CAN YOU EARN A Ph.D. IN ECONOMICS IN FIVE YEARS?

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Abstract

We investigate which of the students who entered economics Ph.D. programs in fall 2002 were more likely to earn a Ph.D. within five years, and which were more likely to have dropped out. Students enrolled in Top-15 ranked programs are less likely to have dropped out, but no more likely than others to have graduated; relatively more of them remain in the pipeline after five years of study. Students with higher verbal and quantitative GRE scores more frequently survive the first five years but are no more likely to have graduated in five years. First-year financial aid appears to reduce attrition and increase completion for U.S. citizens. Those with undergraduate degrees from Top-60 U.S. liberal arts colleges and from foreign universities have both lower attrition and higher completion probabilities. The availability of office space for Ph.D. students is related to higher retention among non-U.S. citizens, but lower completion probabilities among U.S. citizens. There are also important differences in the characteristics associated with retention and completion probabilities between men and women.

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Can You Earn a Ph.D. in Economics in Five Years?

In spite of the fact that the median time-to-degree for economics Ph.D.s was near 5.5 years in 2002 and appears to be rising (Stock and Siegfried, 2006), some students can and do earn a Ph.D. in economics in five years. Of an initial cohort of individuals who began Ph.D. study in economics in fall 2002, 27 percent had a diploma they could display on their office wall by fall 2007.

Economics Ph.D. programs often claim that a degree can be earned in five years. Students who take more than five years incur high opportunity costs of remaining in school, as their peers frequently take jobs paying more than $100,000 annually.[2] Those that never finish also create opportunity costs, for universities, in terms of financial aid and faculty time, and for themselves in terms of psychological costs, foregone earnings, and delayed entry into alternative careers that better match their skills and interests. Aside from the rare prospect of a high-risk admitted student making a seminal contribution to economic research, economics graduate admissions committees prefer to admit students who will eventually earn a degree, preferably in five or fewer years.

I. Completion and Attrition Rates

The goal of this paper is to inform admissions committees and potential graduate students about factors associated with Ph.D. program attrition and completion, in the hope that such information will help admissions committees decide whom to admit and students decide which program to attend. To examine these relationships, we have tracked the progress of all fall 2002 enrollees at 27 U.S. economics Ph.D. programs—a total of 586 individuals—for the past five years. As of fall 2007, we had sufficient information to estimate the proportion of these entrants that dropped out in (or immediately following) their first, second, third, fourth, and fifth years, the proportion that were still working toward a degree, and the proportion that had completed work on a Ph.D. These statistics are reported in Table 1, categorized by 1993 National Research Council (NRC) program ranks (Goldberger et al., 1995).

[2] For example, on April 1, 2008, the PhD-granting schools' starting salary offers in economics listed on www.bluwiki.com/go/Econjobmarket_offer averaged $107,000.

The programs include 15 of the 22 largest plus 12 others, each graduating an average of at least five Ph.D.s annually from 1998 to 2001. They are diverse in terms of 1993 NRC ratings, including nine of the top 15 (Tiers 1 and 2), seven of the next 15 (Tier 3), and 11 of those in Tiers 4 and 5 (ranked 31-48 and above 48, respectively).[3] Together, the 27 sample programs produced 42 percent of economics Ph.D.s awarded in the U.S. from 1998 to 2001. Higher ranked programs are over-represented: 22 of the 27 are among the top NRC-rated 48 programs. Because higher ranked programs recruit better qualified students and have lower early attrition, our data likely understate attrition rates for all economics Ph.D. students.

As Table 1 reveals, 27 percent of the 2002 entering class completed work on their Ph.D. within five years of matriculation. Thirty-four percent of the original cohort dropped out by their fifth anniversary,[4] leaving 39 percent still toiling in the academic vineyard.[5] Based on a sample of 1,154 economics Ph.D.s who graduated in 1996-97 or 2001-02 (cohorts who received degrees during the same years), Siegfried and Stock (1999) and Stock and Siegfried (2004) found that 41 percent *of those who eventually earn a Ph.D. degree* do so by the end of five years. A similar completion distribution for our 2002 entering class sample, adjusted for likely attrition at our disproportionately higher tier sample programs, implies an eventual completion rate around 60 percent for all 2002 economics Ph.D. program entrants.

Fortunately for the sake of minimizing opportunity costs, most attrition among the cohort occurred in the first two years, with four-fifths of the dropouts leaving by the end of year two.[6] Attrition rises as program ranking declines. First-year attrition is almost non-existent in "Top-6" programs, but ranges from 11 to 23 percent of entering classes in lower ranked groups. This may reflect better understanding of content in Ph.D. courses among students entering elite programs, leading to fewer early dropouts because program content

[3] One unranked program was assigned to Tier 5.

[4] Stock, Finegan, and Siegfried (2006) track the rate at which observed dropouts from one program are actually transfers to another Ph.D. program. Their estimates suggest that adjusting for transfers would reduce the two-year attrition rate in economics by four or five percentage points.

[5] For a sample of 1001 individuals who entered one of six unidentified economics Ph.D. programs between 1992 and 2000, the Council of Graduate Schools (2008) found that, after five years, 33 percent had earned their degree, 25 percent had dropped out, and 42 percent remained at work. These outcomes are close to what we find for students enrolled in nine of the top-15 (Tiers 1 and 2) (NRC) ranked economics programs.

[6] In a study of students who entered Ph.D. programs in economics, English, mathematics, and physics at Cornell University from 1962-1986, Ehrenberg and Mavros (1995) found that approximately half of all people who dropped out in the four fields did so within their first two years of graduate school.

fails to meet their expectations (e.g., emphasis on mathematics versus emphasis on applying economics to "real world" problems [Stock and Hansen (2004)]).

After two years, the aggregate attrition rate at the top 15 programs is under 16 percent, while the comparable rate for all other programs exceeds 35 percent. After five years, attrition rates range from only 15 percent for the three Tier 1 programs in our sample, to almost half of the entrants into programs ranked below 48th (Tier 5). As expected, the pattern of completion rates is just the reverse: one-third of Tier 1 program entrants had earned their Ph.D. by the end of their fifth year, while only one-sixth of Tier 5 program entrants had completed their degree five years after entry.

A larger proportion of the entrants remain in their programs after five years at both Tier 1 and Tier 2 institutions because the decline in attrition associated with higher ranked tiers is larger than the rise in completions. Tier 1 and 2 programs appear to be more "efficient" than programs in lower ranked tiers because of their ability to avoid attrition and move their students on to graduation and employment. For this reason we group Tier 1 and Tier 2 programs together when estimating attrition and completion. Similarly, because five year completion rates of students in Tier 3 and Tier 4 institutions are similar, but those for Tier 5 students are much lower, we group programs in Tiers 3 and 4 together; we use that group as a benchmark because it is the largest.

II. Predicting Attrition

Earlier probit estimates (Stock, Finegan, and Siegfried, 2006) to distinguish dropouts from survivors of the first two years in economics Ph.D. programs found that only a few program, student, or financial aid characteristics mattered. Everything else the same, students in Tier 1, Tier 2, and Tier 5 programs, those enrolled in programs where shared offices were available to at least some first year graduate students, students with higher verbal and quantitative GRE scores, and students on research assistantships were less likely to drop out during their first two years.

Estimates analogous to those underlying these preliminary conclusions are reported in column 2 of Table 2.[7,8] They differ slightly from the estimates reported in Stock, Finegan,

[7] The regression sample omits 16 observations that are missing demographic or GRE information.

[8] One could argue that a multinomial logit (ML) procedure should be used to estimate students' status (dropout, continuer, completer) five years after beginning Ph.D. study. We cannot use a ML model because some factors

and Siegfried (2006) because of: (1) revisions to the classification status (completed degree, still-in-program, dropped out) of eight students as data collection continued from 2004 through 2007, (2) loss of two observations when type of undergraduate institution was added as an explanatory variable, and (3) combining the binary indicators for holding a bachelor's degree in mathematics and holding an undergraduate double major in economics and math into a single quantitative background indicator. (Because economics/math double majors outnumber single math majors in our sample by about two to one, we hereafter refer to the combined groups as double majors.) The estimates are largely the same, except that those who received no first-year financial aid now have markedly higher expected attrition than others.[9]

Column 3 of Table 2 repeats the probit estimates in column 2, adding indicators of the type of undergraduate institution each student attended. This has hardly any effect on either the magnitude or significance of the other estimated coefficients, and indicates that students who earned their bachelor's degrees at foreign institutions are less likely to leave during their first two years in an economics Ph.D. program than are those from "other" U.S. colleges (ones neither offering a Ph.D. in economics nor ranked among the Top-60 liberal arts colleges by *U.S. News & World Report* in 2008).[10] Earning an undergraduate degree abroad seems to boost retention during the first two years by over 20 percentage points.[11]

Probit estimates to predict dropouts throughout the first five years of their Ph.D. program are reported in Table 2, column 4. They indicate that students enrolled at Tier 1 or Tier 2 programs are less likely to leave by the end of their fifth year of study, and that those

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that affect completion are not related to attrition (i.e., program-level two year attrition rate, percent of dissertations that are essays, more than five years full financial aid usual, hard and soft completion time limits, pre-thesis research required, and topic-seeking meetings with faculty).

[9] We also estimated the model in column 2 while excluding the indicators for program tier. The results were largely the same as those reported, with the exception that the relationship between *private university* and lower attrition is stronger and statistically significant (-0.148, z-stat = 2.4) and the coefficient on *core exam pass required* is larger (higher attrition) and statistically significant (0.096, z-stat = 2.2).

[10] We added Brigham Young University, Case Western Reserve University, Dartmouth College, Tufts University, the University of Richmond, Trinity University (Texas), the College of William and Mary, and Miami University (Ohio) to the list of the Top-60 liberal arts colleges because they are all highly selective (primarily) undergraduate colleges that emphasize liberal arts.

[11] In an alternate specification of column 2 that includes binary indicators for specific Ph.D. programs rather than program characteristics, the estimated effects of student characteristics are similar to those in Table 2. Two exceptions are: the attrition-reducing effect of *hold undergraduate degree in economics/math* is larger (-0.178) and statistically significant, and holding a no-work fellowship is associated with higher attrition (0.116) and significant.

without any first-year financial aid are more likely to drop out than those with financial support.[12] Ehrenberg, et al. (2008), studying 13,552 Ph.D. students in humanities and social science departments (excluding economics) at ten universities, also found that financial aid reduces the cumulative probability of attrition. Studying at a Tier 1 or Tier 2 institution and receiving first-year aid also appear important—each is associated with roughly 20 percentage point less expected attrition.

GRE scores are the only student characteristics strongly related to five year attrition,[13] but two other characteristics are significant at the ten percent level. Males have about an eight percentage point retention advantage over females, and an additional year between conferral of one's undergraduate degree and the start of doctoral studies is associated with a two point decline in attrition. Two undergraduate educational characteristics are also marginally significant: students who attended a Top-60 liberal arts college in the U.S. have a 16 point lower predicted dropout rate than those who enrolled in other U.S. programs, while students who attended "other foreign" programs have a 22 point lower attrition rate.

The importance of GRE quantitative scores for survival is surprising given the small variation in this characteristic among entering students. Scores are reported on a scale from 200 to 800, at intervals of 10. The median score in our regression sample is 790. Forty percent scored a perfect 800 on the exam, and 65 percent scored 780 or higher. Under such conditions, it is peculiar that GRE quantitative scores could explain differences in attrition, because applicants with low scores are generally not admitted to economics Ph.D. programs and, therefore, are not included in our sample.

Indeed, only 29 of the entering students had a quantitative GRE score below 700. The five-year drop out rate of these low quantitative GRE achievers is 72 percent, *vis-à-vis* only 32 percent for students with a score of 700 or higher. The message is clear: students admitted with low quantitative GRE scores, presumably because of some other compelling credentials,

[12] A similar probit estimating attrition during years three through five of economics Ph.D. study revealed that nothing correlated with attrition except whether a student had received some first-year financial aid. Those with no aid were more likely to drop out.

[13] Ehrenberg and Mavros (1995) found that GRE scores were not associated with either attrition or completion probabilities for economics Ph.D. students at Cornell.

do not seem to justify such special consideration. Only eight survived five years, and not a single one had earned the Ph.D. by that time.[14]

Verbal GRE scores are harder to interpret than quantitative scores because their meaning differs for students whose first language is not English. Indeed, in estimates reported in the appendix (Table A2), we find a relationship between higher verbal GRE scores and lower attrition probabilities only among non-U.S. citizens.

Although both quantitative and verbal GRE scores help to predict two-year and five-year attrition rates, the size of the effects is modest. A one hundred point rise in score on the quantitative exam lowers expected two-year attrition by only ten percentage points, and five year attrition by only 15 percentage points. A similar boost in the GRE verbal score lowers expected two- or five-year attrition by only four percentage points.

No shared offices identifies four programs that provide no office space to first-year Ph.D. students. Of the other 23 programs, 12 provide office space essentially to all students,[15] and 11 provide offices to teaching assistants only, leaving about half of their first-year students without offices. Thus, the estimated difference in attrition between students with and without office access in their first year is biased downward because about a quarter of the benchmark group also did not have access to an office. Moreover, n*o shared offices* might proxy for fewer resources available to Ph.D. students in general.

While first-year office access is quite important for surviving coursework and comprehensive exams, it does not improve retention once students get beyond their second year.[16] This may reflect the fact that economics Ph.D. students take similar courses and similar comprehensive exams during their first two years, and begin to take different field courses and conduct independent research as they move through the program, culminating with each student writing a unique thesis. Contact with other students in the program is likely

[14] One might speculate that affirmative action is involved in the admission of applicants with lower quantitative GRE scores, but that possibility is not supported by our data. The distribution by race for students who were admitted with quantitative GRE scores under 700 is similar to the distribution by race for the remainder of the sample. Of the 317 students in our sample for whom we know their race (white, Asian, or other), 13.6 percent of the students with quantitative GRE scores under 700 were non-white and non-Asian, compared to 11.1 percent of the students whose quantitative GRE scores were 700 or above, a difference that is not statistically significant at the five percent level. There is also no significant difference among racial groups in the fraction earning a perfect 800.

[15] One program, which provides offices only to students with financial aid, had five students enter without aid.

[16] Although we did not ask about office access in years after the first, more advanced students generally have better access to office space, in which case there would be little variation among programs.

to be more important when they are facing similar challenges, but diminish in value as their work becomes more independent.

The requirement that first-year students attend research seminars appears, paradoxically, associated with eight percentage point lower retention, although this association is statistically significant at only the ten percent level. We also find no association between first-year class size and attrition, a result that conflicts with Groen, et al. (2008), who found higher retention in those humanities and non-economics social science Ph.D. programs with smaller first-year classes. This correlation is usually attributed to the prospect that students get more attention in smaller programs. In addition, the insignificant coefficient on *individual advisers assigned* differs from Ehrenberg, et al. (2007), who found lower attrition in humanities and non-economics Ph.D. programs that have better advising.

There is also evidence that attrition is related to whether matriculants had a prior (usually master's) graduate degree, a bachelor's degree in economics or math, or certain fields of interest (theory or not). In contrast, Ehrenberg and Mavros (1995) found a lower probability of dropping out for students entering with a master's degree in hand.

Differences in Attrition between Men and Women

The predicted five-year dropout rate is about eight percentage points higher for women than men, although only marginally significant. This simple comparison, however, conceals an important similarity and a number of interesting differences in the structure of the attrition relationship between men and women. Separate regression estimates by gender are reported in Appendix Table A1.[17]

The interesting similarity is that attending a Tier 1 or 2 program (relative to a Tier 3 or 4 program) is associated with lower attrition of about 25 percentage points for both men and women. Women, but not men, in private universities experience lower attrition, whereas a significant increase in attrition associated with programs requiring seminar attendance is observed only for men. The separate estimates also indicate that the negative relationship between quantitative GRE scores and the probability of attrition derives more from the women in the sample than from the men.

[17] A test for structural differences in the model between males and females cannot reject the hypothesis that all coefficients are the same for the two groups (p-value = 0.23). However, the R-squared values for the separate regressions are about one-third higher for females than males, suggesting that the variables in the model explain more of the variation in attrition among females than among males.

Only women appear to benefit from a double major in economics and math: those who did so have a 23 percentage point lower dropout rate. On the other hand, only men enjoy lower attrition associated with having earned a bachelor's degree from a U.S. economics Ph.D.-granting university, a Top-60 liberal arts college, a Top-50 foreign university or other foreign university (all relative to "other U.S. schools").

Differences in Attrition by Citizenship

There are also important differences in the structure of the attrition relationship by citizenship (see Appendix Table A2).[18] Non-U.S. citizens more frequently attend Tier 1 or 2 programs than do U.S. citizens; they also are older, earn lower GRE verbal scores, but higher GRE quantitative scores. Non-U.S. citizens are also twice as likely to be in programs with no shared office space. Although similar fractions of both groups hold bachelor's degrees in economics, U.S. citizens are twice as likely to have double majors in economics and mathematics. A striking 60 percent of non-U.S. citizens hold advanced degrees when they start economics Ph.D. study, compared to 14 percent of U.S. citizens.

Although eight characteristics are significantly associated (ten percent level) with five-year attrition for non-U.S. citizens, and seven with attrition for citizens, only the GRE quantitative score has the same sign for both groups! Ten more GRE quantitative points is predicted to reduce attrition of both subsets by about two percentage points.

Another characteristic has significantly *opposite* predicted effects: the assignment of individual advisors seems to reduce attrition among U.S. citizens (by 21 points), but increase attrition among non-U.S. citizens (by 19 points). Why this should occur is unclear, but it creates a policy dilemma for directors of graduate studies.

First-year financial aid matters only for U.S. citizens. Americans not receiving financial aid in their first year of Ph.D. study have a whopping 37 percentage point higher probability of dropping out than those awarded teaching assistantships.

Only non-U.S. citizens attending Tier 1 or 2 programs experience lower attrition—by about 30 percentage points—than those at Tier 3 or 4 programs. Attending programs without office space for first-year graduate students appears to be a large, highly significant

[18] We dropped characteristics of undergraduate institution attended from this estimate (and its counterpart predicting completion) because of collinearity between them and citizenship. A test for structural differences in the model between U.S. citizens and non-U.S. citizens easily rejects the hypothesis that the coefficients are the same for the two groups (p-value < 0.01).

disadvantage for non-U.S. citizens, increasing their expected dropout rate by nearly 30 percentage points. Perhaps non-U.S. citizens, finding themselves in an unfamiliar environment far from the traditional support of friends and family, rely more on local peer support than do citizens. Adding a year between earning a bachelor's degree and entering a Ph.D. program increases retention among U.S. citizens by about five percentage points. Finally, only non-U.S. citizens with bachelor's degrees in economics or mathematics are less likely to drop out than peers holding undergraduate degrees in other fields: for this subset, an economics (only) major cuts predicted attrition by about 12 percentage points, while the benefit from a math/econ double major is almost twice as large.

Endogeneity of Financial Aid in Predicting Attrition

Several independent variables in the attrition model are likely to be endogenous. Obvious candidates are the financial aid indicators, since financial aid likely is awarded on the basis of many of the same factors that affect attrition, as well as on considerations unobservable to us, such as transcripts and letters of recommendation. To address endogeneity, we use a bivariate probit regression approach.[19]

Following Groen, et al. (2008), we identify an equation to predict whether each student received *any* first-year financial aid, using the percentage of the other students that received aid in each program's incoming class as the instrument. This percentage is certainly related to whether a given student receives financial aid, as students in programs that give aid to relatively more students should more likely receive aid themselves, ceteris paribus. It is also not likely to affect an individual's probability of dropping out, as it is based on outcomes for other students at the time of entry into the program. The bivariate probit results are reported in Table 3, where we also include, for comparison, estimates from an identical probit model that does not control for endogeneity of financial aid.

The bivariate probit estimates indicate that once its endogeneity is controlled, financial aid has virtually no independent association with attrition. The effect of aid observed in Table 2, therefore, is overstated because it also reflects the role of individual student characteristics

[19] Because our endogenous variable, *received any financial aid*, is binary, traditional two-stage least squares estimation will not produce consistent estimators [see Wooldridge (2002) section 15.7.3 or Greene (2008) section 23.7]. We also took the simpler approach of estimating an attrition model that excludes the financial aid variable, both for the full sample and for a sample that included only students who received financial aid in the first year. The only difference in these estimates is that the coefficient on the GRE quantitative score becomes smaller and insignificant in the restricted sample.

that independently boost retention and concurrently lead to the award of financial aid. Fortunately, other estimated coefficients from the two models are largely similar, implying that endogeneity does not affect our interpretations of other coefficients in a substantive way. The only exceptions are that coefficients on *Tier 5*, *years since undergraduate degree*, and *attended other foreign undergraduate institution*, while similar to the original estimates, have either gained or lost marginal significance.

We also report in Table 3 estimates from the first-stage regression that predicts whether each student *received any financial aid*. Apart from the *percent of incoming class receiving aid* variable, the only variables statistically significant at the five percent level are the analytical and quantitative GRE scores, both positively related to the probability of receiving financial aid. At the ten percent level, *age at entry to program* is negatively associated with financial aid, while having expressed an interest in economic theory on one's graduate school application (or not having specified a field of interest at all) is associated with higher probability of receiving aid relative to those expressing interest in an applied field of the discipline.

III. Predicting Completion

Producing economics Ph.D.s faster without sacrificing necessary learning leads to greater efficiency. The target time-to-degree at most programs is five years. Only rarely does anyone complete a degree in three years (none in our sample of 586 succeeded) or even four years (eight in our sample did). Most students finish in their fifth or sixth year.

Our data distinguish the 159 students who completed their Ph.D. in five years from the 229 who were still working toward it at the beginning of year six, and the 198 who formally dropped out of their programs. In Table 4 we report results of probit estimates designed to predict which individuals among the original matriculants complete their degrees in five or fewer years.[20]

The completion regression includes the full set of variables we used to predict attrition, plus seven other program characteristics that we expect to influence completion rates but not attrition: each program's two-year dropout rate, the percent of a program's dissertations that consist of a set of essays rather than a single-topic treatise, whether students

[20] As with the attrition regression, 16 of the 586 observations are lost because of missing data.

usually are awarded aid beyond their fifth year of study, whether the program has a hard (inflexible) completion time limit, whether the program has a soft (flexible) completion time limit (versus no time limit at all), whether a pre-thesis research paper is required in the program, and whether students seeking dissertation topics must regularly meet with faculty in order to identify a topic.[21]

The two-year dropout rate is included because one might expect surviving students to complete faster when less motivated or less well prepared students leave their program early (i.e., when program-level two-year dropout rates are higher). This could occur either because high attrition instills motivational fear among survivors, or because having fewer students of a given cohort remaining in the program increases the effective faculty-to-student ratio and the attention students receive while writing dissertations. Alternatively, a higher two-year dropout rate may lower the morale of survivors, slowing their completion. Most importantly, however, inclusion of the two-year attrition rate for each student's institution helps control for the fact that dropouts cannot possibly complete their degree, let alone complete it in five years. The results suggest that a ten percentage point increase in the two-year dropout rate for a student's program is associated with an expected six percentage point decline in the probability of graduating within five years, consistent with the "lower morale" hypothesis. This relationship disappears when the same equation is estimated using a sample restricted to only survivors, however.[22] Apparently, either the hypothesized effects of dropouts on survivors do not exist, or they cancel each other.

Among other program-specific characteristics, only *no shared offices* and *first-year class size* are significant at the five percent level. The results indicate that students at programs without any office space for first-year students have a five-year completion probability 25 percentage points lower than students at programs where at least some first-year students have offices. We also find that an increase of one student in the entering class (where average size is 26 students) is associated with a one percentage point rise in the expected probability of completion. Both the direction and size of this association are surprising. Bowen and Rudenstine (1992) found directly contradictory evidence, attributing

[21] We also estimated the completion regression while excluding the program tier variables. The results do not differ substantially from those reported in Table 4.

[22] When the completion model is estimated while excluding those who had dropped out in the first two years, the other results are qualitatively similar to those presented in Table 4.

higher completion rates at smaller programs to the ability of faculty dealing with fewer students to devote more personal attention to each of them.

Two other program characteristics are significant at the ten percent level. First, despite lower attrition, students enrolled in Tier 1 or 2 programs have a 13 percentage point *lower* completion rate — perhaps because of more generous financial aid or more active service as teaching or research assistants. Second, requiring a pre-thesis research paper turns out, surprisingly, to be related to a *lower* predicted five-year completion probability (by 12 percentage points), suggesting that such a paper inhibits thesis progress rather than building a foundation for it. Several undergraduate institutional characteristics also matter. Having earned a bachelor's degree at a Top-60 selective liberal arts college increases the expected probability of earning a Ph.D. within five-years by 27 percentage points relative to having attended an "other" U.S. college or university. Interestingly, students who earned their bachelor's degree at a U.S. economics Ph.D.-granting university are not more likely to complete their Ph.D. in five years than those from "other" U.S. institutions. There is also a large difference (albeit statistically significant at only the ten percent level) in expected completion rates between those who graduated from foreign universities and those who graduated from "other" U.S. institutions. Those from Top-50 foreign universities have a 34 percentage point greater probability of earning their Ph.D. in five-years than students from "other" U.S. colleges and universities, while those from other foreign institutions have a 19 percentage point advantage.

Only two student characteristics are significantly associated with five-year completion probabilities (and only at the ten percent level). Males are predicted to have about a six percentage point higher probability of completion than females, while students with bachelor's degrees in economics have about a nine point lower probability of having finished than those with other fields of concentration, notwithstanding lower attrition.

Unlike with attrition, no GRE score is related to completing the Ph.D. in five years. Neither does first-year financial aid affect completion, perhaps because the amount and incidence of aid may change as students progress through a Ph.D. program.[23]

[23] As with the attrition model, estimates from a completion regression that includes indicators of specific programs rather than more general program characteristics yield results largely similar to those in Table 4. Two exceptions are that the coefficient on *U.S. Top-60 liberal arts* is slightly less significant (p-value = 0.09), and the effect of *no aid* is larger (-0.115) and significant (p-value = 0.02).

Although our sample is more representative across program tiers, our completion estimates are quite similar to those in Athey, et al. (2007), who estimated probit regressions to predict completion probabilities for 782 Ph.D. students who entered four Tier 1 economics programs in the 1990s. Like us, they found no difference in completion probabilities based on GRE scores or gender, but found higher expected probabilities of completion for Ph.D. students whose undergraduate degrees were earned at a foreign university. In some specifications they also found a positive relationship between completion and holding an undergraduate degree from an elite program, although they limit their focus to Top-5 rather than Top-60 liberal arts colleges.

Differences in Completion between Men and Women

As with attrition, we also estimated the completion model separately for men and women. These results, reported in Appendix Table A3, again indicate marked differences by sex.[24] Females who attend Tier 1 or 2 programs have lower probabilities of completion than their peers at Tier 3 or 4 programs, while no such difference emerges for males. For men, attending programs with *no shared offices* appears to lower completion probabilities by 24 percentage points. Unlike the findings for attrition, office availability appears to matter more for completion among men than women, although even among women the effect — a nine point lower probability of completion — is marginally significant.

Women who attend programs that require students to pass written comprehensive or preliminary exams before the start of their second academic year have a 21 percentage point higher probability of completion than women in other programs; the effect on males appears to be zero. There is evidence of a "low morale" impact of the two-year dropout rate on completion among women, and, importantly, it persists in (unreported) estimates on a sample restricted to just those that had not dropped out. Again, no association between completion and early attrition is observed for men. It appears that women (but not men) attending programs where students must regularly meet with faculty in order to identify a thesis topic or where the program has an inflexible completion time limit have lower probabilities of finishing in five years. Finally, only for men is a pre-thesis research requirement significantly associated with lower probability of completion.

[24] A test for structural difference in the model between men and women rejects the hypothesis that the models are structurally the same at the 0.03 significance level.

Only a few student and prior educational characteristics have much influence on the probability of completion when the model is estimated separately by sex, and strong associations are observed only for men. Men having majored in mathematics have an 18 percentage point *lower* probability of finishing in five years, perhaps reflecting that while mathematics skills help students in the first years of the Ph.D. program, they are less helpful for finding dissertation topics and writing dissertations because students tailor the style of their theses to the skills at which they excel. Curiously, no such result appears for females with math majors, even though they account for a larger share of all women in our sample relative to men. Finally, men with bachelor's degrees from an economics Ph.D.-granting university or Top-60 liberal arts college have a completion probability advantage of 44 and 59 percentage points, respectively, relative to peers who attended other U.S. undergraduate institutions; but for women with these prestigious degrees there is no completion advantage.

Differences in Completion by Citizenship

Estimates of the completion regression run separately by citizenship are reported in Appendix Table A4.[25] Unlike for attrition, where the probit predicted retention somewhat better for non-U.S. citizens, the completion model predicts much better for U.S. citizens, as the two pseudo coefficients of determination reveal.

Among non-U.S. citizens, only two program-level variables are significant at the five percent level. Higher faculty-student ratios are associated with higher completion rates, perhaps reflecting the relative value of access to faculty by non-U.S. citizens. More program-level attrition in the first two years is associated with lower completion probabilities (the low morale effect again) among non-U.S. citizens, but has no effect on U.S. citizens. However, this apparent relationship evaporates when it is re-estimated on a sample limited to survivors.

For U.S. citizens, attending Tier 1 or 2 programs, programs providing no shared office space, and programs requiring a pre-thesis research paper all lower completion. Larger first-year class size (increasing the probability of completion by three percentage points for each additional first-year student), requiring passing a comprehensive exam to proceed beyond the

[25] A test for structural differences in the model between citizens and non-U.S. citizens rejects the hypothesis that the models are structurally the same at the 0.01 significance level

first year, and having individual advisers for each incoming student are all associated with higher completion probabilities for U.S. citizens.

Male citizens have higher probabilities of completion within five years, but males from abroad have no such advantage. Strangely, U.S. citizens with undergraduate degrees in economics or mathematics have *lower* probabilities of completion than the 27 percent of U.S. citizens who majored in something else! Perhaps less undergraduate exposure to economics and mathematics renders such citizens less able to serve as teaching and research assistants, thereby speeding their completion by reducing distractions. In contrast, the much larger fraction of non-U.S. citizens with prior graduate degrees (60 percent versus only 14 percent for citizens) may have made their choice of undergraduate major less important. Finally, not being awarded financial aid during the first year of study is associated with a 19 percentage point lower probability of completion among citizens, but has no impact on completion among non-U.S. citizens. Could it be that foreign born students who are self-financed in their first year bring greater motivation and energy to doctoral studies than their counterparts who received financial aid? This would be consistent with our earlier finding that first-year financial aid had no apparent influence on the attrition of non-U.S. citizens.

Endogeneity of Financial Aid in Predicting Completion

As in predicting attrition, the potential endogeneity of financial aid may produce inconsistent estimates of completion. We again address this issue by estimating a bivariate probit model that includes program-level financial aid availability to identify whether a student received financial aid in their first year of Ph.D. study. Although most coefficients in the bivariate probit regression are qualitatively consistent with those reported in Table 4, they are highly sensitive to model specification, causing us to question their validity.

IV. Conclusion

About one in four potential economics Ph.D.s earns a degree within five years. Of all 586 entrants to 27 economics Ph.D. programs in fall 2002, 27 percent had their degree in hand by fall 2007. Thirty-four percent had officially left their Ph.D. program, leaving 39 percent of the entering cohort still working at the start of their sixth year.

Regarding financial aid, we find that U.S. citizens who receive first-year aid are less likely to drop out and more likely to complete their degree within five years; the effect on

attrition is larger than the effect on completion. This is consistent with the results of Groen, et al. (2008), who find that more generous financial aid has a larger impact on reducing attrition than on encouraging completion among humanities and social science Ph.D. students (most of whom are U.S. citizens). Ehrenberg, et al. (2007) note that while financial aid affects attrition among the humanities students in their sample each year, it begins to improve graduation probabilities only in year six, a year beyond that for which we (so far) have data on the entering economics Ph.D. class of fall 2002. Importantly, we believe, controlling for the endogeneity of financial aid suggests that aid has little effect on either attrition or completion independent of the differences in personal characteristics between students who are and are not awarded financial aid.

The empirical estimates do not provide much guidance about how to improve U.S. economics Ph.D. completion rates. One reason is that different characteristics are associated with completion probabilities for women and men, and for citizens and non-U.S. citizens. It appears that increasing cohort size would help (at least for U.S. citizens), although how and why is a mystery, since the usual hypotheses about cohort size imply higher completion rates for smaller rather than for larger cohort sizes. Avoiding situations where no students (especially men and U.S. citizens) have access to shared offices seems to be important for both retention and degree completion, and might be singled out as the most obvious policy change that we could recommend for those programs that do not currently provide space for their first-year economics Ph.D. students. On the other hand, the narrow scope of this characteristic, together with its frequently large probit coefficient, suggests that it may be a proxy for much broader policies, including the amount of resources devoted to the Ph.D. program and the degree of faculty commitment to the early integration of entering students into that program. Our results also suggest that completion rates could be increased by admitting fewer applicants with GRE quantitative scores below 700. Not one of the 29 such entrants in fall 2002 had earned a Ph.D. by fall 2007.

Giving more admission preference to applicants who earned bachelor's degrees at one of America's selective liberal arts colleges might improve completion rates a bit. But, in the end, it appears that many considerations unique to individual students and faculty that we cannot measure — such as ambition, motivation, persistence, organizational skills, and the creativity of students, and interest in students' success as well as mentoring and motivational skills among graduate faculty — matter more than the myriad of characteristics we were able

to measure, which collectively account for less than 15 percent of the variation in completion among students.

References

Athey, Susan, Lawrence F. Katz, Alan B. Krueger, Steven Levitt, and James Poterba. "What Does Performance in Graduate School Predict? Graduate Economics Education and Student Outcomes." *American Economic Review*, 2007 (*Papers and Proceedings*), 97(2), pp. 512-518.

Bowen, William G. and Neil L. Rudenstine. *In Pursuit of the Ph.D.* Princeton NJ: Princeton University Press, 1992.

Council of Graduate Schools. *Ph.D. Completion and Attrition: Analysis of Baseline Program Data from the Ph.D. Completion Project.* Washington DC: Council of Graduate Schools, 2008.

Ehrenberg, Ronald, and P. G. Mavros. "Do Doctoral Students' Financial Support Patterns Affect their Times-to-Degree and Completion Probabilities?" *Journal of Human Resources*, 1995, 30(3), pp. 581-609.

Ehrenberg, Ronald, George H. Jakubson, Jeffrey Groen, Eric So, and Joseph Price. "Inside the Black Box of Doctoral Education: What Program Characteristics Influence Doctoral Students' Attrition and Graduation Probabilities?" *Educational Evaluation and Policy Analysis,* 2007, 29(2), pp. 134-150.

Goldberger, Marvin; Maher, Brendan A and Flattau, Pamela E., eds. *Research-Doctorate Programs in the United States: Continuity and Change.* Washington DC: National Academies Press, 1995.

Greene, William H. *Econometric Analysis, Sixth Edition*, Upper Saddle River New Jersey: Pearson/Prentice Hall, 2008.

Groen, Jeffrey A., George H. Jakubson, Ronald G. Ehrenberg, Scott Condie, and Albert Y. Liu. "Program Design and Student Outcomes in Graduate Education." *Economics of Education Review*, 2008, 27(2), pp. 111-124.

Siegfried, John J. and Wendy A. Stock. "The Labor Market for New Ph.D. Economists." *Journal of Economic Perspectives*, 1999, 13(3), pp. 115-134.

Siegfried, John J. and Wendy A. Stock. "The Market for New Ph.D. Economists in 2002." *American Economic Review*, 2004 (*Papers and Proceedings*), 94(2), pp. 272-285.

Stock, Wendy A. and W. Lee Hansen, "Ph.D. Program Learning and Job Demands: How Close is the Match?" *American Economic Review*, 2004 (*Papers and Proceedings*), 94(2), pp. 266-271.

Stock, Wendy A., T. Aldrich Finegan, and John J. Siegfried, "Attrition in Economics Ph.D. Programs," *American Economic Review*, 2006 (*Papers and Proceedings*), 96(2), pp. 458-466.

Stock, Wendy A. and John J. Siegfried. “Time-to-Degree for the Economics Ph.D. Class of 2001-2002.” *American Economic Review*, 2006 (*Papers and Proceedings*), 96(2), pp. 467-474.

Wooldridge, Jeffrey M. *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press, 2002.

Table 1 - Ph.D. Program Attrition and Completion Rates, by Program Rank

	Tier					
	1	2	3	4	5	Total
Program Rank	1-6	7-15	16-30	31-48	>48	-
Number of programs	3	6	7	6	5	27
Number of students	103	149	141	127	66	586
First year attrition rate	2.9$^{<}$	12.8	10.6	22.0$^{>}$	22.7$^{>}$	13.7
Second year attrition rate	10.7	4.7$^{<}$	22.0$^{>}$	17.3	15.2	13.8
Third year attrition rate	1.0	3.4	2.1	3.1	9.1$^{>}$	3.2
Fourth year attrition rate	0.0	2.7	2.8	2.4	0.0	1.9
Fifth year attrition rate	0.0	1.3	2.8$^{>}$	0.0$^{<}$	1.5	1.2
Total two year attrition rate	13.6$^{<}$	17.4$^{<}$	32.6$^{>}$	39.4$^{>}$	37.9$^{>}$	27.5
Total five year attrition rate	14.6$^{<}$	24.8$^{<}$	40.4	44.9$^{>}$	48.5$^{>}$	33.8
Still in program rate	52.4$^{>}$	43.6	33.3	31.5$^{<}$	34.8	39.1
Ph.D. completion rate	33.0	31.5	26.2	23.6	16.7$^{<}$	27.1

Attrition, still in program, and completion rates are all calculated relative to the original population of entering students (N=586), and are reported as percentages. The > and < superscripts indicate that the rate is statistically different from the rate for the rest of the sample at the 0.05 significance level (two-tailed tests).

Table 2 - Predicting Attrition, probit regressions
(Dependent Variable = 1 if student dropped out)

	1	*2*		*3*		*4*	
		dropout years 1-2		*dropout years 1-2*		*dropout years 1-5*	
	mean	*dY/dX*[a]	*z-stat.*	*dY/dX*[a]	*z-stat.*	*dY/dX*[a]	*z-stat.*
Program Characteristics							
Tier 1 or 2	0.44	-0.213**	-3.96	-0.210**	-3.90	-0.216**	-3.70
Tier 3 or 4	0.46			-	-	-	-
Tier 5	0.10	-0.141**	-2.18	-0.155**	-2.39	-0.137*	-1.66
First-year class size	26.39	0.000	0.07	0.000	0.05	0.000	-0.07
Faculty-student ratio	0.27	0.166	0.54	0.144	0.47	0.109	0.31
Private university	0.42	-0.037	-0.56	-0.049	-0.71	-0.054	-0.73
Terminal master's degree offered	0.15	-0.054	-0.71	-0.054	-0.71	-0.052	-0.61
Seminar attendance required	0.59	0.081*	1.65	0.081*	1.66	0.086*	1.64
Core exam pass required	0.65	0.060	1.34	0.060	1.31	0.023	0.46
No shared offices	0.17	0.217**	2.16	0.233**	2.30	0.160	1.51
Individual advisers assigned	0.32	0.054	1.10	0.055	1.10	0.062	1.13
Student Characteristics							
GRE analytical score ($*10^{-1}$)	72.38	-0.003	-1.28	-0.003	-1.22	-0.004	-1.34
GRE verbal score ($*10^{-1}$)	56.32	-0.004**	-2.49	-0.004**	-2.58	-0.004**	-2.02
GRE quantitative score ($*10^{-1}$)	77.19	-0.011**	-2.17	-0.010**	-2.09	-0.015**	-2.75
U.S. Citizen	0.34	0.032	0.63	-0.096	-1.40	-0.080	-1.00
Male	0.65	-0.051	-1.20	-0.055	-1.28	-0.076*	-1.64
Age at entry to program	25.40	0.000	-0.04	-0.002	-0.22	0.004	0.39
Hold prior graduate degree	0.45	-0.024	-0.50	-0.010	-0.21	-0.021	-0.40
Hold undergraduate degree in economics	0.70	-0.077	-1.55	-0.076	-1.54	-0.070	-1.30
Hold undergraduate degree in economics/math	0.09	-0.127*	-1.74	-0.143*	-1.95	-0.128	-1.54
Years since undergraduate degree	2.66	-0.020*	-1.71	-0.017	-1.43	-0.023*	-1.70
Theory field interest	0.34	-0.035	-0.77	-0.033	-0.72	-0.040	-0.82
Other field interest	0.41	-	-	-	-	-	-
No specified field of interest	0.25	-0.007	-0.14	-0.002	-0.04	-0.011	-0.20
Type of Undergraduate Institution Attended							
U.S. economics Ph.D.-granting	0.25	-	-	-0.102	-1.27	-0.108	-1.13
U.S. top-60 liberal arts	0.09	-	-	-0.121	-1.40	-0.163*	-1.64
Other U.S.	0.05	-	-	-	-	-	-
Top-50 foreign	0.04	-	-	-0.205**	-2.01	-0.193	-1.44
Other foreign	0.57	-	-	-0.264**	-2.59	-0.216*	-1.88
Financial Aid During First Year							
Fellowship	0.47	0.040	0.73	0.050	0.90	0.051	0.84
Research assistantship	0.05	-0.146*	-1.64	-0.145	-1.60	-0.106	-0.98
Teaching assistantship	0.28	-	-	-	-	-	-
No aid	0.20	0.120**	1.98	0.135**	2.22	0.194**	2.91
Number of Observations	570	570		570		570	
Pseudo R-squared		0.128		0.138		0.133	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Asterisks indicate coefficients with p-values less than 0.05 (**) and 0.10 (*). Z-statistics are adjusted for heteroskedasticity.

Table 3 - Predicting Attrition, probit and bivariate probit regressions

		Bivariate Probit				Probit	
		dropout years 1-5		*received any financial aid*		*dropout years 1-5*	
Program Characteristics	*mean*	*dY/dX*[a]	*z-stat.*	*dY/dX*[a]	*z-stat.*	*dY/dX*[a]	*z-stat.*
Tier 1 or 2	0.44	-0.174**	-3.55	-0.012	-0.28	-0.190**	-3.40
Tier 3 or 4	0.46	-	-	-	-	-	
Tier 5	0.10	-0.067	-1.06	0.034	0.59	-0.136*	1.66
First-year class size	26.39	0.000	0.25	-0.005	-1.27	0.000	0.05
Faculty-student ratio	0.27	0.349	0.76	0.236	0.89	0.153	0.44
Private university	0.42	-0.063	-0.07	-0.057	-1.05	-0.053	-0.75
Terminal master's degree offered	0.15	-0.071	-0.06	-0.067	-0.96	-0.058	-0.64
Seminar attendance required	0.59	0.068	1.38	0.008	0.21	0.081	1.54
Core exam pass required	0.65	0.003	0.21	-0.005	-0.11	0.024	0.48
No shared offices	0.17	0.166	1.27	0.088	1.43	0.162	1.53
Individual advisers assigned	0.32	0.031	1.12	-0.041	1.13	0.052	0.96
Student Characteristics							
GRE analytical score ($*10^{-1}$)	72.38	-0.002	-1.40	0.004**	2.01	-0.004	-1.19
GRE verbal score ($*10^{-1}$)	56.32	-0.003**	-2.01	0.000	0.32	-0.003*	-1.93
GRE quantitative score ($*10^{-1}$)	77.19	-0.008**	-3.00	0.015**	3.90	-0.016**	-2.86
U.S. Citizen	0.34	-0.076	-0.76	-0.048	-0.74	-0.007	-0.10
Male	0.65	-0.061	-1.53	0.000	0.01	-0.072	-1.54
Age at entry to program	25.40	-0.001	-0.52	-0.013*	-1.71	0.004	0.31
Hold prior graduate degree	0.45	-0.019	-0.39	-0.004	-0.10	-0.022	-0.43
Hold undergraduate degree in economics	0.70	-0.046	-1.32	0.026	0.72	-0.067	-1.24
Hold undergraduate degree in economics/math	0.09	-0.085	-1.55	0.068	1.23	-0.112	-1.34
Years since undergraduate degree	2.66	-0.014*	-1.76	0.012	1.39	-0.021	-1.60
Theory field interest	0.34	-0.010	-0.95	0.061*	1.83	-0.039	-0.81
Other field interest	0.41	-	-	-	-	-	
No specified field of interest	0.25	0.037	0.12	0.062*	1.74	-0.005	0.10
Financial Aid During First Year							
Received any financial aid	0.80	0.007	-0.06	-	-	-0.186**	3.34
Percent of incoming class receiving aid	0.80	-	-	0.902**	8.19	-	-
Type of Undergraduate Institution Attended							
U.S. economics Ph.D.-granting	0.25	-0.097	-0.88	-0.070	-0.88	-0.104	-1.09
U.S. top-60 liberal arts	0.09	-0.135	-1.43	-0.051	-0.53	-0.163	-1.63
Other U.S.	0.05	-		-	-	-	-
Top-50 foreign	0.04	-0.199	-1.13	-0.266	-1.60	-0.191	-1.41
Other foreign	0.57	-0.201	-1.48	-0.102	-1.25	-0.205*	-1.77
Number of Observations	570		570			570	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean, estimated using the bivariate probit model. Asterisks indicate coefficients with p-values less than 0.05 (**) and 0.10 (*).

Table 4 - Predicting Completion, probit regression
(Dependent Variable = 1 if student completed Ph.D. within five years)

Program Characteristics	*Mean*	*dY/dX* [a]	*z-stat.*
Tier 1 or 2	0.44	-0.132*	-1.66
Tier 3 or 4	0.46	-	-
Tier 5	0.10	0.092	0.90
First-year class size	26.39	0.013**	2.17
Faculty-student ratio	0.27	0.623	1.43
Private university	0.42	0.127	1.37
Terminal master's degree offered	0.15	0.097	0.88
Seminar attendance required	0.59	-0.039	-0.58
Core exam pass required	0.65	0.028	0.43
No shared offices	0.17	-0.247**	-2.75
Individual advisers assigned	0.32	0.023	0.36
Program-level two year attrition rate	0.28	-0.632*	-1.64
Percent of dissertations essays	67.20	0.002	1.36
More than five years full financial aid usual	0.21	-0.057	-0.79
Hard completion time limit	0.23	0.016	0.13
Soft completion time limit	0.46	0.073	0.97
Pre-thesis research required	0.46	-0.116*	-1.67
Topic seeker meetings with faculty	0.42	0.028	0.43
Student Characteristics			
GRE analytical score ($*10^{-1}$)	72.38	0.002	0.70
GRE verbal score ($*10^{-1}$)	56.32	0.000	-0.17
GRE quantitative score ($*10^{-1}$)	77.19	0.008	1.39
U.S. Citizen	0.34	0.044	0.58
Male	0.65	0.065*	1.64
Age at entry to program	25.40	-0.009	-0.80
Hold prior graduate degree	0.45	-0.027	-0.56
Hold undergraduate degree in economics	0.70	-0.087*	-1.77
Hold undergraduate degree in economics/math	0.09	-0.101	-1.39
Years since undergraduate degree	2.66	0.012	1.01
Theory field interest	0.34	0.009	0.19
Other field interest	0.41	-	-
No specified field of interest	0.25	-0.011	-0.21
Type of Undergraduate Institution Attended			
U.S. economics Ph.D.-granting	0.25	0.164	1.41
U.S. top-60 liberal arts	0.09	0.273**	1.98
Other U.S.	0.05	-	-
Top-50 foreign	0.04	0.337*	1.89
Other foreign	0.57	0.194*	1.71
Financial Aid During First Year			
Fellowship	0.47	-0.005	-0.09
Research assistantship	0.05	0.116	0.96
Teaching assistantship	0.28	-	-
No aid	0.20	-0.092	-1.61
Number of Observations	570	570	
Pseudo R-squared		0.128	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Asterisks indicate coefficients with p-values less than 0.05 (**) or 0.10 (*).

Table A1 - Predicting Attrition, probit regressions by gender
(Dependent Variable = 1 if student dropped out in years 1-5)

	Males			Females		
Program Characteristics	*mean*	*dY/dX*[a]	*z-stat.*	*mean*	*dY/dX*[a]	*z-stat.*
Dropout years 1-5	0.32	-	-	0.38	-	-
Tier 1 or 2	0.46	-0.231**	-3.20	0.40	-0.265**	-2.58
Tier 3 or 4	0.44	-	-	0.51	-	-
Tier 5	0.10	-0.125	-1.29	0.09	-0.255	-1.54
First-year class size	26.5	0.003	0.53	26.2	-0.009	-0.92
Faculty-student ratio	0.27	-0.035	-0.08	0.27	0.688	1.06
Private university	0.42	0.066	0.73	0.44	-0.261**	-2.04
Terminal master's degree offered	0.16[>b]	-0.005	-0.05	0.12[<]	-0.124	-0.82
Seminar attendance required	0.57	0.132*	1.95	0.61	0.062	0.68
Core exam pass required	0.64	0.002	0.03	0.66	-0.016	-0.16
No shared offices	0.19[>]	0.104	0.83	0.13[<]	0.326	1.37
Individual advisers assigned	0.32	0.091	1.26	0.34	0.022	0.24
Student Characteristics						
GRE analytical score (*10^{-1})	71.2[<]	-0.008**	-2.25	73.6[>]	0.008	1.28
GRE verbal score (*10^{-1})	55.2[<]	-0.003	-1.19	58.5[>]	-0.007*	-1.92
GRE quantitative score (*10^{-1})	77.2	-0.015**	-2.32	77.1	-0.031**	-2.59
U.S. Citizen	0.36	-0.053	-0.52	0.29	0.023	0.13
Age at entry to program	25.8[>]	0.001	0.10	24.7[<]	0.003	0.10
Hold prior graduate degree	0.46	0.027	0.41	0.42	0.021	0.19
Hold undergraduate degree in economics	0.74[>]	-0.05	-0.72	0.64[<]	-0.102	-1.09
Hold undergraduate degree in economics/math	0.08	-0.023	-0.19	0.12	-0.229*	-1.73
Years since undergraduate degree	2.9[>]	-0.016	-0.97	2.3[<]	-0.047*	-1.66
Theory field interest	0.36[>]	0.011	0.19	0.30[<]	-0.127	-1.39
Other field interest	0.39	-	-	0.45	-	-
No specified field of interest	0.25	-0.068	-0.99	0.25	0.134	1.40
Type of Undergraduate Institution Attended						
U.S. economics Ph.D.-granting	0.27[>]	-0.192*	-1.82	0.20[<]	0.207	0.95
U.S. top-60 liberal arts	0.08	-0.240**	-2.39	0.10	0.189	0.77
Other U.S.	0.06	-	-	0.04	-	-
Top-50 foreign	0.05	-0.231*	-1.69	0.04	0.224	0.62
Other foreign	0.54	-0.296**	-2.17	0.62	0.111	0.47
Financial Aid During First Year						
Fellowship	0.47	0.021	0.28	0.47	0.072	0.64
Research assistantship	0.04	-0.092	-0.67	0.06	-0.109	-0.58
Teaching assistantship	0.28	-	-	0.28	-	-
No aid	0.21	0.218**	2.68	0.19	0.158	1.25
Number of Observations		371			199	
Pseudo R-squared		0.153			0.204	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Z-statistics are adjusted for heteroskedasticity. Asterisks indicate coefficients with p-values less than 0.05 (**) or 0.10 (*).

[b] The > and < superscripts indicate that the mean is statistically different from the mean for the rest of the sample at the 0.05 significance level (two-tailed tests).

Table A2 - Predicting Attrition, probit regressions by citizenship
(Dependent Variable = 1 if student dropped out in years 1-5)

	non-U.S. Citizens			U.S. Citizens		
Program Characteristics	*mean*	*dY/dX*[a]	*z-stat.*	*mean*	*dY/dX*[a]	*z-stat.*
Dropout years 1-5	0.32	-	-	0.37	-	-
Tier 1 or 2	0.48[>b]	-0.300**	-4.28	0.37[<]	0.063	0.51
Tier 3 or 4	0.43	-	-	0.51	-	-
Tier 5	0.09	-0.171*	-1.82	0.12	-0.002	-0.01
First-year class size	27.2[>]	-0.006	-0.99	24.8[<]	0.004	0.41
Faculty-student ratio	0.27[<]	-0.130	-0.32	0.29[>]	0.462	0.73
Private university	0.45	-0.064	-0.74	0.38	-0.121	-0.90
Terminal master's degree offered	0.12[<]	-0.008	-0.07	0.19[>]	-0.240*	-1.67
Seminar attendance required	0.58	0.095	1.45	0.60	0.116	1.21
Core exam pass required	0.65	-0.028	-0.46	0.64	0.137	1.45
No shared offices	0.20[>]	0.287**	2.10	0.10[<]	0.044	0.22
Individual advisers assigned	0.29[<]	0.186**	2.55	0.38[>]	-0.214**	-2.46
Student Characteristics						
GRE analytical score ($*10^{-1}$)	71.9[<]	-0.005	-1.53	73.3[>]	0.001	0.19
GRE verbal score ($*10^{-1}$)	54.3[<]	-0.003*	-1.67	60.4[>]	-0.005	-1.00
GRE quantitative score ($*10^{-1}$)	78.1[>]	-0.019*	-1.92	75.4[<]	-0.019**	-2.47
Male	0.63	-0.035	-0.65	0.70	-0.095	-1.08
Age at entry to program	25.8[>]	0.000	0.01	24.6[<]	0.039*	1.67
Hold prior graduate degree	0.60[>]	-0.040	-0.68	0.14[<]	-0.024	-0.17
Hold undergraduate degree in economics	0.71	-0.121**	-2.01	0.69	0.031	0.27
Hold undergraduate degree in economics/math	0.07[<]	-0.227**	-2.44	0.14[>]	0.079	0.47
Years since undergraduate degree	3.0[>]	-0.016	-0.87	2.1[<]	-0.051**	-2.01
Theory field interest	0.37[>]	-0.042	-0.72	0.29[>]	-0.117	-1.14
Other field interest	0.40	-	-	0.43	-	-
No specified field of interest	0.23	0.068	1.01	0.28	-0.193*	-1.83
Financial Aid During First Year						
Fellowship	0.49	0.083	1.13	0.43	-0.010	-0.09
Research assistantship	0.05	-0.081	-0.65	0.05	-0.201	-0.90
Teaching assistantship	0.27	-	-	0.30	-	-
No aid	0.19	0.079	0.93	0.22	0.370**	3.35
Number of Observations		379			191	
Pseudo R-squared		0.176			0.220	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Z-statistics are adjusted for heteroskedasticity. Asterisks indicate coefficients with p-values less than 0.05 (**) or 0.10 (*).

[b] The > and < superscripts indicate that the mean is statistically different from the mean for the rest of the sample at the 0.05 significance level (two-tailed tests).

Table A3 - Predicting Completion, probit regressions by gender
(Dependent Variable = 1 if student completed Ph.D. within five years)

	Males			Females		
Program Characteristics	*Mean*	*dY/dX* [a]	*z-stat.*	*Mean*	*dY/dX* [a]	*z-stat.*
Complete Ph.D. within five years	0.28	-	-	0.25	-	-
Tier 1 or 2	0.46	-0.055	-0.57	0.40	-0.253**	-3.61
Tier 3 or 4	0.44	-	-	0.51	-	-
Tier 5	0.10	0.077	0.64	0.09	0.068	0.48
First-year class size	26.5	0.015**	2.19	26.2	0.014*	1.66
Faculty-student ratio	0.27	0.076	0.15	0.27	1.232**	2.09
Private university	0.42	0.182	1.61	0.44	-0.026	-0.22
Terminal master's degree offered	0.16[>b]	0.311**	2.03	0.12[<]	-0.088**	-2.08
Seminar attendance required	0.57	0.067	0.81	0.61	-0.078	-0.97
Core exam pass required	0.64	-0.014	-0.18	0.66	0.211**	3.18
No shared offices	0.19[>]	-0.243**	-2.12	0.13[<]	-0.092*	-1.80
Individual advisers assigned	0.32	0.104	1.24	0.34	-0.053	-0.84
Program-level two year attrition rate	0.27	0.001	0.00	0.28	-2.142**	-3.99
Percent of dissertations essays	67.2	0.001	0.56	67.3	0.004**	2.50
More than five years full financial aid usual	0.23	-0.176**	-2.14	0.17	0.096	1.36
Hard completion time limit	0.24	0.227	1.41	0.21	-0.138**	-2.12
Soft completion time limit	0.45	0.115	1.31	0.49	0.096	1.12
Pre-thesis research required	0.47	-0.186**	-2.16	0.44	-0.045	-0.91
Topic seeker meetings with faculty	0.43	0.052	0.72	0.41	-0.199**	-2.70
Student Characteristics						
GRE analytical score ($*10^{-1}$)	71.2[<]	0.005	1.46	73.6[>]	-0.002	-1.20
GRE verbal score ($*10^{-1}$)	55.2[<]	0.000	-0.21	58.5[>]	0.000	-0.12
GRE quantitative score ($*10^{-1}$)	77.2	0.009	1.28	77.1	0.002	0.59
U.S. Citizen	0.36	-0.056	-0.57	0.29	0.006	0.10
Age at entry to program	25.8[>]	-0.005	-0.33	24.7[<]	-0.011	-1.13
Hold prior graduate degree	0.46	-0.049	-0.81	0.42	-0.015	-0.39
Hold undergraduate degree in economics	0.74[>]	-0.084	-1.28	0.64[<]	-0.071*	-1.67
Hold undergraduate degree in economics/math	0.08	-0.184**	-2.14	0.12	0.000	0.01
Years since undergraduate degree	2.9[>]	0.012	0.81	2.3[<]	0.007	0.72
Theory field interest	0.36[>]	0.038	0.66	0.30[<]	-0.047*	-1.64
Other field interest	0.39	-	-	0.45	-	-
No specified field of interest	0.25	0.026	0.37	0.25	-0.055*	-1.94
Type of Undergraduate Institution Attended						
U.S. economics Ph.D.-granting	0.27[>]	0.409**	2.37	0.20[<]	-0.060	-1.05
U.S. top-60 liberal arts	0.08	0.587**	2.96	0.10	-0.059	-1.22
Other U.S.	0.06	-	-	0.04	-	-
Top-50 foreign	0.05	0.369	1.40	0.04	0.080	0.48
Other foreign	0.54	0.254	1.44	0.62	0.010	0.10
Financial Aid During First Year						
Fellowship	0.47	0.048	0.65	0.47	-0.066	-1.34
Research assistantship	0.04	0.040	0.27	0.06	-0.049	-0.87
Teaching assistantship	0.28	-	-	0.28	-	-
No aid	0.21	-0.118*	-1.72	0.19	-0.063	-1.63
Number of Observations		371			199	
Pseudo R-squared		0.157			0.279	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Z-statistics are adjusted for heteroskedasticity. Asterisks indicate coefficients with p-values less than 0.05 (**) or 0.10 (*).

[b] The > and < superscripts indicate that the mean is statistically different from the mean for the rest of the sample at the 0.05 significance level (two-tailed tests).

Table A4 - Predicting Completion, probit regressions by citizenship
(Dependent Variable = 1 if student completed Ph.D. within five years)

	non-U.S. Citizens			U.S. Citizens		
Program Characteristics	*Mean*	*dY/dX* [a]	*z-stat.*	*Mean*	*dY/dX* [a]	*z-stat.*
Complete Ph.D. within five years	0.27	-	-	0.27	-	-
Tier 1 or 2	0.48[>b]	-0.090	-0.82	0.37[<]	-0.241**	-2.50
Tier 3 or 4	0.43	-	-	0.51	-	-
Tier 5	0.09	0.147	1.09	0.12	-0.081	-0.75
First-year class size	27.2[>]	0.003	0.37	24.8[<]	0.030**	3.53
Faculty-student ratio	0.27[<]	1.099**	1.96	0.29[>]	-0.624	-0.93
Private university	0.45	-0.051	-0.44	0.38	0.494**	2.46
Terminal master's degree offered	0.12[<]	-0.008	-0.06	0.19[>]	0.431*	1.66
Seminar attendance required	0.58	-0.130	-1.38	0.60	0.087	0.86
Core exam pass required	0.65	-0.064	-0.71	0.64	0.216**	2.50
No shared offices	0.20[>]	-0.151	-1.01	0.10[<]	-0.176**	-2.87
Individual advisers assigned	0.29[<]	-0.153*	-1.90	0.38[>]	0.357**	2.46
Program-level two year attrition rate	0.28	-1.119**	-1.97	0.27	-0.395	-0.55
Percent of dissertations essays	68.9[>]	0.000	0.14	63.8[<]	0.004**	2.40
More than five years full financial aid usual	0.22	-0.026	-0.28	0.18	-0.079	-0.98
Hard completion time limit	0.22	-0.169	-1.09	0.25	0.340	1.13
Soft completion time limit	0.48	0.020	0.21	0.42	0.164	1.51
Pre-thesis research required	0.45	-0.024	-0.27	0.48	-0.320**	-3.19
Topic seeker meetings with faculty	0.45[>]	-0.041	-0.54	0.37[<]	0.071	0.60
Student Characteristics						
GRE analytical score ($*10^{-1}$)	71.9[<]	0.000	-0.07	73.3[>]	0.012**	2.41
GRE verbal score ($*10^{-1}$)	54.3[<]	0.000	-0.24	60.4[>]	0.003	0.80
GRE quantitative score ($*10^{-1}$)	78.1[>]	0.004	0.53	75.4[<]	-0.007	-1.04
Male	0.63	0.009	0.18	0.70	0.135**	3.01
Age at entry to program	25.8[>]	-0.016	-1.19	24.6[<]	-0.014	-0.75
Hold prior graduate degree	0.60[>]	-0.025	-0.46	0.14[<]	0.074	0.70
Hold undergraduate degree in economics	0.71	-0.020	-0.36	0.69	-0.230**	-2.80
Hold undergraduate degree in economics/math	0.07[<]	-0.079	-0.81	0.14[>]	-0.124**	-2.20
Years since undergraduate degree	3.0[>]	0.019	1.26	2.1[<]	0.004	0.25
Theory field interest	0.37[>]	-0.002	-0.04	0.29[>]	0.053	0.83
Other field interest	0.40	-	-	0.43	-	-
No specified field of interest	0.23	0.045	0.64	0.28	0.018	0.26
Financial Aid During First Year						
Fellowship	0.49	0.005	0.07	0.43	-0.049	-0.63
Research assistantship	0.05	0.190	1.05	0.05	-0.061	-0.74
Teaching assistantship	0.27	-	-	0.30	-	-
No aid	0.19	0.015	0.18	0.22	-0.193**	-4.17
Number of Observations		379			191	
Pseudo R-squared		0.112			0.379	

[a] Reports predicted change in the probability for a one-unit change in the independent variable at the mean. Z-statistics are adjusted for heteroskedasticity. Asterisks indicate coefficients with p-values less than 0.05 (**) or 0.10 (*).

[b] The > and < superscripts indicate that the mean is statistically different from the mean for the rest of the sample at the 0.05 significance level (two-tailed tests).