369)					
Total Number of Authors	33	160	98	71	57
% of Group A	8.94	43.36	26.56	19.24	15.45
Total Number of Articles	43	307	150	81	63
Average Number of Articles	1.30	1.91	1.53	1.14	1.10
Maximum Number of Articles	4	8	6	3	2
Minimum Number of Articles	1	1	1	1	1
Total Number of Articles/Author	25.81	159.16	82.69	45.65	36.06
Average Number of Articles/Author	0.78	0.99	0.84	0.64	0.63
Maximum Number of Articles/Author	2.5	4.33	3	2	2
Minimum Number of Articles/Author	0.33	0.25	0.25	0.25	0.25
Panel C: Group B (304)					
Total Number of Authors	9	26	23	14	1
% of Group B	2.69	8.55	7.56	4.60	0.32
Total Number of Articles	11	32	29	15	1
Average Number of Articles	1.22	1.23	1.26	1.07	1
Maximum Number of Articles	2	4	2	2	1
Minimum Number of Articles	1	1	1	1	1
Total Number of Articles/Author	5.32	14.9	12.37	6.49	0.5
Average Number of Articles/Author	0.59	0.57	0.53	0.46	0.5
Maximum Number of Articles/Author	1	1.33	1	1	0.5
Minimum Number of Articles/Author	0.33	0.25	0.25	0.33	0.5
z-statistic: Percentages	3.19*	10.05*	6.39*	5.69*	6.96*
t-statistic: Articles	0.42	4.19*	1.98*	0.81	2.56*
t-statistic: Articles/Author	1.44	5.01*	3.80*	2.53*	

Table 7—Regression Models for Research Productivity

The basic regression model is

$$R = \beta_0 + \beta_1 \text{ PROG} + \beta_2 \text{ CLASS} + \beta_3 \text{ PRESTIGE} + \beta_4 \text{ YAG} + \varepsilon_t \quad (2)$$

where R represents different measures of research productivity such as the number of publications, the number of pages, the number of publications adjusted by the number of authors, the number of pages adjusted by the number of authors, the number of publications in top journals, and the number of publications in top journals adjusted by the number of authors, PROG is a dummy variable that equals 1 if the graduates are from Group A and zero if not. CLASS is the number of classes demanded by each doctoral program. PRESTIGE is a dummy variable that equals 1 if the doctoral programs are among the best 50 programs ranked by Chan, Chen, and Steiner (2002) and zero if not. YAG is the number of years after graduation.

The main goal of these models is to verify if doctoral programs that are more mathematically-oriented have a significant influence on the research productivity of the graduates after controlling for the number of classes in the program, the prestige of the university granting the degree, and the years after graduation. If our hypothesis is supported by the evidence, we expect coefficients β_1 to be positive and significantly different from zero. Because the residuals of all the regressions suffer from heteroskedasticity, the t-statistics are corrected using White's (1980) heteroskedasticity consistent covariance matrix. * Significant at 5 percent level

Variables	Constant	PROG	CLASS	PRESTIGE	YAG	Adj. R^2	F
Publications	-0.153	0.442	0.007	0.08	0.235*	0.0371	10.57*
t-statistics	0.14	1.52	0.11	0.24	6.62		
Pages	-5.428	24.188*	0.202	6.97	3.630*	0.0452	12.69*
t-statistics	-0.22	4.20	0.13	1.31	4.51		
Pubs/Author	-0.065	0.382*	-0.007	0.153	0.117*	0.0429	12.12*
t-statistics	-0.11	2.52	-0.20	0.99	6.32		
Pages/Author	-2.281	15.153*	-0.074	4.769	1.804*	0.0563	15.81*
t-statistics	-0.17	5.02	-0.09	1.86	4.27		
Top Pubs	-0.703	0.882*	0.020	0.242*	0.041*	0.0906	25.73*
t-statistics	-1.26	7.59	0.54	3.88	2.36		
Top Pubs/Author	-0.357	0.500*	0.011	0.119*	0.018*	0.0945	26.91*
t-statistics	-1.12	8.26	0.54	4.06	2.04		

Because the residuals of all the regressions suffer from heteroskedasticity, the t-statistics are corrected using White's (1980) consistent covariance matrix.[6] Table 7 presents the results of this investigation.

As shown in Table 7, the coefficient β_1 is positive and significantly different from zero in all the equations, except when the dependent variable is the number of publications. In other words, there is not a significant difference among the groups in

[6]Similar results are observed using Newey-West's (1987) heteroskedasticity and autocorrelation consistent covariance matrix. Following Chang, Pinegar, and Ravichandran (1993) and Brusa and Liu (2004), we also estimate equation (2) using trimmed least squares with trim at 5 percent and 20 percent. The results of these regressions are essentially the same as those presented in Table 7. The results of the analysis indicate that outliers do not influence the results. We also examine the degree of multicollinearity among the independent variables estimating the condition indexes associated with these variables. The condition indexes are 1, 1.75, 5.46, and 9.34, and they indicate the lack of multicollinearity. See Gujarati (1995) page 338 for further details.

relation to the number of articles published by their graduates, but there are important differences when the measure of research productivity is the number of pages published, the number of publications adjusted by the number of authors, the number of publications in top journals, and the number of publications in top journals adjusted by the number of authors. Similarly, the variable YAG is significantly positive in all the regressions. These results support the common idea that the longer the period after graduation, the larger the research productivity of the graduates.

Another interesting result presented in Table 7 is the significantly positive coefficient of the variable PRESTIGE when the regression model examines the publications in top journal. This result indicates that the record of publications in top journals is not only influenced by the characteristics of the classes offered by the program, but also for the academic prestige of the program granting the degree.

In summary, graduates from Group A do not publish, on average, more articles than graduates from Group B, but their articles have more pages even after adjusting for the number of authors, and they are published by the most prestigious journals. The results of the regressions are consistent with the results of the previous sections and support the hypothesis.

Summary and Conclusions

In this study we investigate the academic content of doctoral programs in finance and its influence on the record of publication and placement of the graduates of these programs. The results of this investigation indicate that the course content of practically all the programs can be grouped into three main categories: economics, finance, and mathematics/statistics. The main difference in the academic content is the emphasis placed by some programs on more mathematically-oriented courses such as continuous time finance and/or stochastic calculus. The more mathematically-oriented programs not only require more sophisticated courses, but also more courses to complete the program. The graduates from these programs do not produce, on average, more publications than graduates from other programs, but their publications have more pages and they appear in more prestigious journals. Also, the large majority of graduates from these programs tend to hold positions in research institutions while their counterparts from other programs tend to be hired by non-doctoral institutions.

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