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

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Abstract

This paper considers the influence of labor demand for new PhD recipients on time to the doctorate. I use student-level data on all doctorates awarded by U.S. universities in seven fields in the humanities and social sciences together with the annual number of job listings in each field from 1975 to 2005. According to estimates from a discrete-time duration model, an increase in job listings is associated with a decrease in expected time to degree. A simulation reveals that time-series variation in job listings explains a large share of variation over time in average time to degree within fields.

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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 instance, some students complete the PhD in 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 labor demand for new PhD recipients on time to the doctorate. Within a field the demand for new PhDs 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 Princeton University history professor Anthony Grafton, in an article on the state of graduate education in the humanities, remarked, "In most years, new Ph.D.s—to say nothing of all

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

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 lengthening TTD and raising attrition. As a result, the Foundation decided to add a set of control departments to its evaluation strategy in order to separate the effect of the job market from the effect of the program (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 financial support, program characteristics (e.g., advising), and student characteristics (e.g., gender).[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.

Answering the research question of this paper can also 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-to-year variation (Hoffer

[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), Stock and Siegfried (2006), and Tuckman, Coyle, and Bae (1990).

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

This paper makes several contributions. First, it constructs credible measures of the demand for new PhDs, based on job listings from seven academic fields over a 30-year period.[3] 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 data used in the empirical analysis, which covers seven fields in the humanities and social sciences and is based on two student-level databases 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 Section 6 uses a simulation to assess the importance of time-series variation in job listings to variation in field-specific TTD. Section 7 concludes.

2. Conceptual Framework

To motivate the empirical analysis, this section outlines a conceptual framework for understanding how labor demand for new PhDs may affect 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

[3] 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 for new doctorate recipients.

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 size of college-going cohorts, the demand for undergraduate courses in the field, the performance of university endowments, and other factors.

When the demand curve shifts out, the market equilibrium shifts along the (short-run) 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 doctorate 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.[4]

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.

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

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 students include access to library resources at their universities and 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 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.[5] The financial payoff to obtaining a PhD in a field is a function of starting salaries for academic positions, the number of 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 or effort; if student takes 5 years to finish a dissertation, how much research can he or she 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 job market in a given field would influence the speed of student progress (and hence TTD) primarily through opportunity costs. An increase in labor demand 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

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

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 unemployed workers searching for a job 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 at particular times (for example, during the coursework stage); this is analogous to an unemployed worker interrupting search to seek additional training.

3. Data

The empirical analysis in the paper is based on micro data on students who received doctorates from 1975 to 2005. The primary source of student-level data is 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).

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 this measure of TTD 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.[6] In Section 5, I show that my main findings are robust to these 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 doctoral program, based on the National Research Council's 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.

The SED sample used in this paper covers seven fields in the humanities and social sciences: anthropology, classics, economics, English, history, philosophy, and political science. Table 1 summarizes the personal characteristics of doctorate recipients in these fields from 1975 to 2005. Table 2 summarizes the distribution of TTD (from graduate entry) by field over this

[6] 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.

period. Median TTD is largest in anthropology (9.8 years) and smallest in economics (7.3 years). In each field the mean TTD exceeds the median, reflecting the long right tail of the distribution. 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 58 departments in six fields (the seven fields in the SED sample, except economics) that were involved in an evaluation of the Mellon Foundation's Graduate Education Initiative (GEI) (Groen et al. 2008). These departments were situated in 10 major research universities and had doctoral 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 2006 and contain information on the progress of these students through 2006. To be comparable to the SED data, I limit the analysis of the GEI data in this paper to students who completed the PhD between 1985 and 2005.

One advantage of the GEI data relative to the SED data is a measure of TTD that starts when students enter a PhD program. Another advantage is the availability of student-quality measures (GRE scores and an indicator for having a master's degree upon entry to the PhD program) and annual information on type of financial support. The support variables indicate whether each student had any of four types of support in a particular year: fellowship, teaching or research assistantship, tuition grant, and summer support. Students may have more than one type of support in a given year; for example, it is common for students with a fellowship or assistantship to also have a tuition grant.

I measure labor demand for new PhDs 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 for details). Each association serves a vital organizing role in the labor market for doctorate recipients in a discipline by publishing listings (advertisements) of job vacancies. The counts of job listings used in this paper are a more direct measure of labor demand than 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 of public institutions.

Despite their appeal at the conceptual level, counts of 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 annual total number of listings that is available 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 measurement 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 potential concern with the time series is that the composition of jobs that are included in the listings could change over time.[7] This could happen if either (1) the types of jobs that are included changes

[7] I expect that nearly all academic vacancies are included in these listings in order to comply with university anti-discrimination provisions and to satisfy the professional obligation to advertise open positions. For example, the Ethics Guide of the American Political Science Association (APSA) reads: "It is a professional obligation of all political science departments to list in the APSA Personnel Service Newsletter all positions for which they are recruiting at the Instructor, Assistant, and Associate Professor levels. In addition, the listing of openings at the Full Professor level is strongly encouraged. It is also a professional obligation for departments to list temporary and visiting positions" (quoted in Brintnall 2005).

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 credible measure of the labor demand for new doctorate recipients. First, time-series trends are similar across fields, as shown by Figure 1. This pattern is clearest in the bottom panel of the figure, which normalizes the number of job listings by the field-specific average over 1984–2002 (the period over which listings are available for all fields).[8] (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 positively 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 per student at public universities (positively), expenditures per student at public universities (positively), and faculty salaries (positively).

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 nearly 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—

[8] The raw correlation between any two fields in the normalized listings ranges from 0.34 to 0.92.

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 trough in job listings coming one or two years after the corresponding one for the help-wanted index.

For a third piece of evidence, I consider whether job listings, the unemployment rate, or the help-wanted index best predicts job outcomes for new PhDs.[10] The unemployment rate has been used as a 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 definite work 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.

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[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 advertisements (Barnichon 2010).
[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.

Among the three measures, job listings are the best predictor of the 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 none of the outcomes when either the unemployment rate or 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 annual (academic-year) basis, I use a discrete-time model. For each graduate, 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 ($t_p - t_e + 1$).[11] 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 t of the program (starting in year 4), given that the student has not yet graduated, takes the form

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

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

[11] Time from PhD entry or from BA receipt is obtained by substituting for t_e the academic year of PhD entry or BA receipt, respectively.

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

$$g_i(t_{0i}, t_i^*) = \left\{\prod_{t=4}^{t_i^*-1}[1 - \lambda_i(t_{0i}, t)]\right\}\lambda_i(t_{0i}, t_i^*).$$

For other students, the count of job listings is not available for one or more years at the end of their spells. In these cases, I drop the observations that correspond to the student-years with missing data. This creates incomplete spells for these students: their TTD is censored at $\overline{t_\iota}$, and we know only that their TTD exceeds $\overline{t_\iota}$. The contribution to the likelihood function for these cases is

$$[1 - G(t_{0i}, \overline{t_\iota})] = \prod_{t=4}^{\overline{t_\iota}}[1 - \lambda_i(t_{0i}, t)].$$

The likelihood function is then

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

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

$$E(TTD) = \sum_{t=4}^{T} t \cdot g(t_0, t),$$

where T is the maximum TTD observed. For this calculation, I set the X 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 by limiting the sample to doctorate recipients with TTD between 4 and 20 years.[12] In the estimation sample, each student contributes one observation for each academic year from the fourth year of graduate school to the year of the PhD. I match these data to the counts of job listings by field and year for 1975–2005. Some fields do not have jobs data for this entire period; the years without jobs data for at least one field are 1975–1983 and 2003–2005. I require that students have jobs data for their fourth year, 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.

The SED sample used in the main estimation consists of 421,851 observations on 71,988 individuals who completed a PhD between 1975 and 2005. The observations come from academic years 1975–2001. Observations for years 2002–2005 are excluded from the sample because the probability of completion for these observations is unusually high due to the requirement that those in the sample have earned a PhD by 2005.

Some of the SED analysis is based only on individuals who completed a PhD between 1992 and 2005 because the alternative measure of TTD based on PhD entry can be constructed starting in 1992. The observations used in this part of the analysis come from academic years 1992–2001. Observations for years 1975–1991 are excluded because the probability of completion is zero prior to 1992. The students in these samples must have reached their fourth year in the program in 1992 or later; this requirement is analogous to the exclusion of left-

[12] In the SED data, 0.5 percent of the graduates have TTD (from graduate entry) less than 4 years and 4.3 percent have TTD more than 20 years.

censored spells from the full SED sample. As a result, the maximum TTD for the sample based on 1992–2005 PhDs is 13 years, compared with a maximum of 20 years in the full SED sample.

The key explanatory variable is the number of job listings in a year relative to the field-specific mean. The other time-varying explanatory variables are year-in-program indicators (single years 4–18 and years 19 and 20 combined). The time-invariant explanatory variables include indicators for field and rank of the doctoral program. Program rank is parameterized using 11 categories, with 10 of these for deciles of the distribution within field and one category for programs that do not appear in the 1993 NRC rankings. The remaining time-invariant explanatory variables are gender, citizenship/race, age at graduate entry, and primary source of support.

5. Results

Parameter estimates for the full SED sample are shown in Table 5. The baseline specification (specification 1) includes all of the explanatory variables except source of support; support is excluded because a student's TTD may affect which source of support is considered "primary." For this specification, the estimated coefficient on job listings is 0.350 and 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.

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 sample means of the variables for the time-invariant characteristics.[13] From these predicted probabilities I first set job listings to 1.0 (i.e., the field-specific average) and compute an expected TTD of 9.41 years. Then I increase job listings by 10 percent and re-do the calculations; expected TTD falls to 9.31 years, a difference of 0.10 year (or 1.2 months). In addition, increasing job listings by 10 percent increases the cumulative probabilities of completing within 6 years by 0.60 percentage point (from 20.04 to 20.64) and within 8 years by 1.09 percentage points (from 46.77 to 47.86).

Adding primary source of support to the baseline specification (in specification 2) reduces the estimated effect of job listings by a small amount, to -0.08. Compared to using personal funds, each of the major sources of support (teaching assistantship, research assistantship, and fellowship) 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 student ability is not controlled for in this specification.

Gender and race/citizenship are included in both specifications in Table 5. The estimates imply that, all else equal, women in these fields have longer TTD than men. This finding is consistent with several analyses of gender differences in TTD, including Tuckman et al. (1990) and Bowen and Rudenstine (1992). The estimates in Table 5 also imply that non–U.S. citizens have longer TTD than white U.S. citizens, and that among U.S. citizens, non-whites have longer TTD than whites. The estimated pattern of TTD by citizenship differs from Ehrenberg and Mavros (1995) and Siegfried and Stock (2001), both of which found lower TTD (higher completion hazards) for non–U.S. citizens than U.S. citizens.[14] The difference in results could reflect differences in the scope of the samples (those analyzed by Ehrenberg and Mavros (1995)

[13] The sample means used to compute marginal effects reported in Table 5 and Table 6 are based on students who completed the PhD between 1975 and 2005. For Table 7, these means are based on students in the GEI departments who completed the PhD between 1992 and 2005.
[14] Stock and Siegfried (2006) found no differences in TTD by citizenship.

and Siegfried and Stock (2001) covered doctorate recipients in only one institution or field) or differences in the timing of data collection (the SED records citizenship at the time of completion, whereas other sources record citizenship at the time of admission).

A potential concern about the validity of the estimated effect of job listings reported in Table 5 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 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 in these fields from 1992 to 2005, average time to the PhD is 7.7 years from PhD entry, 10.4 years from graduate entry, and 12.4 years from BA receipt.

Table 6 reports results of the baseline specification for alternative measures of TTD separately for two ranges of exit years. Despite the differences in scale, all three measures of TTD lead to similar estimates of the effect of job listings on completion probabilities and TTD for the sample based on 1992–2005 PhDs. The estimated marginal effects are -0.04 when PhD entry is used, -0.06 when graduate entry is used, and -0.05 when BA receipt is used. For 1975–2005, the estimated marginal effect of job listings on expected TTD is -0.10 when graduate entry is used to define TTD and -0.11 when BA receipt is used.[15]

Table 7 compares regression results for the SED data and the GEI data, using samples restricted to students from 58 departments that are represented in the GEI data. The TTD

[15] The results for the 1975–2005 and 1992–2005 samples are not necessarily comparable because the 1975–2005 sample covers TTD up to 20 years whereas the 1992–2005 covers TTD up to only 13 years.

measure based on PhD entry is used for the SED in order to be comparable to the GEI. Using data for students who completed their PhDs between 1992 and 2005 and a common specification (columns 3 and 4), the estimated marginal effect of job listings on expected TTD is -0.04 in both two datasets. In addition, the estimated effects of the demographic variables are similar across datasets, with women having longer TTD than men, non–U.S. citizens having shorter TTD than white U.S. citizens, and non-white U.S. citizens having longer TTD than white U.S. citizens.

The GEI results also clarify the roles of student ability and financial support. When these additional controls are included in a specification (column 7) estimated on 1985–2005 PhDs, math and verbal GRE scores and the indicator for having a prior master's degree are positively related to the probability of completion (shorter TTD).[16] Except for fellowship, each type of support is negatively related to the probability of completion (longer TTD); this is consistent with financial support lowering the opportunity costs of remaining in a PhD program. The effects of 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. Simulation

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 in job listings involves a sequence of increases and decreases. As an alternative way of representing the magnitude of the estimated

[16] The GEI estimation sample that covers 1985–2005 PhDs includes observations from academic years 1985–2001. The GEI sample that covers 1992–2005 PhDs includes observations from academic years 1992–2001 and is restricted to students who reached their fourth year in the program in 1992 or later.

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 plots time series of mean and median TTD by field using time from graduate entry (1975–2005) and time from PhD entry (1992–2005). These plots reveal substantial year-to-year variation within field, especially before the mid-1990s. This variation may be caused by a variety of factors in addition to labor demand for new doctorate recipients, including 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 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.[17] Figure 4 plots averages of expected TTD by entry year and field. There is noticeably less variation over time in average expected TTD when average jobs are used instead

[17] I use 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.

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 listings, 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 job listings is $(SD_{act} – SD_{avg}) / SD_{act}$. The average of this statistic over the seven fields is 42.7 percent.[18] Therefore, among the potential factors included in my model, labor demand for new doctorate recipients is a major factor in time-series trends in average TTD within fields.

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 the issue by constructing credible measures of labor demand 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.

[18] 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 job listings is 74.8 percent. When I use year 20 as the cutoff, the average share explained is 11.1 percent.

The demand for new PhDs is measured by the annual number of job listings advertised by professional associations in these fields. 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 trends are similar 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 baseline estimates imply that permanently increasing the number of job listings in a field by 10 percent reduces expected time to degree by 0.10 year (or 1.2 months) and increases the cumulative probability of completing within 8 years by 1.1 percentage points. A simulation using the model estimates reveals that the observed time-series variation in job listings explains 43 percent of the variation over time in average TTD within fields.

Beyond time to degree, several other outcomes of doctoral students could be influenced by the labor demand for new PhDs. For instance, in response to an increase in the number of advanced students in a doctoral program (due to a decrease in labor demand), do programs increase attrition or reduce the size of their entering cohorts? Among students who complete the PhD, how does variation in labor demand affect the types of positions they obtain? In particular, are new PhDs more likely to take non-academic or temporary academic positions when labor demand is relatively weak? These are promising avenues for future research.

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* (1975–2004) and online in the AAA Jobs Database (2001–2005).
- 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* (e.g., Siegfried (2001)), 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 (total including supplement) from Table 1 of 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 (1975–2003).
- 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; as used in Rizzo (2006). 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; as used in Rizzo (2006). 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.

References

Abedi, Jamal, and Ellen Benkin. 1987. "The Effects of Students' Academic, Financial, and Demographic Variables on Time to the Doctorate." *Research in Higher Education* 27 (1): 3-14.

Abraham, Katherine G., and Lawrence F. Katz. 1986. "Cyclical Unemployment: Sectoral Shifts or Aggregate Disturbances?" *Journal of Political Economy* 94 (3): 507-522.

American Philosophical Association. 2004. "Appendix to Board Minutes." *Proceedings and Addresses of the American Philosophical Association* 77 (5): 111-149.

Barnichon, Regis. 2010. "Building a Composite Help-Wanted Index." *Economics Letters* 109 (3): 175-178.

Bowen, William G., Graham Lord, and Julie Ann Sosa. 1991. "Measuring Time to the Doctorate: Reinterpretation of the Evidence." *Proceedings of the National Academy of Sciences USA* 88 (3): 713-717.

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

Breneman, David W. 1976. "The Ph.D. Production Process." In Joseph T. Froomkin, Dean T. Jamison, and Roy Radner (eds.), *Education as an Industry* (pp. 3-52). Cambridge, MA: Ballinger.

Brintnall, Michael. 2005. "Academic Jobs in Political Science: A Review of Listings with the APSA Jobs Service." *PS: Political Science and Politics* 38 (1): 125-127.

Cross, John G., and Edie N. Goldenberg. 2009. *Off-Track Profs: Nontenured Teachers in Higher Education* (Cambridge, MA: MIT Press).

Ehrenberg, Ronald G. 1992. "The Flow of New Doctorates." *Journal of Economic Literature* 30 (2): 830-875.

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

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

Ehrenberg, Ronald G., and Liang Zhang. 2005. "Do Tenured and Tenure-Track Faculty Matter?" *Journal of Human Resources* 40 (3): 647-659.

Ehrenberg, Ronald G., Harriet Zuckerman, Jeffrey A. Groen, and Sharon M. Brucker. 2009. *Educating Scholars: Doctoral Education in the Humanities* (Princeton, NJ: Princeton University Press).

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

Grafton, Anthony G. 2010. "Humanities and Inhumanities." *New Republic,* March 11, pp. 32-36.

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

Ham, John C., and Samuel A. Rea Jr. 1987. "Unemployment Insurance and Male Unemployment Duration in Canada." *Journal of Labor Economics* 5 (3): 325-353.

Hoffer, Thomas B., Vincent Welch Jr., Kristy Webber, Kimberly Williams, Brian Lisek, Mary Hess, Daniel Loew, and Isabel Guzman-Barron. 2006. *Doctorate Recipients from United States Universities: Summary Report 2005.* Chicago: National Opinion Research Center.

Jenkins, Stephen P. "Easy Estimation Methods for Discrete-Time Duration Models." *Oxford Bulletin of Economics and Statistics* 57 (1): 129-138.

Kahn, Lisa B. 2010. "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy." *Labour Economics* 17 (2): 303-316.

Messer, Dolores, and Stefan C. Wolter. 2010. "Time-to-Degree and the Business Cycle." *Education Economics* 18 (1): 111-123.

National Center for Education Statistics. 2007. *Digest of Education Statistics: 2006* (NCES 2007-017). Washington, DC: U.S. Government Printing Office.

Oreopolous, Philip, Till von Wachter, and Andrew Heisz. 2008. "The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates." IZA Discussion Paper 3578. Bonn, Germany: Institute for the Study of Labor.

Oyer, Paul. 2006. "Initial Labor Market Conditions and Long-Term Outcomes for Economists." *Journal of Economic Perspectives* 20 (3): 143-160.

Rizzo, Michael J. 2006. "State Preferences for Higher Education Spending: A Panel Data Analysis, 1977–2001." In Ronald G. Ehrenberg (ed.), *What's Happening to Public Higher Education*? (pp. 3-36). Westport, CT: Praeger.

Shimer, Robert. 2005. “The Cyclical Behavior of Equilibrium Unemployment and Vacancies.” *American Economic Review* 95 (1): 25-49.

Shulman, Lee S. 2010. “Doctoral Education Shouldn’t Be a Marathon.” *Chronicle of Higher Education,* April 9, B9.

Siegfried, John J. 2001. “Report of the Director, *Job Openings for Economists*.” *American Economic Review* 91 (2): 492-494.

Siegfried, John J., and Wendy A. Stock. 2001. “So You Want to Earn a Ph.D. in Economics: How Long Do You Think It Will Take?” *Journal of Human Resources* 36 (2): 364-378.

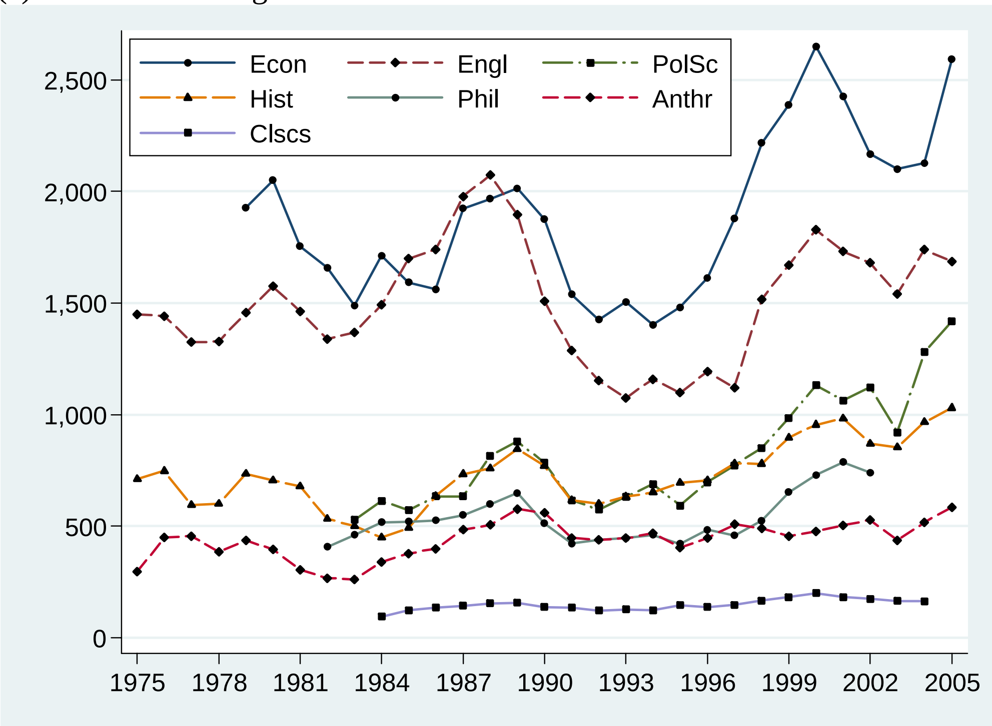
Stephan, Paula, and Jennifer Ma. 2005. “The Increased Frequency and Duration of the Postdoctoral Career Stage.” *American Economic Review* 95 (2): 71-75.

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

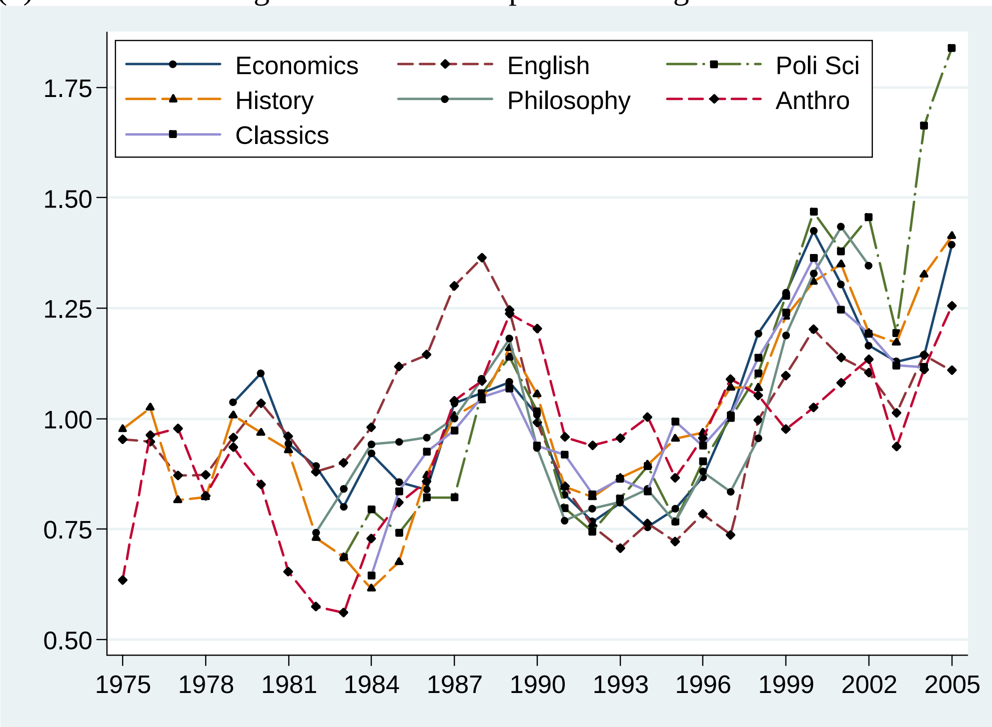
Tuckman, Howard, Susan Coyle, and Yupin Bae. 1990. *On Time to the Doctorate: A Study of the Increased Time to Complete Doctorates in Science and Engineering*. Washington, DC: National Academies Press.

Figure 1. Job Listings by Field, 1975–2005

(a) Number of listings



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

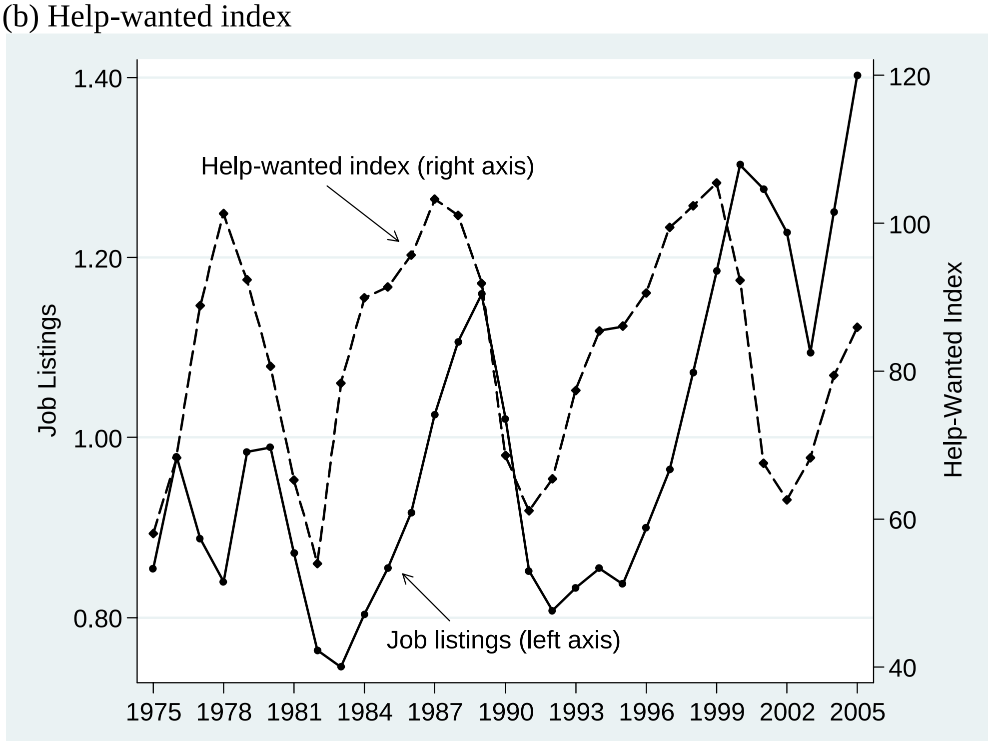


Source: See Appendix A.

Figure 2. Job Listings and Economywide Labor-Market Indicators, 1975–2005

(a) Unemployment rate

(b) Help-wanted index



Source: See Appendix A.

Figure 3. Time to Degree by Field and Year of PhD, 1975–2005

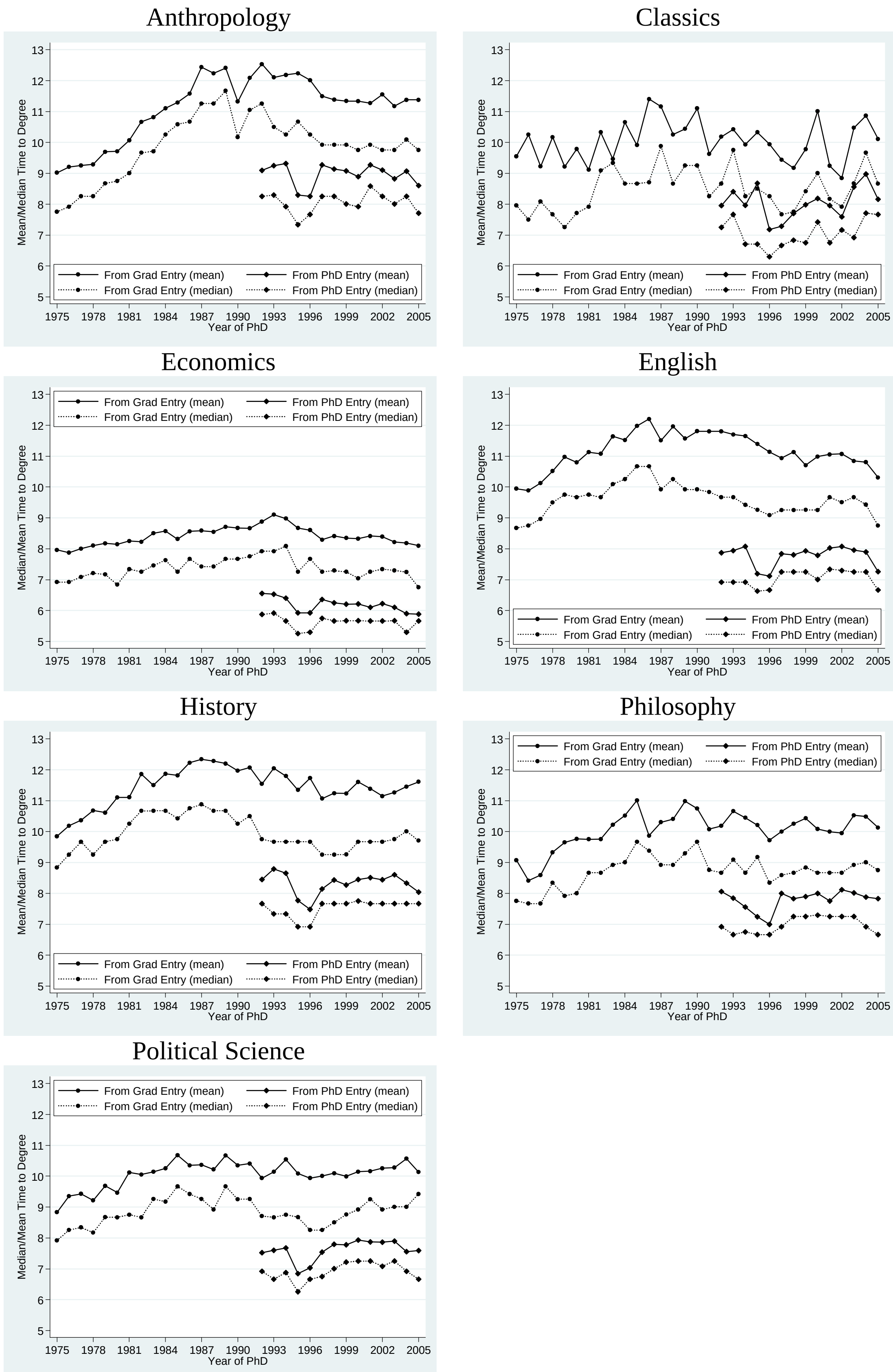


Figure 4. Expected Time to Degree by Field and Year of Graduate Entry, 1972–1991

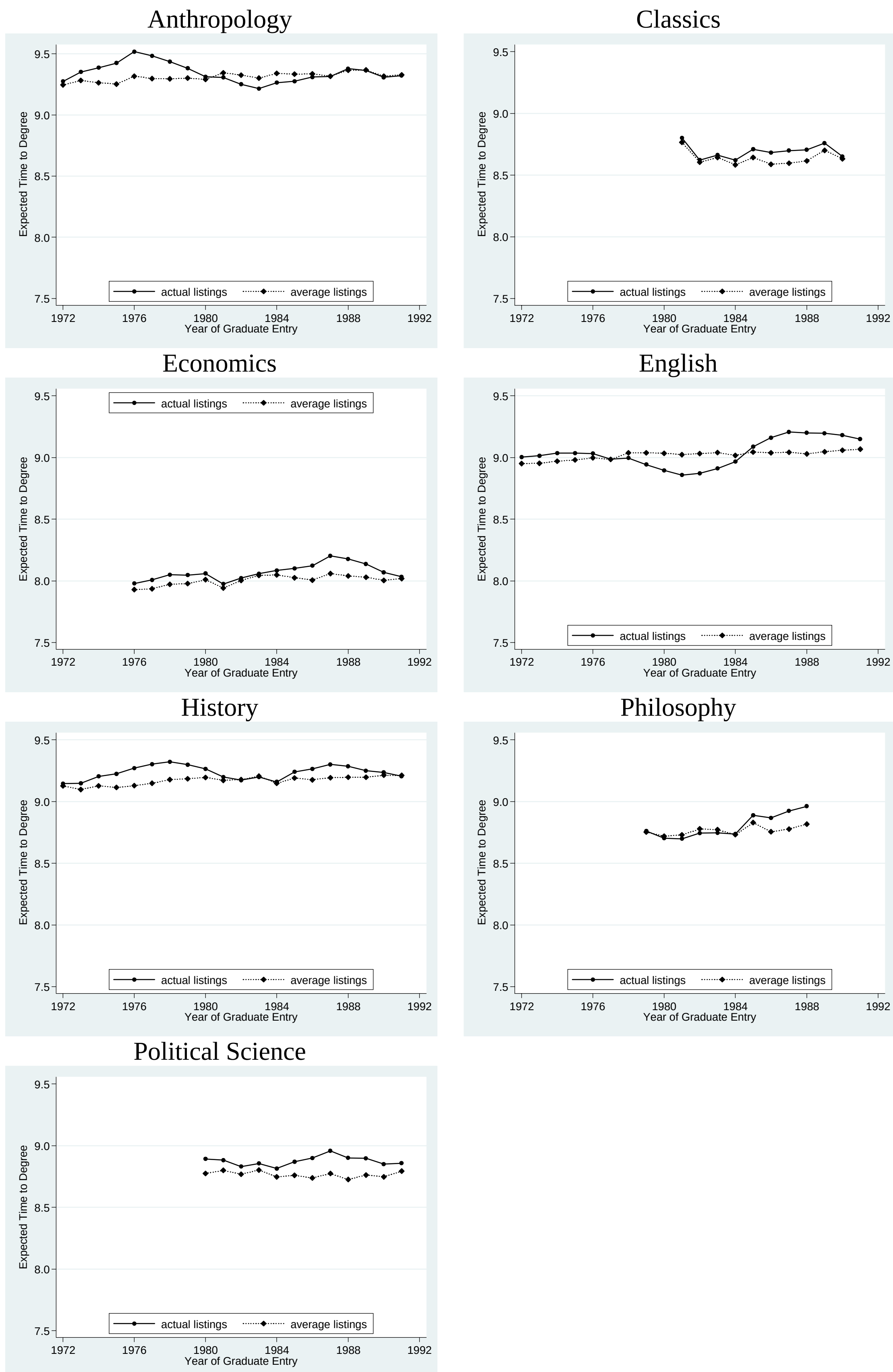


Table 1. Characteristics of Doctorate Recipients in Seven Fields, 1975–2005

Characteristic	Percent	Median TTD	Mean TTD
Sex			
Men	62.92	8.67	9.95
Women	37.08	9.34	10.96
Citizenship/Race			
Non–U.S. citizen	20.96	8.59	9.35
U.S. citizen, non-white	7.56	9.26	10.86
U.S. citizen, white	69.87	9.01	10.57
Missing	1.61	8.75	10.03
Primary Source of Support			
Teaching assistantship	29.04	8.25	9.19
Research assistantship	4.81	7.67	8.52
Fellowship	21.03	7.92	9.03
Personal funds	31.36	10.75	12.50
Other source	3.65	9.43	10.98
Missing	10.10	9.67	11.03
Age at Graduate Entry			
21 or younger	7.57	9.67	11.55
22	26.77	8.67	10.22
23	18.67	8.67	10.10
24	12.61	8.76	10.08
25	8.61	8.92	10.26
26	6.25	8.92	10.27
27	4.27	9.25	10.31
28 to 29	5.34	9.25	10.42
30 to 33	5.09	9.34	10.54
34 or older	4.82	9.34	10.26
Total	100.00	8.92	10.33

Notes: N=107,468. Tabulations of financial support are based on 1977–2005 because primary source of support was not requested by the survey prior to 1977. TTD is the number of years from graduate entry to the PhD.

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

Field	Median	Mean	25th Pctile	75th Pctile	75th – 25th	N	N/year
Anthropology	9.76	11.13	7.67	13.01	5.34	11,633	375.3
Classics	8.50	10.02	6.67	11.67	5.00	1,719	55.5
Economics	7.34	8.42	5.67	9.92	4.25	23,834	768.8
English	9.67	11.13	7.25	13.09	5.84	25,175	812.1
History	9.75	11.36	7.67	13.26	5.59	22,328	720.3
Philosophy	8.67	10.03	6.67	11.67	5.00	8,300	267.7
Political Science	8.75	10.04	6.75	11.76	5.01	14,479	467.1

Notes: N=107,468. Time to degree is the number of years from graduate entry to the PhD.

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

Fiscal Variable	Mean	Coef.	S.E.	R^2	N
Unemployment rate	6.12	-0.087*	(0.016)	0.33	185
Help-wanted index	83.36	0.002	(0.002)	0.04	185
State appropriations per student[a]	6.37	0.222*	(0.036)	0.38	147
College expenditures per student[a]	10.96	0.025*	(0.007)	0.16	147
Faculty salaries[a]					
All faculty	62.45	0.027*	(0.007)	0.28	152
Full professor	82.81	0.020*	(0.004)	0.37	152
Associate professor	61.39	0.032*	(0.007)	0.32	152
Assistant professor	50.84	0.034*	(0.008)	0.32	152
Instructor	41.93	0.021*	(0.004)	0.35	152
Lecturer	44.15	0.062*	(0.015)	0.33	152
No rank	53.45	-0.034	(0.020)	0.12	152

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.

[a]In thousands of dollars.

*$p < .05$

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

		Demand Measure			
Outcome	Mean	Job Listings	Unemp. Rate	Help Wanted	N
Definite job	60.15	4.523*	0.674*	0.006	92,756
		(0.795)	(0.118)	(0.011)	
Definite job or training	66.20	9.955*	-0.107	0.008	92,756
		(0.770)	(0.114)	(0.010)	
Definite job and type reported	70.97	13.829*	-0.133	-0.039*	77,239
		(0.820)	(0.119)	(0.011)	
Definite job with U.S. employer	64.24	13.213*	0.156	-0.029*	77,239
		(0.847)	(0.123)	(0.011)	
Definite job with U.S. academic	48.55	10.921*	0.849*	-0.081*	77,239
		(0.892)	(0.130)	(0.012)	
Predictor mean		1.00	6.11	82.90	

Notes: Each cell comes from a separate regression (linear probability model). Standard errors are reported in parentheses. Dependent variables are indicators (0/1) multiplied by 100. In addition to the relevant demand measure shown, the independent variables include age at PhD completion (8 categories), citizenship/race (4 categories), gender, field, rank of doctoral program (11 categories), and TTD from graduate entry (15 categories). "U.S. academic" includes 4-year institutions and 2-year colleges.

*$p < .05$

Table 5. Parameter Estimates from Duration Model

Variable	(1)	(2)
Job listings	0.350*	0.288*
	(0.112)	(0.105)
Mgl. eff. on E(TTD)	[-0.101]	[-0.081]
Female	-0.121*	-0.123*
	(0.013)	(0.013)
Non–U.S. citizen	-0.217*	-0.253*
	(0.018)	(0.019)
U.S. citizen, white	—	—
U.S. citizen, non-white	-0.229*	-0.249*
	(0.024)	(0.024)
Teaching assistantship		0.411*
		(0.023)
Research assistantship		0.457*
		(0.033)
Fellowship		0.388*
		(0.030)
Personal funds		—
Other source		0.102*
		(0.037)
Pseudo R^2	0.093	0.100
N	421,851	421,424
Students	71,988	71,716
Mean TTD	9.06	9.08

Notes: Regressions also include controls for year in program, field, program rank, age at graduate entry, and an indicator for missing data on race/citizenship. Specification (2) also includes an indicator for missing data on financial support. Marginal effects on expected TTD (in brackets) are for an increase in job listings of 10 percent. Standard errors (in parentheses) allow for correlation in the error term within cells defined by year and field.

*p < .05

Table 6. Parameter Estimates Using Alternative Measures of Time to Degree

	1975–2005		1992–2005		
	Graduate Entry to PhD	BA to PhD	PhD Entry to PhD	Graduate Entry to PhD	BA to PhD
Job listings	0.350*	0.375*	0.277*	0.479*	0.542*
	(0.112)	(0.119)	(0.080)	(0.104)	(0.134)
Mgl. eff. on E(TTD)	[-0.101]	[-0.105]	[-0.041]	[-0.061]	[-0.054]
Pseudo R^2	0.093	0.159	0.089	0.116	0.186
N	421,851	475,270	118,669	128,234	120,511
Students	71,988	63,782	32,986	28,599	21,746
Mean TTD	9.06	10.13	7.04	8.15	8.88

Notes: Means are for the estimation sample, which covers doctorate recipients with TTD between 4 and 20 years (1975–2005) or between 4 and 13 years (1992–2005). Marginal effects on expected TTD (in brackets) are for an increase in job listings of 10 percent. Standard errors (in parentheses) allow for correlation in the error term within cells defined by year and field.

*$p < .05$

Table 7. Comparison of Parameter Estimates from SED and GEI Datasets

	Survey of Earned Doctorates			Graduate Education Initiative			
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Job listings	0.358*	0.281*	0.336*	0.326*	0.397*	0.436*	0.419*
	(0.130)	(0.129)	(0.130)	(0.119)	(0.104)	(0.108)	(0.107)
Mgl. eff. on E(TTD)	[-0.046]	[-0.036]	[-0.043]	[-0.040]	[-0.077]	[-0.089]	[-0.085]
Female	-0.146*	-0.148*	-0.142*	-0.114*	-0.100*	-0.116*	-0.086*
	(0.045)	(0.045)	(0.045)	(0.048)	(0.036)	(0.036)	(0.036)
Non–U.S. citizen	0.138	0.077	0.118	0.181*	0.234*	0.200*	0.213*
	(0.075)	(0.074)	(0.075)	(0.078)	(0.049)	(0.051)	(0.051)
U.S. citizen, white	—	—	—	—	—	—	—
U.S. citizen, non-white	-0.186*	-0.225*	-0.177*	-0.193*	-0.125*	-0.122*	-0.067
	(0.069)	(0.068)	(0.068)	(0.076)	(0.062)	(0.061)	(0.061)
Assistantship		0.069				-0.382*	-0.384*
		(0.068)				(0.051)	(0.050)
Fellowship		0.330*				0.046	0.048
		(0.050)				(0.042)	(0.042)
Tuition grant						-0.097*	-0.104*
						(0.048)	(0.047)
Summer support						-0.184*	-0.187*
						(0.058)	(0.058)
Personal funds		—					
Other source		0.511*					
		(0.141)					
Prior master's degree							0.163*
							(0.038)
GRE verbal / 100							0.037
							(0.020)
GRE math / 100							0.093*
							(0.021)
Age at graduate entry	Yes	No	No	No	No	No	No
Pseudo R^2	0.143	0.143	0.139	0.156	0.128	0.134	0.136
N	17,973	17,973	17,973	18,304	35,191	35,191	35,191
Students	4,739	4,739	4,739	4,849	8,300	8,300	8,300
Mean TTD	7.30	7.30	7.30	7.34	7.58	7.58	7.58
Exit years—first	1992	1992	1992	1992	1985	1985	1985
Exit years—last	2005	2005	2005	2005	2005	2005	2005

Notes: Numbers in the table are coefficient estimates for samples of students in GEI departments. Regressions also include controls for year in program, field, program rank, and an indicator for missing data on race/citizenship. Specifications (2), (6), and (7) also include indicators for missing data on financial support. Specification (7) also includes indicators for missing data on GRE scores and prior master's degree. The SED analysis involves the TTD measure starting from PhD entry. Marginal effects on expected TTD (in brackets) are for an increase in job listings of 10 percent. Standard errors (in parentheses) allow for correlation in the error term within cells defined by year and field.

*$p < .05$