Time to the Doctorate and the Labor Market for New PhD Recipients *

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Abstract

Training for a doctorate takes an amount of time that varies widely across students within a given field. This paper considers the influence of the labor market for new PhD recipients on time to the doctorate. The demand side of the labor market for graduates in a given field varies from year to year. This variation affects the opportunity cost of remaining a student and thus affects the incentive for students to complete their degrees. This paper uses micro data from the Survey of Earned Doctorates together with annual counts of job listings from 1975 to 2005 in seven fields in the humanities and social sciences. Estimates from a discrete-time duration model show an effect of the job market on the probability of completion (in a given year) that is positive and statistically significant. The estimates imply that permanently increasing the number of job listings in a field by 10 percent reduces expected time to degree by 0.26 year and increases the cumulative probability of completing within 8 years by 3.0 percentage points. Simulations using the model estimates reveal that the observed time-series variation in job listings explains 72 percent of the variation over time in average time to degree within fields.

Keywords: Time to degree, Doctoral degrees, Academic labor market

JEL codes: I23 (Higher education), J2 (Demand and supply of labor), J44 (Professional labor markets)

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1. Introduction

Unlike training for professional degrees such as an MBA or a JD, doctoral education is characterized by its "open-endedness" (Shulman 2010). Training for a PhD takes an amount of time that varies widely across students within a given field. In the humanities, for example, the median time from entering graduate school to earning a PhD for students who received their degrees in 2005 was 9.7 years (Hoffer et al. 2006), but some students take as little as 5 or 6 years while others take 11 or 12 years (Ehrenberg, Zuckerman, Groen, and Brucker 2009).

This paper considers the influence of the labor market for new PhD recipients on time to the doctorate. Within a field the demand side of the labor market varies from year to year as the number of employers hiring and the number of positions available depend on macroeconomic conditions, state budgets, and university priorities. As a result, two students from the same department seeking jobs in consecutive years may face quite different sets of opportunities.

The open-endedness of doctoral education allows PhD students the opportunity to adjust their completion decisions to match the labor market—thereby reducing the influence of market risk on their job outcomes. Students can choose when to go on the job market, and even if they are unsuccessful in finding a (desirable) job they can choose to remain enrolled while continuing to search for jobs. As a student in English noted, "I could certainly have finished my dissertation up to a year sooner, if I had had a job in prospect. I chose to delay my defense and graduation by one year in order to continue qualifying for a teaching assistantship, which in turn enabled me to retain my health insurance and to defer my undergrad loan repayment."[1]

Many observers of U.S. doctoral education believe that a poor job market in a field lengthens time to degree (TTD), but there is no credible evidence of such a relationship. The history professor Anthony Grafton, in an article on state of graduate education in the humanities,

[1] This quotation is taken from a response to the Graduate Education Survey (Ehrenberg et al. 2009).

remarked, “In most years, new Ph.D.s—to say nothing of all qualified job seekers—outnumbered new jobs. No wonder, then, that the time to degree grew longer and longer, as students clung to subsistence income in the pleasant cities and college towns they already knew” (Grafton 2010, p. 34).

When the Andrew W. Mellon Foundation started its Graduate Education Initiative, which provided $58 million over 10 years (1991–2000) to 54 humanities departments at 10 major research universities, the Foundation initially planned to evaluate its effects on student outcomes using changes over time within participating departments. However, the poor academic job market in the 1990s led to concerns that the job market was dragging down student outcomes (such as lengthening TTD and raising attrition). To try to separate the effect of the job market from the effect of the program, the Foundation decided to add a set of control departments to its evaluation strategy (Ehrenberg et al. 2009).

Determining the effect of the job market on TTD is important so that researchers and practitioners can understand the relative effects on TTD of the job market and other factors such as student funding, program design, and advising.[2] Institutions are increasingly concerned about long TTD and high attrition rates in PhD programs (Ehrenberg et al. 2009). The extent to which TTD is influenced by the job market can inform decisions on institutional policies such as whether to set limits on TTD and/or the number of years PhD students may receive institutional funding.

At a more macro level, answering the research question of this paper can improve understanding of time-series fluctuations in TTD for particular fields of study. Average TTD over all fields shows very little change over time, but for a given field there is considerable year-

[2] Prior research on the influences on TTD includes Abedi and Benkin (1987), Ehrenberg et al. (2007), Ehrenberg and Mavros (1995), Groen, Jakubson, Ehrenberg, Condie, and Liu (2008), Siegfried and Stock (2001), and Tuckman, Coyle, and Bae (1990).

to-year variation (Hoffer et al. 2006). How much of this variation is due to changes on the demand side of the labor market for new doctorates?

The relationship between TTD and the job market is also relevant for research that attempts to identify cohort effects in labor markets for doctorate recipients (e.g., Oyer 2006). These studies typically assume that job-market conditions do not affect characteristics of doctorate recipients.[3] However, if job-market conditions affect TTD, then students graduating when the job market is strong would have lower average TTD than students graduating when the job market is weak. As a result, time-series variation in job-market conditions would be correlated with graduates' TTD, which itself is related to graduates' job outcomes (Ehrenberg et al. 2009).

This paper makes several contributions relative to most of the prior literature. First, it constructs appropriate measures of the demand side of the labor market, based on job listings from seven academic fields over a 30-year period.[4] Second, it approaches the problem econometrically using a duration model with both fixed and time-varying explanatory variables. Third, it uses individual-level data on doctorate recipients, which allows one to control for individual variables such as financial aid and demographics.

The remainder of the paper proceeds as follows. The next section presents a conceptual framework of student progress towards the PhD. Section 3 describes the dataset used in the empirical analysis, which covers seven fields in the humanities and social sciences and is based

[3] Studies of cohort effects in labor markets have also examined MBAs (Oyer 2008) and bachelor's degrees (Kahn 2010; Oreopolous, von Wachter, and Heisz 2008). The papers on bachelor's degrees try to account for the fact that the timing and location of college graduation could be affected by economic conditions.

[4] Several authors have noted the difficulty in measuring the strength of the job market for new doctorates. Stephan and Ma (2005, p. 72) remarked: "Measures of the strength of the job market are notoriously difficult to construct. For example, information on academic job vacancies is not readily available." Given this difficulty, some papers (e.g., Abedi and Benkin 1987) have not even controlled for changing market opportunities for doctorates in different fields over time. Other papers (e.g., Ehrenberg and Mavros 1995; Stephan and Ma 2005) used proxies, but these proxies do not adequately isolate the demand side of the labor market for new doctorate recipients.

on the Survey of Earned Doctorates and annual counts of job listings by field from 1975 to 2005. Section 4 presents the econometric model that is used to capture the influence of the labor market on the probability of a student completing the PhD in a given year. The empirical estimates are presented in Section 5, and some implications of the results are discussed in Section 6.

2. Conceptual Framework

To motivate the empirical analysis, this section outlines a conceptual framework for understanding how the labor market relates to student progress towards the PhD. Prior to discussing the problem at the micro level, a few preliminary statements are in order to situate the problem at the macro level. Consider the academic labor market in the United States in a particular field (such as history or economics) in terms of a standard model of supply and demand. The demand for labor in the field shifts due to changes in state appropriations, the performance of university endowments, changes in the size of college-going cohorts, and other factors.

When the demand curve shifts out, the market equilibrium shifts along the supply curve, and both wages and the quantity of labor increase. The amount that quantity increases depends on the elasticity of supply. One component of the supply elasticity is the responsiveness of the production of new PhDs to a change in demand. Given the typical length of time from entering a doctoral program to earning a PhD, it is not feasible for new entrants to PhDs programs to generate an increase in the number of doctoral recipients in the short run in response to an increase in demand.

However, students who are already enrolled in PhD programs and working on their dissertations could speed up their progress in order to move more quickly into the job market. At the market level, then, this paper addresses whether the number of PhDs produced in a field responds to short-run changes in demand in the academic labor market via completion behavior of existing students. The overall elasticity of supply is also affected by the responses of other potential suppliers, including doctorate holders who are not currently working, those working in the non-academic sector, and those working in other countries.[5]

At the micro level, the speed at which a student progresses towards the PhD is determined by a variety of factors. Some of the factors relate to the student's institution or department, such as funding, advising, and course requirements. Other factors are largely in control of students, including the effort and amount of time they devote to their studies and research as compared to leisure activity and outside employment.

Students can be expected to influence their degree progress by balancing the costs and benefits of additional time spent working on their research and writing. Chief among the benefits is the quality of the dissertation; in turn, a better dissertation may lead to a better job. Other benefits that are productive for the student include access to library resources at her university and easy access to advisors, classmates, and others on campus. Remaining a PhD student rather than finishing up also confers several consumption benefits, including on-campus student housing, subsidized health insurance, and the student lifestyle.

The costs of longer TTD include the direct financial costs (i.e., tuition and related expenses) as well as the opportunity cost of remaining a student compared to finishing up and getting a job. This cost reflects the greater payoff in the labor market to having a PhD due to being qualified for academic jobs and other jobs requiring a PhD.[6] The financial payoff to obtaining a PhD in a field is a function of starting salaries for academic positions, the number of

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[5] Figure 1 in Ehrenberg (1992) illustrates the complexity of the supply side of the academic labor market.

[6] The relationship between opportunity costs and PhD time to degree has been emphasized in general terms by Breneman (1976) and Tuckman, Coyle, and Bae (1990). The role of opportunity costs in influencing undergraduate TTD has been considered by Messer and Wolter (2010).

academic positions available, and the availability of nonacademic alternatives for those with doctorates. Beyond opportunity costs, longer TTD can be costly by providing a negative signal of individual ability; if student takes 5 years to finish a dissertation, how much research can he be expected to produce as an assistant professor? Even in the humanities (a set of fields with long average TTD), degree times longer than 8 years are associated with worse job outcomes (Ehrenberg et al. 2009).

The strength of the academic job market in a given field would influence the speed of student progress (and hence TTD) primarily through opportunity costs. An increase in demand in the academic labor market would raise the financial payoff to obtaining a PhD, thereby increasing the opportunity cost of remaining a student. This cost can be considered an increasing function of the probability of getting an academic job, the starting salary of that job, and the status of that job (e.g., tenure status and type of institution).

Conceptually, the decision problem faced by doctoral students is similar to other economic problems. One related problem is job search by unemployed workers in the presence of time-varying labor-market conditions (e.g., Ham and Rea 1987). Just as a long duration of unemployment can be associated with a high reservation wage, a long TTD can be associated with high standards for an academic placement. A difference between these two problems is that it can be productive for doctoral students to refrain from searching for jobs, especially during their coursework; this is analogous to an unemployed worker seeking additional training before searching. Another related problem is the decision of a homeowner to place a house on the market as a function of the local demand for housing. Taking the home off the market and fixing it up is analogous to improving the dissertation, while having a house on the market for many months is analogous to doctoral students having long TTD.

3. Data

The empirical analysis in the paper is based on micro data on individuals who received doctorates from 1975 to 2005. The data are from the Survey of Earned Doctorates (SED), which is a census of research doctorates from U.S. universities. The survey, which is sponsored by the National Science Foundation and five other U.S. government agencies, is administered to doctorate recipients once they finish their degree requirements. The response rate is very high (usually over 90 percent annually), and basic information for nonrespondents (field of study, degree date, doctorate institution, and sex) is obtained from their degree-granting institutions and from public records (Hoffer et al. 2006).

Though the SED covers all fields of study, the sample used in this paper is restricted to seven fields in the humanities and social sciences: anthropology, classics, economics, English, history, philosophy, and political science. This restriction is made due to the availability of data on job listings (described below).

The primary measure of TTD used in this analysis is the number of years from graduate entry to the PhD, where "graduate entry" is defined as the entrance into the first institution after the first baccalaureate was earned. For students who completed a stand-alone master's degree before entering a PhD program, "graduate entry" would be defined as the start of the master's program. As a result, for some students the TTD measure overstates the amount of time spent working on the PhD.

Two alternative measures of TTD can be constructed using the SED data. The first is the number of years from the baccalaureate to the PhD. This measure also overstates the amount of time spent working on the PhD, but it is well defined and available for the entire sample period, 1975–2005. The second alternative measure more closely approximates the amount of time spent working on the PhD, but it is available for only the last 13 of the 31 years in the sample period, 1992–2005. This measure is the number of years from PhD entry to the PhD, where "PhD entry" is defined as the year of entry into any graduate program at the institution that awarded the doctorate.[7] In Section 5, I document that my main results are robust to alternative measures of TTD.

In addition to TTD, several other variables are created from the student responses to the SED. Financial aid received by students is summarized by the primary source of support during graduate school. Information on each student's institution and field are used to assign a rank of the graduate program from the National Research Council 1993 rankings (Goldberger, Maher, and Flattau 1995). Programs are ranked within each field by the average rating of the scholarly quality of program faculty. Also available from the SED are standard demographic variables (age, sex, and race/ethnicity) along with citizenship.

Table 1 summarizes the personal characteristics of doctorate recipients in the seven fields from 1975 to 2005. Table 2 summarizes the distribution of TTD by field over this period. Median TTD is largest in anthropology (9.8 years) and is smallest in economics (7.3 years). In each field the mean TTD exceeds the median TTD, reflecting the long right tail of the distribution of TTD. Within fields there is substantial variation in TTD across students, with a difference of 5 years between the 25th and 75th percentiles being typical. In anthropology, for example, one-fourth of doctorate recipients took 7.7 years or less while one-fourth took 13 years or more.

As a secondary source of student-level data, I use data from 57 departments in six fields (the seven fields in the SED sample, except economics) that were involved in an evaluation of

[7] This measure of TTD includes time spent in a master's program if the master's degree was awarded by the same institution as the PhD. But for students who didn't attend their PhD institution as a graduate student prior to starting their PhD program, this measure accurately captures time spent working on the PhD.

the Mellon Foundation's Graduate Education Initiative (GEI) (Groen et al. 2008). These departments came from 10 major research universities and had graduate programs that were highly ranked (usually in the top 20 percent by field). The data cover all students who started PhD programs in these departments between 1982 and 2002. The primary advantages of the GEI data relative to the SED data are (1) a measure of TTD that starts when students enter a PhD program and (2) better control variables, including student-quality measures (GRE scores and an indicator for having a master's degree upon entry to the PhD program) and annual information on financial support.

I measure job-market conditions using the annual number of job listings in each field. I collected these data from a professional association for each of the seven fields (see Appendix A). Each association serves a vital organizing role in the labor market for doctorate recipients in a discipline by publishing listings (advertisements) of job vacancies. As a measure of labor demand, the counts of job listings I use in the paper are an improvement over the proxy variables used in the literature on the academic labor market. For example, Ehrenberg and Mavros (1995) use the mean starting salary for new assistant professors in a field and Stephan and Ma (2005) use the percentage change in total current-fund revenue for public institutions.

Despite their appeal at the conceptual level, counts of job listings in disciplinary employment services are an imperfect measure of the labor demand for new doctorate recipients for several reasons. First, the counts typically include listings for positions of all ranks, including positions for full professors as well as those for assistant professors. Second, a given listing is often published multiple times (for instance, in October and November), and in some cases the total number of listings includes only new listings whereas in other cases the total includes both new and repeat listings. Third, a given listing can advertise multiple vacancies; in some cases the figure used in the analysis is the total number of listings whereas in others the figure used is the total number of vacancies. I deal with the second and third issues by allowing differences across fields but ensuring consistency over time within a field.

Another issue is that at a given point in time, a given job service contains most but not all of the listings that are of interest to new doctorates in a given field. A concern with the time series is that the composition of jobs that are included in the listings could change over time. This could happen if either (1) the types of jobs that are included changes over time or (2) there is differential growth in the jobs that are included and excluded from the listings. An example of (1) is if non-academic jobs are increasingly included in the listings. An example of (2) is if non-tenure-track jobs are excluded from the listings but grow faster than tenure-track jobs over time (Cross and Goldenberg 2009; Ehrenberg and Zhang 2005).

Given these measurement issues, I provide several pieces of evidence that counts of job listings are a good measure of the labor demand for new doctorate recipients. First, time-series trends are similar across fields, as shown by Figure 1.[8] This pattern is clearest in the bottom panel of the figure, which normalizes the number of job listings by the field-specific average. (The normalized measure of job listings is the one that is used in the remainder of the empirical analysis.) That time trends are similar suggests that listings are a good measure of demand because field-specific demands should be correlated due to the influence of common factors, such as state appropriations.

Second, job listings are correlated with fiscal variables that are plausibly related to demand. As shown in Table 3, variation over time in job listings (controlling for field differences) is correlated with the national unemployment rate (negatively), state appropriations

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[8] The pattern in the figure is confirmed by the joint significance of year effects in a regression of job listings on field dummies and year dummies.

per student (positively), college expenditures per student (positively), and faculty salaries (positively). (See Appendix A for details on the fiscal variables.)

The time-series relationship of job listings to the national unemployment rate is shown in the top panel of Figure 2. (The measure of job listings shown is the average across fields in the normalized counts.) A negative correlation between the series is obvious: the time pattern of job listings is a mirror image of the pattern followed by the unemployment rate. The bottom panel of Figure 2 compares job listings to a standard proxy for vacancies across the economy—the Conference Board's help-wanted index, which is based on the help-wanted advertisements in 51 major newspapers and on the internet.[9] Although the series are not highly correlated, they follow a similar time pattern, with each peak and through in job listings coming one or two years after the corresponding one for the help-wanted index.

Third, I consider whether job listings, the unemployment rate, or the help-wanted index is a better predictor of job outcomes for new PhDs.[10] The unemployment rate has been used as a time-varying measure of labor demand in studies of cohort effects for college graduates (Kahn 2010; Oreopolous, von Wachter, and Heisz 2008). The help-wanted index has been used as a proxy for job vacancies (e.g., Abraham and Katz 1986, Shimer 2005). Although they are widely used in analysis of the economy as a whole, these measures may not adequately represent the demand for new PhDs because the labor market in a particular discipline is very specialized.

To measure the job outcomes of new PhD recipients, I use their responses to questions in the SED regarding postgraduation plans. The survey asks whether a graduate has made a definite commitment for work or further training (such as a postdoc). For those who have a

[9] As explained in Appendix A, the help-wanted index used here is the newspaper index through December 1994 and then a composite index based on the newspaper index and the number of online ads.
[10] Oyer (2006) showed that the number of academic job listings in economics at the time of completion is correlated with the quality of initial placement.

definite job commitment, the survey also asks about the type of employer. I construct five indicator variables for job plans and regress each on a measure of demand conditions in the year of completion. These regressions are linear probability models that include controls for field, rank of the doctoral program, TTD, and demographic characteristics. Because the regressions include controls for field, the estimated effect of job listings on job outcomes is identified from variation in job listings over time within fields.

Compared to the other two measures, job listings are a better predictor of job outcomes of new PhD recipients. Table 4 reports the estimated coefficient on the demand measure in each regression. For job listings, the coefficient is positive and statistically significant for all five job outcomes. By contrast, the estimated coefficient is of the expected sign and statistically significant for only two of the outcomes when the unemployment rate is used and for none of the outcomes when the help-wanted index is used.

4. Econometric Model

I use a duration model to capture the influence of the labor market on doctoral completions. Because the counts of job listings are constructed on an academic-year basis, I use a discrete-time duration model. For each graduate in the SED, I determine the academic year of entry to graduate school (t_e) and the academic year of the PhD (t_p). (For the latter, I assign PhDs awarded in the fall to the prior academic year.) Then I compute TTD as the number of academic years between entry and completion ($t_p - t_e + 1$). Following Ham and Rea (1987) and Jenkins (1995), I arrange the student data with one observation per year for each student. These data are then matched by year and field to the counts of job listings.

For a student who enters graduate school in academic year t_{0i}, I assume that the probability of the student completing the PhD in year in the program t (1, 2,…), given that the student has not yet graduated, takes the form

$$\lambda(t_{0i}, t) = \frac{\exp[y_i(t_{0i}, t)]}{1+\exp[y_i(t_{0i}, t)]}, \text{ where } y_i(t_{0i}, t) = \theta + h(t) + \gamma' X_i + \beta' Z_i(t_{0i} + t - 1).$$

In this equation, θ is a constant; $h(t)$ is a vector of dummy variables for year in the PhD program; X_i is a vector of time-invariant characteristics; and Z_i is a vector of time-varying characteristics (for academic year $t_{0i} + t - 1$), including the count of job listings.

For most students in the SED, we observe that they graduated in academic year $t_{0i} + t^* - 1$; thus, their TTD is t^* years. The probability of the completed spell is

$$g_i(t_{0i}, t_i^*) = \left\{\prod_{t=1}^{t_i^*-1}[1 - \lambda_i(t_{0i}, t)]\right\} \lambda_i(t_{0i}, t_i^*).$$

For other students, the count of job listings is not available for the year that they graduated, so in my analysis dataset they are incomplete spells. Their TTD is censored at $\overline{t_i}$, and we know only that TTD exceeds $\overline{t_i}$. The contribution to the likelihood function for these cases is

$$[1 - G(t_{0i}, \overline{t_i})] = \prod_{t=1}^{\overline{t_i}}[1 - \lambda_i(t_{0i}, t)].$$

The likelihood function is then

$$L = \prod_{i \in C} g_i(t_{0i}, t_i^*) \prod_{i \in IN}[1 - G(t_{0i}, \overline{t_i})],$$

where C denotes completed spells, and IN denotes incomplete spells. Parameter estimates are obtained by maximizing L with respect to the parameters. This can be done using a standard logit program with a dependent variable equal to 1 for the year the student graduates and equal to 0 for other years. Because the measure of job listings does not vary across student-year observations in the same year and field, I compute standard errors that allow for correlation in the error term within cells defined by year and field.

To aid the interpretation of the estimates, I compute the implied marginal effects of job listings on expected TTD. Given the parameter estimates, expected TTD is

$$E(TTD) = \sum_{t=1}^{T} t \cdot g(t_0, t),$$

where T is the maximum TTD observed. For this calculation, I set the X and Z variables at their mean values. The effect of changing demand conditions on expected TTD can be obtained by numerically differentiating this equation. The interpretation of this effect is how expected TTD would respond to a permanent increase in the number of job listings.

I implement this model using the SED data by limiting the sample to doctorate recipients with TTD between 4 and 20 years.[11] I organize the student data into multiple observations per individual, with one observation for each academic year from the fourth year of graduate school to the year of the PhD. Then I match the SED data to the counts of job listings by academic year and field for academic years 1975–2005. Some fields do not have jobs data for this entire period (see Figure 1). I require that students have jobs data for the start of their spells (year 4), but I allow students to have missing jobs data after that—in which case their spells are right censored at the last year for which they have jobs data.[12] The final sample used in the estimation consists of 445,205 observations on 72,330 individuals.

The key independent variable is the number of job listings in a year relative to the field-specific mean. The other time-varying explanatory variables are student age (which is grouped into 12 categories) and year-in-program dummies (single years 4–18 and years 19 and 20 combined). The time-invariant explanatory variables include dummy variables for field; thus, the variation in job listings that identifies the estimates is variation over time within fields. The remaining time-invariant variables are rank of the doctoral program, source of support, gender,

[11] There are only a handful of individuals with TTD less than 4 years. There are relatively more graduates with TTD more than 20 years—about 5 percent of all graduates in the overall sample.
[12] Only 1 percent of the spells in my analysis sample are right censored.

and citizenship/race.[13] Program rank is parameterized using 11 categories, with 10 of these for deciles of the distribution (1 for highest rank to 10 for lowest rank) within field and one category for programs that do not appear in the 1993 NRC rankings.

5. Results

Parameter estimates are shown in Table 5. The estimated coefficient on job listings is 0.951 and is statistically significant. Since it is positive, the estimated coefficient indicates that a stronger job market increases the probability of completion in a given year—which translates into a shorter TTD. The estimated coefficients on the ranking variables imply that TTD is higher for students in lower-ranked programs. Compared to using personal funds, having a teaching assistantship, research assistantship, or fellowship as a primary source of support is associated with a larger probability of completion (shorter TTD); this relationship may reflect that higher-ability students are more likely to be awarded support, because measures of student ability are not available in the SED. All else equal, the estimates imply that women have longer TTD than men; non-U.S. citizens have longer TTD than white U.S. citizens; and among U.S. citizens, non-whites have longer TTD than whites.[14]

I compute the marginal effect of job listings on expected TTD by first predicting the probability of completion for each year t=4–20 for a student who has not graduated by the beginning of year t. For this prediction, I use the estimated parameters and set the independent variables (except the year dummies) equal to their sample means; the year dummies are set to correspond to the year of the conditional probability. From these predicted probabilities I

[13] The SED also collects information on marital status and the number of children, but I do not include this information in my analysis. In the SED this information refers to the time of PhD completion, so it can be influenced by a student's TTD.
[14] The estimated effect of citizenship is somewhat surprising because other research (Ehrenberg and Mavros 1995; Siegfried and Stock 2001) has found non-U.S. citizens to have lower TTD than U.S. citizens. Because this pattern is evident in the summary statistics reported in Table 1, the estimated effect from the duration model probably arises from the inclusion of particular control variables in the model.

compute the expected TTD for the baseline case, which is 9.27 years. Then I increase job listings by 10 percent (from 1.0 to 1.1) and re-do the calculations; expected TTD falls to 9.01 years, a difference of 0.26 year. This is a sizeable effect. As shown in Table 6, the increase in job listings increases the cumulative probabilities of completing in 6 years by 1.68 percentage points, in 8 years by 2.99 percentage points, and in 10 years by 3.04 percentage points.

The estimated effects of the job market presented thus far are average effects across the seven fields. To allow the effects to vary by field, I replace the job-listings variable in the baseline model with interaction terms between job listings and the field dummies. I also follow a similar procedure for estimating separate effects by rank group and year in the program. Parameter estimates and marginal effects on TTD for these specifications are shown in Table 7.

For all fields, ranking groups, and years in the program, a stronger job market increases the probability of completion in a given year. Across fields, the estimated marginal effects of job listings on TTD are smallest for English and largest for history. Across ranking groups, the estimated marginal effects are fairly uniform. Notably, the job market matters even for students at highly ranked departments—which is consistent with faculty guiding student placement to maximize their own prestige (Breneman 1976). Across years in the program, estimated effects are fairly uniform across years 5–12 and smaller in year 4 and after year 12.[15]

A potential concern about the validity of the estimates is that the measure of TTD begins at the time of entry into the first graduate program after the bachelor's degree. For students who completed a master's degree at one institution and then a PhD at another, this measure of TTD overstates the amount of time spent in the doctoral program. As discussed in Section 3, the SED provides two alternative measures of TTD: time from the baccalaureate to the PhD (available for

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[15] Marginal effects on expected TTD are not reported in Table 7 for the model with interactions by year in the program because it would not make sense to compute them. This is because evaluating the effect on expected TTD requires computing conditional probabilities of completion for each year.

the full sample period, 1975–2005) and time from PhD entry to the PhD (available for 1992–2005). There are large differences in average TTD across the three measures: for doctorates awarded 1992–2005, average time to the PhD is 7.3 years from PhD entry, 9.0 years from graduate entry, and 10.5 years from BA receipt.[16]

Despite the differences in scale, the three measures of TTD lead to roughly similar estimates of the effect of job listings on completion probabilities and TTD. Table 8 reports results of the baseline model for alternative measures of TTD separately for two ranges of exit years. For 1975–2005, the estimated marginal effect of job listings on expected TTD is -0.24 when graduate entry is used to define TTD and -0.28 when BA receipt is used. For 1992–2005, the estimated marginal effects are -0.24 when PhD entry is used, -0.37 when graduate entry is used, and -0.40 when BA receipt is used. Intuitively, the estimates should be similar across the measures of TTD because the research question relates to the point of exit from a doctoral program, and that is common to all three measures.

The regression results reported in Table 9 demonstrate that the estimated effect of job listings is similar in the SED data and the GEI data. Using data for students from the departments in the GEI data who completed their PhDs between 1992 and 2002 and a common specification (columns 3 and 4), the estimated marginal effect of job listings on expected TTD is -0.27 in the SED data and -0.29 in the GEI data.[17] In addition, the demographic differences in

[16] These figures come from the samples used in estimating the results reported in Table 8. As such, the averages are for doctorate recipients with TTD between 4 and 20 years. In samples without this restriction, the averages for 1975–2005 (N=102,217) are 10.3 years from graduate entry and 12.1 years from BA receipt; the averages for 1992–2005 (N=50,150) are 7.7 years from PhD entry, 10.4 years from graduate entry, and 12.4 years from BA receipt.
[17] Exit years 1992–2002 are used to compare the SED and GEI datasets because the TTD measure involving PhD entry is available in the SED for 1992–2005 and the GEI data are available for exit years 1985–2002.

the probability of completion are similar across datasets, with women having lower probabilities than men and non-U.S. citizens having higher probabilities than white U.S. citizens.[18]

The GEI results also clarify the roles of student ability and financial support. As expected, both measures of student ability (GRE scores and having a prior master's degree) are positively related to the probability of completion (shorter TTD). Compared to having no support, each type of support is negatively related to the probability of completion (longer TTD). The effects of financial support estimated from the SED are of the opposite pattern; the difference in patterns likely reflects that the SED does not contain measures of student ability and its measures of support do not vary over time for a given student. In other words, the measured effects of support in the SED reflect differences in student ability, which are correlated with support.

6. Implications

The process of computing a marginal effect of job listings on expected TTD involves increasing job listings by 10 percent and holding it at the increased level permanently. This is somewhat artificial because the actual year-to-year variation (see Figure 1) in job listings involves ups and downs. As an alternative way of representing the magnitude of the estimated effect of job listings on TTD, I compute how much of the observed year-to-year variation in field-specific TTD can be accounted for by year-to-year variation in job listings.

In the raw data from the SED, there is substantial variation in field-specific TTD by year of PhD. Figure 3 contains time-series plots of average TTD by field using two variables based on the time from graduate entry to the PhD. The first involves a continuous measure of TTD at

[18] Note that the estimated effect of citizenship for the SED data in Table 9 is of the opposite sign as the effect estimated for the baseline model (Table 5). The difference arises because the baseline model uses SED data on students in all departments who completed their degrees between 1975 and 2005 whereas the estimates reported in Table 9 are based on SED data for students in GEI departments who completed their degrees between 1992 and 2005.

the individual level (based on the month and year of entry and the month and year of the PhD) and is based on all doctorate recipients (regardless of their TTD). The second involves the discrete measure of TTD used in the duration model (based on the year of entry and year of the PhD) and is based on doctorate recipients with TTD between 4 and 20 years—the same restriction used in constructing the sample for the duration model. Each series shows substantial year-to-year variation within field. This variation may be caused by a variety of factors in addition to the job market for doctorate recipients, including trends in student demographics, student quality, and the size of entering cohorts (Bowen, Lord, and Sosa 1991).

To relate variation in field-specific TTD to variation in job listings, I use the SED data and parameter estimates from the baseline model to simulate expected TTD by entry year and field. I construct a synthetic dataset in which each doctorate recipient in the estimation sample contributes 17 observations, one for each potential year in the program from year 4 to year 20. These observations are matched to the jobs data by academic year to get the number of job listings (relative to the field-specific mean) for that year in the student's field. The remaining explanatory variables in the model (e.g., age and financial support) are based on the actual values for each student.

For each student, I use the model estimates and the values of the explanatory variables to predict conditional probabilities of completion for each year in the program, and I use them to compute the probability of completing in each year. From these probabilities I compute expected TTD (over years 4–15) for each student separately for two scenarios: (1) using the actual number of job listings in each year, and (2) holding that number at the field-specific average in all years.[19] Figure 4 plots averages of expected TTD by entry year and field. There is

[19] I chose year 15 rather than year 20 as the upper limit of the range for computing expected TTD in order to increase the number of entry cohorts for which predictions are available.

much less variation over time in average expected TTD when average jobs are used instead of actual jobs. The difference in variation between the two series (within a field) reflects the importance of time-series variation in job listings as a factor in trends in average TTD.

More concretely, let SD_{act} and SD_{avg} denote the standard deviation of average expected TTD using actual and average jobs, respectively, within a field. SD_{act} measures the total variation over time in average expected TTD, across all factors that serve as explanatory variables in the model. By constrast, SD_{avg} measures the variation over time in average expected TTD that remains after time-series variation in job listings is removed. Therefore, the share of total variation in average expected TTD that comes from time-series variation in jobs is $(SD_{act} - SD_{avg}) / SD_{act}$. The average of this statistic over the seven fields is 71.7 percent.[20] Therefore, among the potential factors represented in my model, the labor demand for new doctorate recipients is a dominant factor in time-series trends in average TTD within fields.

Another implication of the results of this paper concerns the design of research on cohort effects in labor markets for doctorate recipients. One notable study (Oyer 2006) found that economists who graduated when the labor market was strong obtained better initial jobs and had better long-term outcomes (job quality and publications) than economists who graduated when the market was weak. In that study, regressions were estimated in which a long-term outcome was a function of initial job placement and the number of economics job listings in the year of completion served as an instrument for initial job placement.

The validity of the instrument in this context requires that job-market conditions are uncorrelated with individual characteristics that are related to job outcomes. The results of my analysis suggest that this is not the case. In particular, the time-series variation in average TTD

[20] When I use year 10 as the cutoff for computing expected TTD, the average across fields in the share of total variation that is explained by jobs is 86.7 percent. When I use year 20 as the cutoff, the average share explained is 49.8 percent.

together with the estimated effect of job listings on expected TTD suggest that the composition of graduates by TTD varies with job-market conditions. These findings, along with evidence that TTD is independently related to job outcomes (Ehrenberg et al. 2009), suggest that Oyer's estimation strategy is problematic. However, the strategy could be rescued by adding control variables for TTD.

7. Conclusion

The state of the job market in a field is a constant concern for PhD students and their faculty advisors. Students want to know whether they will be able to find a job, and faculty members want to know whether the number and type of jobs available in the market in a given year will be sufficient to place their graduating students and maintain the department's reputation. The influence of the labor market for new PhD recipients on time to the doctorate is an important issue in graduate education, but there is no systematic empirical evidence on this relationship. This paper makes progress on this issue by constructing credible measures of the demand side of the labor market over a 30-year period and using student-level data on all doctorates awarded by U.S. universities in seven fields in the humanities and social sciences.

The demand-side measures are based on the annual number of job listings advertised by professional associations. I present several pieces of evidence that counts of job listings are a good measure of the labor demand for new doctorate recipients. First, time-series trends are common across fields, reflecting the influence of common factors such as state appropriations. Second, job listings are correlated with fiscal variables that are plausibly related to labor demand. Third, job listings are correlated with job outcomes of new PhD recipients, and listings are a better predictor of outcomes than is the national unemployment rate or the help-wanted index.

Estimates from a discrete-time duration model show an effect of the job market on the probability of completion (in a given year) that is positive and statistically significant. The estimates imply that permanently increasing the number of job listings in a field by 10 percent reduces expected time to degree by 0.26 year and increases the cumulative probability of completing within 8 years by 3.0 percentage points. Simulations using the model estimates reveal that the observed time-series variation in job listings explains 72 percent of the variation over time in average TTD within fields.

Appendix A: Data Appendix

Definition of academic year

Unless otherwise noted, a "year" is an academic year. Academic year t is defined as going from August of calendar year t through July of calendar year t+1.

Job listings by field

- Anthropology (1975–2005): American Anthropological Association (AAA). Counts of job listings published monthly in *Anthropology News* and online in the AAA Jobs Database.
- Classics (1984–2004): American Philological Association (APA). Annual counts of vacancies from APA placement reports for 2001 and 2004.
- Economics (1979–2005): American Economic Association. "New jobs" series (academic plus non-academic) published annually in the May issue of *American Economic Review,* based on listings in *Job Openings for Economists.* Data are for calendar years; I match calendar year t to the academic year starting in t (e.g., 1979 to 1979–80).
- English (1975–2005): Modern Language Association (MLA). Number of positions listed in the English Edition of the MLA *Job Information List;* counts from Table 1 (total including supplement) in Fall 2004 *MLA Newsletter.* Data for 2004 through 2006 are taken from Table 1 of the report "Trends in the MLA *Job Information List,* September 2007."
- History (1975–2005): American Historical Association (AHA). Job openings advertised in *Perspectives*; counts based on AHA reports (2004 and 2005) and electronic data provided by AHA (through 2003).
- Philosophy (1982–2002): American Philosophical Association. Total number of jobs advertised in *Jobs for Philosophers*; data from pp. 130–131 of American Philosophical Association (2004).
- Political Science (1983–2005): American Political Science Association (APSA). Data for 1983 through 2003 are based on Brintnall (2005); data for 2004 and 2005 were provided by APSA. Data for 1983 through 1992 are estimates because APSA has only counts of total listings each month, not new listings each month. Data are missing for 1993, and are imputed based on the average of 1992 and 1994.

Unemployment rate

National unemployment rate for civilian labor force age 16 and older. Rate for an academic year is computed as the average of monthly seasonally adjusted unemployment rates for August through July. Source: Bureau of Labor Statistics (series LNS14000000).

Help-wanted index

Index for an academic year is computed as the average of the monthly seasonally adjusted index for August through July. The monthly values from August 1975 through December 1994 are from the Conference Board's index of help-wanted advertising in 51 major newspapers. The monthly values from January 1995 through July 2006 are from the composite help-wanted index created by Barnichon (2010). The composite index combines information from the newspaper index (available through May 2008) with the Conference Board's count of total online help-wanted ads (which started in May 2005).

State appropriations

State appropriations per full-time-equivalent student are for all U.S. public universities and are expressed in constant (calendar year 2000) dollars. Source: Grapevine database assembled by the Center for the Study of Education Policy at Illinois State University. Data used in Table 3 are for academic years 1975–1999.

College expenditures

College expenditures per full-time-equivalent student are for all U.S. public universities and are expressed in constant (calendar year 2000) dollars. Expenditures are current educational and general expenditures, net of sponsored research. Source: IPEDS, U.S. Department of Education. Data used in Table 3 are for academic years 1975–1999.

Faculty salaries

Faculty salaries are the average salary of full-time instructional faculty on 9-month contracts in degree-granting institutions, and are expressed in constant (academic year 2005–06) dollars. Source: National Center for Education Statistics (2007), Table 240. Data used in Table 3 are for selected academic years in 1975–2005.

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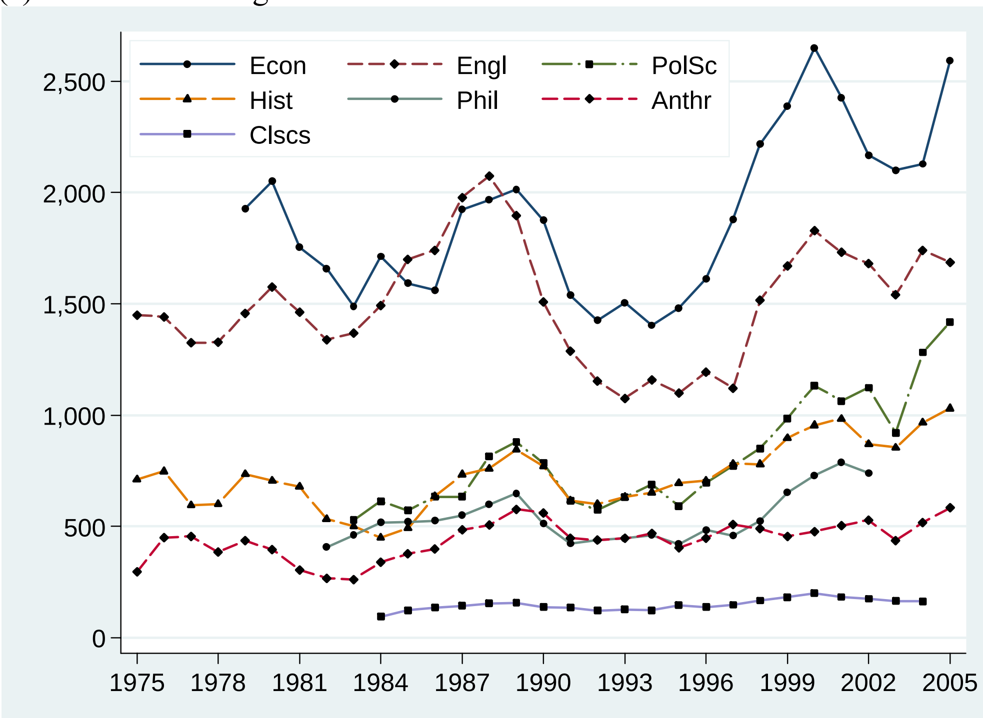
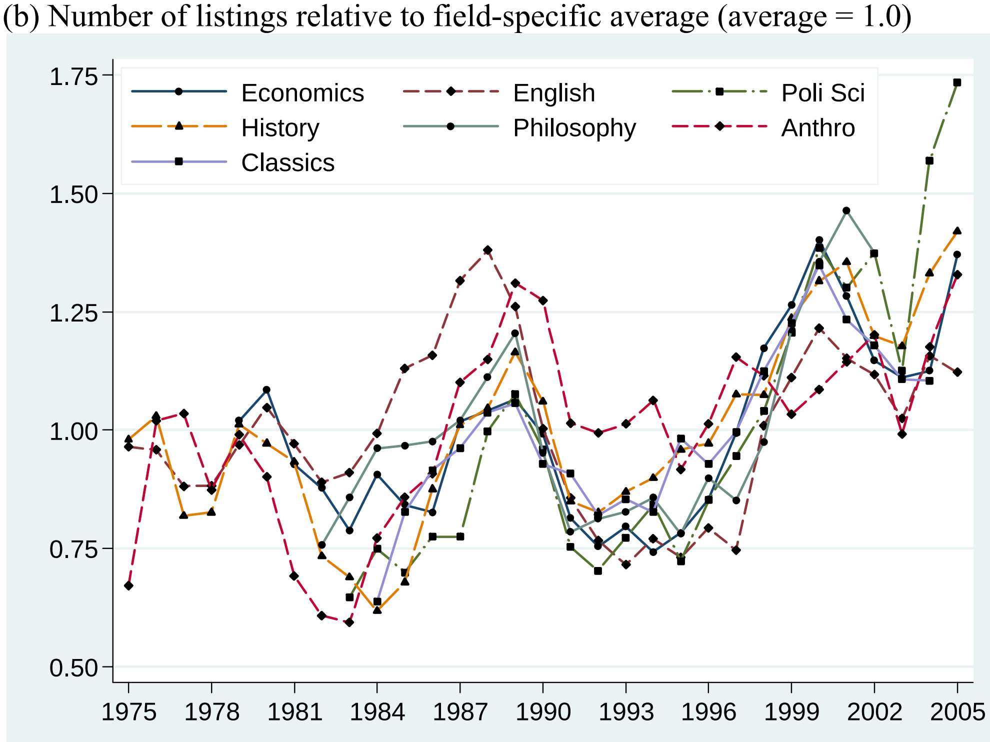
Figure 1. Job Listings by Field, 1975–2005

(a) Number of listings



(b) Number of listings relative to field-specific average (average = 1.0)

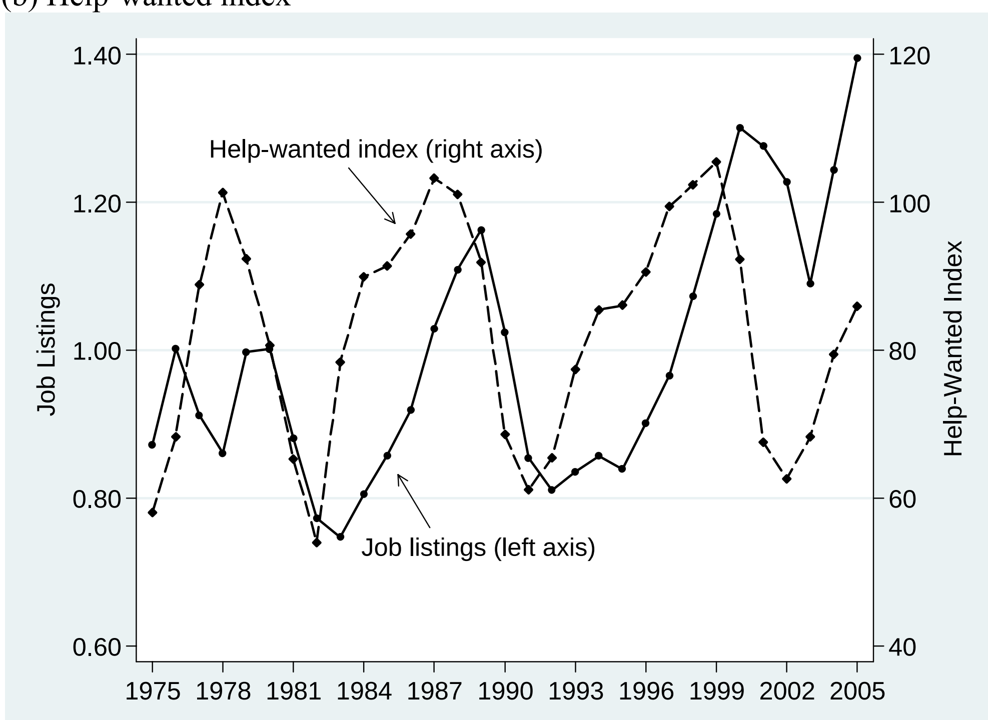


Sources: See Appendix A.

Figure 2. Job Listings and Economywide Labor-Market Indicators

(a) Unemployment rate

(b) Help-wanted index



Sources: See Appendix A.

Figure 3. Average Time to Degree by Field and Exit Year, 1975–2005

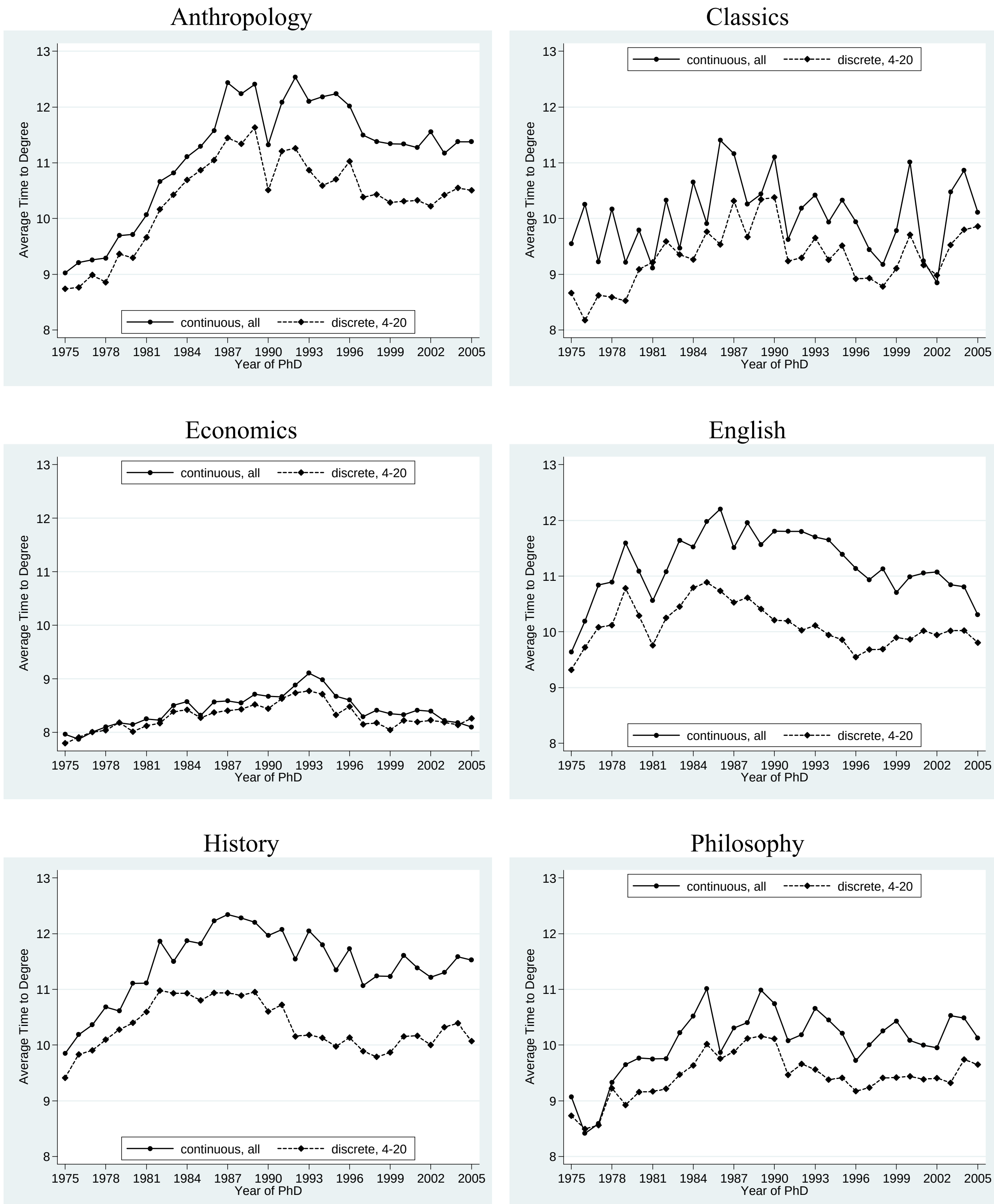


Figure 3, continued.

Political Science

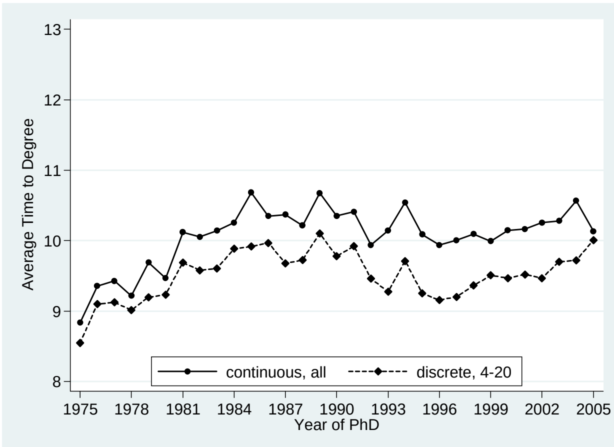


Figure 4. Expected Time to Degree by Field and Entry Year, 1972–1991

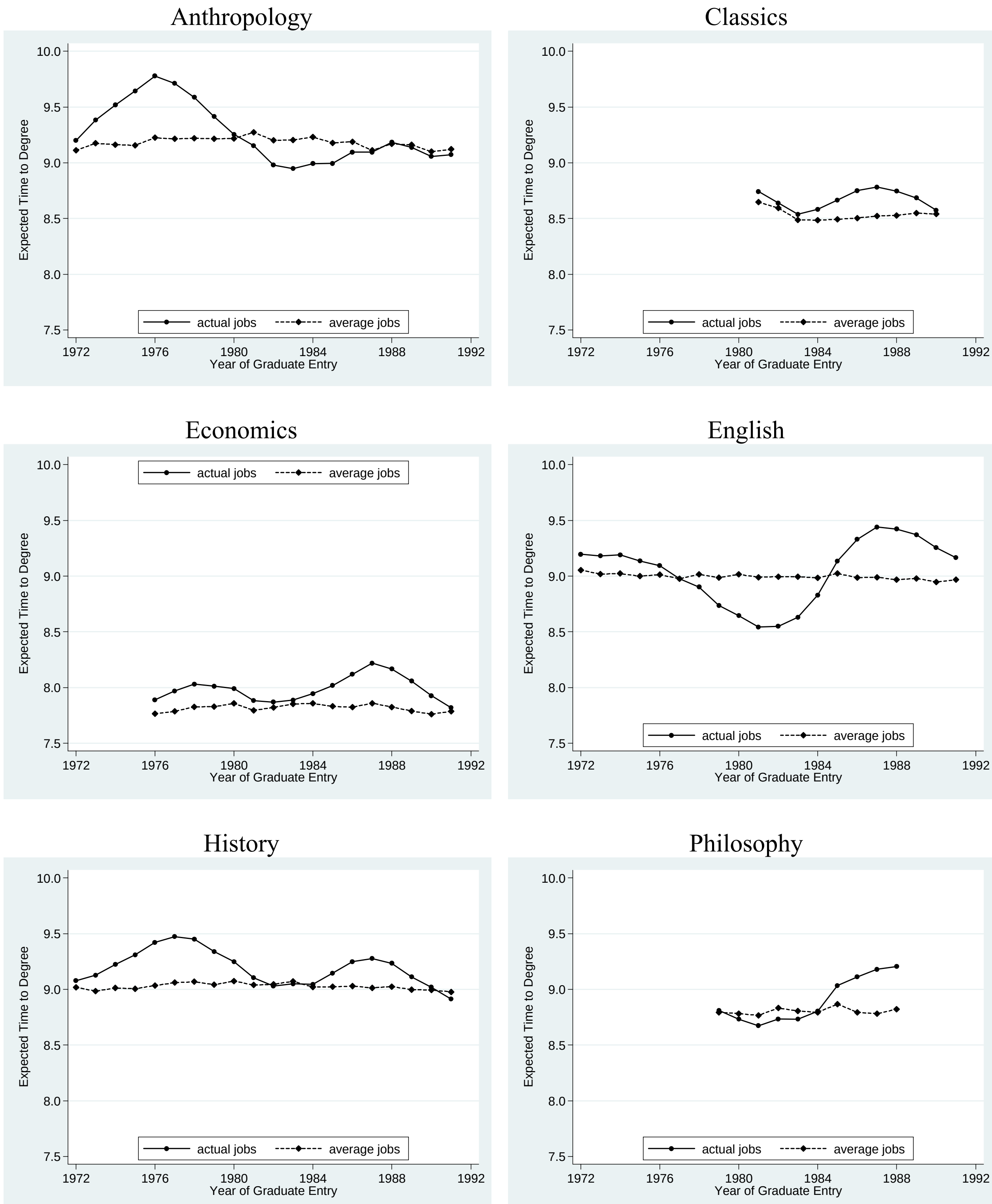


Figure 4, continued.

Political Science

Table 1. Characteristics of Doctorate Recipients in Seven Fields, 1975–2005

Characteristic	Percent	Average TTD
Primary Source of Support		
Teaching assistantship	27.66	9.15
Research assistantship	4.86	8.49
Fellowship	20.63	9.01
Personal funds	29.41	12.49
Other source	4.46	10.90
Missing	12.97	10.50
Age at PhD (years)		
28 or less	9.74	5.28
29 to 31	24.40	7.10
32 to 34	23.08	9.01
35 to 40	25.31	11.60
41 or more	17.47	17.51
Sex		
Men	63.42	9.96
Women	36.58	10.96
Citizenship/Race		
Non-US citizen	21.63	9.34
US citizen/non-white	7.69	10.86
US citizen/white	69.13	10.58
Missing	1.54	9.96

Note: N=102,756.

Table 2. Time to Degree by Field, 1975–2005

Field	Median	Mean	25th Pctile	75th Pctile	75th –25th	N
Anthropology	9.76	11.13	7.67	13.01	5.34	11,633
Classics	8.50	10.02	6.67	11.67	5.00	1,719
Economics	7.34	8.42	5.67	9.92	4.25	23,834
English	9.67	11.29	7.34	13.26	5.92	20,659
History	9.75	11.37	7.67	13.34	5.67	22,132
Philosophy	8.67	10.03	6.67	11.67	5.00	8,300
Political Science	8.75	10.04	6.75	11.76	5.01	14,479

Table 3. Correlation of Job Listings with Fiscal Variables, 1975–2005

Fiscal Variable	Mean	Coef.	S.E.	t	R^2
Unemployment rate	6.12	-0.087	0.016	-5.53	0.32
Help-wanted index	83.36	0.002	0.002	0.95	0.02
State appropriations per student ($1,000)	6.37	0.223	0.036	6.23	0.40
College expenditures per student ($1,000)	10.96	0.025	0.007	3.49	0.18
Faculty salaries ($1,000)					
All faculty	62.45	0.027	0.007	4.15	0.26
Professor	82.81	0.020	0.004	5.31	0.36
Associate professor	61.39	0.032	0.007	4.57	0.31
Assistant professor	50.84	0.034	0.008	4.44	0.30
Instructor	41.93	0.021	0.004	5.41	0.33
Lecturer	44.15	0.062	0.015	4.10	0.31
No rank	53.45	-0.034	0.020	-1.68	0.09

Notes: Each row is a separate regression of job listings (mean = 1.00) on the fiscal variable and a set of indicators for field. The unit of observation is a field-year. Standard errors allow for correlation in the error term by year. See Appendix A for details on the fiscal variables.

Table 4. Predicting Job Outcomes of New Doctorate Recipients, 1975–2005

Dependent Variable	Mean	Coef.	S.E.	t	N
Independent variable: Job listings (mean = 1.00)					
Definite job	59.25	6.47	0.79	8.18	90,431
Definite job or training	65.55	11.55	0.77	15.08	90,431
Definite job and type reported	70.60	15.39	0.82	18.85	74,516
Definite job with U.S. employer	63.74	15.47	0.84	18.36	74,516
Definite job with U.S. academic	47.95	10.55	0.88	11.96	74,516
Independent variable: Unemployment rate (mean = 6.06)					
Definite job	59.25	0.61	0.12	5.09	90,431
Definite job or training	65.55	-0.18	0.12	-1.51	90,431
Definite job and type reported	70.60	-0.21	0.12	-1.68	74,516
Definite job with U.S. employer	63.74	-0.02	0.13	-0.17	74,516
Definite job with U.S. academic	47.95	0.63	0.13	4.73	74,516
Independent variable: Help-wanted index (mean = 82.97)					
Definite job	59.25	0.01	0.01	0.48	90,431
Definite job or training	65.55	0.00	0.01	0.45	90,431
Definite job and type reported	70.60	-0.05	0.01	-4.35	74,516
Definite job with U.S. employer	63.74	-0.03	0.01	-2.87	74,516
Definite job with U.S. academic	47.95	-0.08	0.01	-6.88	74,516

Notes: Each row is a separate regression (linear probability model). Dependent variables are indicators (0/1) multiplied by 100. In addition to the demand measure shown above each panel, the independent variables include age (8 categories), citizenship/race (4 categories), gender, field, rank of doctoral program (11 categories), and TTD (15 categories).

Table 5. Parameter Estimates from Duration Model

Variable	Coef.	S.E.	z
Job listings	0.951	0.189	5.03
Year 5	1.255	0.042	29.70
Year 6	1.855	0.064	28.79
Year 7	2.252	0.082	27.32
Year 8	2.492	0.090	27.58
Year 9	2.614	0.093	28.12
Year 10	2.758	0.094	29.33
Year 11	2.850	0.097	29.36
Year 12	2.875	0.096	29.89
Year 13	2.910	0.095	30.72
Year 14	2.992	0.097	30.78
Year 15	3.014	0.098	30.90
Year 16	3.189	0.102	31.38
Year 17	3.302	0.098	33.57
Year 18	3.538	0.110	32.04
Year 19-20	4.860	0.122	39.79
Anthropology	-0.084	0.117	-0.72
Classics	0.228	0.123	1.85
Economics	0.719	0.111	6.49
History	-0.052	0.108	-0.48
Philosophy	0.148	0.097	1.52
Political Science	0.247	0.113	2.18
Program rank 2	-0.097	0.018	-5.39
Program rank 3	-0.173	0.019	-8.94
Program rank 4	-0.269	0.023	-11.59
Program rank 5	-0.308	0.024	-13.02
Program rank 6	-0.226	0.023	-9.79
Program rank 7	-0.339	0.033	-10.18
Program rank 8	-0.359	0.029	-12.51
Program rank 9	-0.406	0.031	-12.93
Program rank 10	-0.447	0.035	-12.82
Program unranked	-0.415	0.035	-11.99
Teaching assistantship	0.441	0.024	18.75
Research assistantship	0.483	0.031	15.37
Fellowship	0.458	0.032	14.10
Other source of support	0.147	0.032	4.59
Source missing	0.247	0.091	2.72
Age 26	0.067	0.055	1.21
Age 27	0.111	0.057	1.94
Age 28	0.113	0.063	1.80
Age 29	0.114	0.068	1.68
Age 30	0.090	0.070	1.29
Age 31	0.074	0.072	1.03

Age 32	0.079	0.071	1.12
Age 33-34	0.079	0.072	1.11
Age 35-36	0.074	0.072	1.02
Age 37-40	0.081	0.071	1.13
Age 41+	0.184	0.072	2.57
Female	-0.085	0.011	-7.39
Non-US citizen	-0.238	0.022	-10.81
US citizen/non-white	-0.174	0.026	-6.62
Citizenship/race missing	0.129	0.059	2.18
Constant	-4.979	0.208	-23.88

Notes: N=445,205 student years (72,330 students). Log likelihood = -175,312.2. Pseudo R^2=0.11. Reference categories: year 4, English, program rank 1, personal funds, age ≤ 25, and U.S. citizen/white. Standard errors allow for correlation in the error term within cells defined by year and field.

Table 6. Marginal Effects of Job Listings on Expected TTD and Completion Probabilities

	Expected	Pr(TTD≤X)		
	TTD	6 years	8 years	10 years
Job listings = 1.00	9.27	20.14	47.56	69.87
Job listings = 1.10	9.01	21.82	50.55	72.91
Difference	-0.26	1.68	2.99	3.04

Table 7. Heterogeneity in the Effect of Job Listings

	Coef.	S.E.	z	Mgl. Eff. on E(TTD)
Field				
Anthropology	0.747	0.440	1.70	-0.23
Classics	0.512	0.449	1.14	-0.13
Economics	0.920	0.397	2.32	-0.19
English	0.169	0.305	0.56	-0.05
History	1.681	0.426	3.95	-0.49
Philosophy	0.700	0.191	3.66	-0.19
Political science	1.486	0.464	3.20	-0.38
Program Rank				
1 (highest)	0.895	0.195	4.59	-0.22
2	0.891	0.195	4.58	-0.23
3	0.858	0.187	4.58	-0.23
4	0.865	0.211	4.10	-0.24
5	0.835	0.212	3.94	-0.24
6	0.955	0.218	4.37	-0.27
7	1.048	0.258	4.06	-0.30
8	1.003	0.214	4.68	-0.29
9	0.903	0.226	4.00	-0.27
10 (lowest)	1.077	0.219	4.91	-0.33
Unranked	1.449	0.230	6.30	-0.43
Year in Program				
4	0.497	0.341	1.46	
5	0.972	0.303	3.21	
6	1.098	0.203	5.42	
7	0.986	0.191	5.16	
8	1.062	0.215	4.94	
9	0.935	0.217	4.32	
10	1.005	0.205	4.91	
11	0.911	0.220	4.14	
12	1.004	0.225	4.46	
13	0.831	0.252	3.29	
14	0.716	0.269	2.66	
15	0.773	0.258	3.00	
16	0.702	0.285	2.46	
17	0.744	0.313	2.38	
18	0.325	0.352	0.92	
19-20	0.115	0.316	0.37	

Notes: N=445,205 student years (72,330 students). Each panel contains estimates from a separate regression. Marginal effects are for an increase in job listings of 10 percent. Standard errors allow for correlation in the error term within cells defined by year and field.

Table 8. Robustness Check Using Alternative Measures of Time to Degree

Exit Years/TTD Measure	Mean	Coef. (S.E.)	Mgl. Eff. on E(TTD)	Students	Student Years
1975-2005					
Graduate entry to PhD	8.75	0.937 (0.190)	-0.24	63,249	371,928
BA to PhD	10.15	0.992 (0.199)	-0.28	63,249	497,283
1992-2005					
PhD entry to PhD	7.28	1.128 (0.265)	-0.24	42,349	186,740
Graduate entry to PhD	8.99	1.359 (0.295)	-0.37	42,349	259,505
BA to PhD	10.51	1.437 (0.310)	-0.40	42,349	348,800

Notes: Means are for the estimation sample, which covers doctorate recipients with TTD between 4 and 20 years. Marginal effects are for an increase in job listings of 10 percent. Standard errors allow for correlation in the error term within cells defined by year and field.

Table 9. Comparison of Parameter Estimates from SED and GEI Datasets

	SED			GEI			
	1	2	3	4	5	6	7
Job listings	1.162*	1.167*	1.292*	1.706*	1.423*	1.455*	1.414*
[Mgl. Eff. on E(TTD)]	[-0.243]	[-0.237]	[-0.268]	[-0.286]	[-0.234]	[-0.271]	[-0.263]
Assistantship	0.420*	0.425*				-0.465*	-0.475*
Fellowship	0.657*	0.661*				-0.186*	-0.196*
Tuition grant						-0.235*	-0.243*
Summer support						-0.292*	-0.290*
Other source	0.700*	0.699*					
Female	-0.085*	-0.084*	-0.075*	-0.058	-0.093*	-0.105*	-0.073*
Non-US citizen	0.162*	0.166*	0.223*	0.240*	0.258*	0.214*	0.255*
US citizen, non-white	-0.126*	-0.130*	-0.047	0.047	-0.004	0.012	0.079
Prior master's degree							0.169*
GRE verbal / 100							0.045*
GRE math / 100							0.114*
Age dummies	x						
Exit years—first	1992	1992	1992	1992	1985	1985	1985
Exit years—last	2002	2002	2002	2002	2002	2002	2002
Students	6,844	6,844	6,844	5,819	7,143	7,143	7,143
Student years	33,408	33,408	33,408	28,617	33,260	33,260	33,260
Pseudo R^2	0.137	0.136	0.127	0.165	0.151	0.164	0.167

Notes: Numbers in the table are coefficient estimates for samples from the GEI departments. Reference categories for the variables shown in the table: personal funds/no support and white U.S. citizen. In addition to the variables shown in the table, the independent variables in all specifications include field, rank of doctoral program, and year in the program. Other variables for particular specifications include indicators for missing data on financial support, race/citizenship, GRE scores, and prior master's degree. The SED analysis involves the TTD measure starting from PhD entry.

* Significantly different from zero at the 5% level, based on standard errors that allow for correlation in the error term within cells defined by year and field.