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Cyclicality and the Labor Market for Economists

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The 1987 academic market was strong, whereas the 1997 market was weak. A multimarket theory of optimal search suggests that job seekers will respond to a weakening market by changing their search strategies at the extensive margin (which markets to enter) and the intensive margin (how many applications to submit per market). Employers respond to the weakening market by raising their hiring standards. High-quality applicants will obtain an increased share of academic interviews in weak markets while applicants from weaker schools will increasingly secure interviews outside of the academic market. Empirical results show that in the bust market, graduates of elite schools shifted their search strategies to include weaker academic institutions, while graduates of lower-ranked schools shifted their applications away from academia and toward the business sector. In bust conditions, academic institutions increasingly concentrate their interviews on elite school graduates, women, and U.S. residents.

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1. Introduction

The market for Ph.D. economists has attracted a great deal of attention in the literature. This is not surprising given the personal stake that many economists hold regarding the performance of this market. Yet, another motivation for studying this particular labor market rests on its highly organized structure, characterized by three distinct segments: advertisement of jobs during the few months prior to the Allied Social Science Association (ASSA) meetings, interviewing candidates at the ASSA meetings in late December or early January, and on-site visits and offers during the few months after the ASSA meetings.

Most studies of this market concentrate on explaining variation in earnings or type of employment, with variables such as gender, age, race, nationality, quality of Ph.D. institution, and number of publications significantly affecting employment or earnings success (see Barbezat 1992; Broder 1993; Formby, Gunther, and Sekano 1993; Singell and Stone 1993; McMillan and Singell 1994; Kahn 1995; Siegfried and Stock 1999; List 2000). Although employment outcomes of new Ph.D. economists have been thoroughly addressed, little attention has been given to how new Ph.D. economists set search strategies. Moreover, as studies tend to examine outcomes in one hiring period, evidence of intertemporal change in search strategies and outcomes is lacking.

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To fill the current gaps in the literature, we address the intertemporal relationship between applicant characteristics, search strategies, and outcomes of new Ph.D. economists. This is accomplished through the use of a survey instrument that documents behavior and outcomes of participants in the Ph.D. labor market in two years—1987 and 1997—that we loosely deem as "boom" and "bust" markets, respectively.[1] We organize the remainder of the paper as follows. Section II discusses the nature of those two markets. Section III presents a model that illustrates how agents on the supply and demand side will alter search strategies in response to perceived strength of the market. In Section IV, we discuss the survey instrument that was used to gather information on Ph.D. candidate behavior in the 1987 and 1997 markets. As shown in Section V, the survey results indicate that search intensity is naturally tied to the severity of excess labor supply. In Section VI, a model of search outcome is estimated across the two market periods. The results show that the effect of various applicant characteristics on numbers of interviews, visits, and job offers is related to the strength of the market. Concluding remarks are provided in Section VII.

2. The 1987 and 1997 Markets for Ph.D. Economists

We concentrate on two labor market periods, 1986–1987 and 1996–1997. Serendipitously, the last years coincided exactly with Siegfried and Stock's (1999) survey paper on labor market outcomes for Ph.D. economists. They found that graduates from higher-ranked schools were more likely to have a full-time job, were paid better, and were more likely to agree that their job was commensurate with their education. Graduates from weaker programs were less successful financially, but virtually all were employed. Nevertheless, Siegfried and Stock refer to a substantial number of graduates from all ranks who expressed disappointment in their market outcomes, with typical assessments about the market ranging from the most positive ("I got lucky") to less so ("It sucks!").

The negative reaction of new Ph.D.s to the 1997 market is understandable in light of data from *Job Openings for Economists* (*JOE*)—see Table 1. Although 1997 was unusually bleak, there were substantial differences across sectors. In particular, the academic and government sectors were weaker in 1997, whereas the business sector was the strongest in years. Using the number of advertised jobs per new Ph.D. as a measure of the arrival rate of job offers, arrivals fell 18% over the 10-year period reported in Table 1. The decline was most pronounced in academia (–28%) and government (–32%), whereas arrival rates rose in business. Statistics on the job market for economists reported by Siegfried (2002) indicate that no market since 1996–1997 was worse in terms of the number of new jobs per new Ph.D. recipient, including that of the 2001–2002 recession year. Consequently, the 1996–1997 market seems well-characterized as a "bust" market, whereas the 1986–1987 market can be characterized as a "boom."[2]

As a discipline, economics is oriented toward optimizing behavior, and so new Ph.D.s should adapt their search strategies to available market information. The economics labor market is structured to make information on market strength easy to obtain. The market is centered on the annual ASSA meetings.[3]

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[1] The "1987 market" coincides with the 1986–1987 academic year and the "1997 market" coincides with the 1996–1997 academic year.

[2] While the relative number of jobs listed in 1987 and 1997 is useful to characterize stronger and weaker markets, we do not believe they are indicative of the actual number of vacancies. Taken literally, the ratio of listed jobs to Ph.D.s is always greater than 1, even in bust markets. It appears that employers may list several jobs per vacancy and that some employers retract jobs after listing them.

[3] See Carson and Navarro's (1988) and Cawley's (2002) descriptions of the Ph.D. economics market. Similar to those two studies, our analysis concentrates on the market defined by individuals who attend the ASSA meetings and are applying for jobs in the United States. That includes the vast majority of new Ph.D. economists produced in the United States, but it does not include all employers in the global market for produced Ph.D.s, which includes employers and clearing mechanisms outside the United States.

Table 1. Supply and Demand for U.S. Economics Ph.D. Graduates[a]

Academic Year	Ph.D. Recipients	Job Listings			
		Academic	Government	Business	Total
1986–1987	750	1193 (1.59)	167 (0.22)	274 (0.37)	1673 (2.23)
1987–1988	770	1284 (1.67)	241 (0.31)	333 (0.43)	1887 (2.45)
1988–1989	827	1383 (1.67)	196 (0.24)	360 (0.44)	1959 (2.37)
1989–1990	806	1444 (1.79)	195 (0.24)	357 (0.44)	2018 (2.50)
1990–1991	802	1296 (1.62)	121 (0.15)	237 (0.30)	1695 (2.11)
1991–1992	866	1056 (1.22)	140 (0.16)	332 (0.38)	1549 (1.79)
1992–1993	879	1018 (1.02)	98 (0.11)	235 (0.27)	1372 (1.56)
1993–1994	869	1108 (1.28)	72 (0.08)	261 (0.30)	1457 (1.68)
1994–1995	910	1080 (1.19)	117 (0.13)	242 (0.27)	1467 (1.61)
1995–1996	1008	1038 (1.03)	62 (0.06)	316 (0.31)	1446 (1.43)
1996–1997	950	1083 (1.14)	143 (0.15)	479 (0.50)	1737 (1.83)
	27%↑	9%↓ (28%)↓	14%↓ (32%)↓	75%↑ (35%)↑	4%↑ (18%)↓

[a] Data on numbers of new Ph.D. recipients came from the National Research Council and Siegfried and Stock (1999). Data on job listings were compiled from U.S. jobs listed in the American Economic Association's (AEA) *Job Openings for Economists*. Foreign jobs were excluded. Academic job listings include two-year and four-year colleges and universities. Government job listings include Federal, state, and local agencies. Business job listings include private sector employers in banking, finance, and industry; consulting firms; and research institutes. AEA jobs listed as "other" were not included in our aggregations for academic, government or business jobs, so the total numbers are not the sum of the first three columns. "Other" jobs are a small proportion of the total (i.e., 2.33% of the total in 1986–87 and 1.84% in 1996–97). Job listings per new Ph.D. recipient are provided in parentheses.

Each fall, prospective Ph.D. recipients submit applications to academic institutions, government and international agencies, and private employers. Information on the demand-side of the market is virtually costless to obtain, as most jobs are advertised in the American Economic Association's publication, *JOE*. Since the number of jobs by field and type of employer are known early in the market cycle, job seekers have unusually good information on which to base expected returns from search. Nonetheless, their search strategies must be set by early December, as the great majority of interviews are conducted at the annual meetings. The opportunities for sequential search are therefore quite limited.

Submission of applications is not costless. In addition to mailing costs, for example, there are costs associated with the time required to research employer attributes and tailor materials to match different employers. Consequently, it may not be optimal to apply to every job, or even to apply to every job in one's field. Instead, the applicant must decide how many applications to submit and what type of employers to target on the basis of information available about the strength of labor demand. On the other side of the market, employers must decide how many people to interview and what type of applicants to pursue. These strategies are formalized in the next section.

3. Search Intensity in Multiple Markets

Using a framework that integrates features of Stern (1989) and Fallick (1992), we show how a weakening labor market affects search strategies on the extensive margin (that is, how many markets to sample) and on the intensive margin (that is, how many applications to submit per market). The model's main features are summarized here, and the details of the derivations are included in the Appendix.

Job Search by Applicants

Suppose there are J employer submarkets within the market for new Ph.D.s.[4] Submarket j opens in the fall when $\hat{v}_j$ employers each decide to advertise one job vacancy with an attached precommitted compensation level, w. Using the announcements as information on market strength, $\hat{n}_j$ job seekers opt to search in submarket j. Each of the seekers perceives a distribution of compensation packages (w) in each submarket, defined by the cumulative distribution function, $F_j(w)$. Compensation packages include salary, benefits, and teaching and research support.[5] Seekers also perceive the probability $\delta_j(\hat{v}_j,\hat{n}_j)$ that an application will yield a job offer. The arrival rate of offers, δ_j, is treated as a parameter by individual job seekers when they are deciding on applications. It will be larger when seekers perceive that there are more job vacancies, $\hat{v}_j$, and when they perceive that there are fewer seekers, $\hat{n}_j$. Later in the search process when matching occurs, employers and job seekers may adjust their strategies by entering or withdrawing, and thus the initial decisions regarding $\hat{v}_j$ and $\hat{n}_j$ may not equal their final realizations, v_j and n_j. We will show the equilibrium conditions that set v_j and n_j later.

Letting a rejection be viewed as a zero compensation offer, the compensation outcome from one application in submarket j is distributed according to

$$G_j(w) = (1 - \delta_j) + \delta_j F_j(w). \tag{1}$$

Seekers will submit A_j applications in submarket j and then select the best compensation package, $\bar{w}$. The probability that A_j applications submitted to sector j will generate a maximum offer of $\bar{w}$ is $[G_j(\bar{w})]^{A_j}$. The cumulative distribution function for receiving a best offer of $\bar{w}$ across J submarkets is designated as $\Gamma(\bar{w})$ with an associated density function, $\gamma(\bar{w})$. Their functional forms are given in the Appendix.

Applications cost c_j apiece. Application costs may differ across employer submarkets. For example, application costs at schools with graduate programs may be lower because applicants already have good information on the attributes of those schools.

Define ξ as the reservation compensation level, which is the lowest compensation package the applicant would accept. As shown in the Appendix, the optimum strategy is to set the reservation compensation level at

$$\xi = \beta\left\{\int_{\xi}^{\infty} [1 - \Gamma(w)]dw + \xi\right\} - \sum_{j=1}^{J} c_j A_j, \tag{2}$$

which is the multimarket equivalent of the form derived by Stern (1989). Equation 2 implies that seekers will set a constant reservation compensation level across all submarkets.

Extensive Search

Extensive search involves deciding in which of the J employer submarkets to search. The conditions dictating which markets a seeker will target come from the first-order conditions for the

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[4] Examples of academic employer submarkets would include elite graduate programs, lower-tier graduate programs, and liberal arts colleges. Examples of nonacademic employer submarkets would be the government sector, private employers, and international agencies.

[5] We could also include the hedonic value of the job including its prestige, amenities of the locale, and any other nonpencuniary job attributes that raise or lower the attractiveness of a job.

optimal number of applications per submarket. Differentiating Equation 2 with respect to A_j and setting $d\xi/dA_j = 0$ for all j, these J first-order conditions for applications in the jth submarket are of the form

$$-\beta \int_{\xi}^{\infty} \Gamma(w) \ln G_j(w) dw \geq c_j; \qquad j = 1, 2, \ldots, J. \tag{3}$$

The left-hand side of Equation 3 is the discounted expected marginal return from an additional application in submarket j and the right-hand side is the marginal cost of an application in submarket j. If Condition 3 is violated for all positive values of A_j, then the optimum strategy is to set $A_j = 0$, so that the applicant will decide to eliminate submarket j from his search set. The n_j seekers in submarket j are those for whom Condition 3 is satisfied.

There are two interesting cases under which Condition 3 is violated. One is when an individual's reservation compensation level is high relative to the distribution of compensation offers in submarket j. The other interesting case is when $\delta_j = 0$ because the individual perceives he cannot get an offer in submarket j. As we argue below, the likelihood of these cases will differ by the quality of the seeker and by whether the labor market is in boom or bust.

Intensive Search

Search intensity is the number of applications per submarket. The optimal search intensity is determined by the level of A_j that makes Condition 3 hold with equality. Our primary concern is to analyze how search intensity changes in response to changes in the strength of sectoral labor demand. For our purposes, it is convenient to describe a bust as a decrease in the arrival rate of offers in a given sector j.[6,7] A decline in δ_j will have an ambiguous effect on sector j applications, but will unambiguously increase applications in the other sectors ($\partial A_i/\partial \delta_j < 0$; $i \neq j$). That implies that the decrease in offer arrival rates in the academic and government sectors between 1987 and 1997 should increase search intensity outside of government and academia, but the effect on academic or government sector applications is uncertain.

Search and Seeker Quality in Boom and Bust Markets

Applicants who signal high ability to the market, presumably those from the most prestigious graduate programs, will have the highest arrival rate of offers and hence the highest relative ξ in both boom and bust markets. As ξ increases, the probability that Condition 3 is violated rises, and so perceived high-ability applicants will have the highest probability of excluding a submarket.

The incentive for elite seekers to exclude a submarket falls in bust conditions as ξ declines. To illustrate, suppose that elite graduates search in "prestigious" submarket 1 but not in submarket j during boom conditions. Further, suppose that a bust occurs in submarket 1 such that no vacancies are announced, meaning that $\hat{v}_1 = \delta_1 = 0$. Reservation compensation ξ falls, and so the probability that

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[6] We could also have characterized a bust market as a decline in the mean of the offer distribution, rather than a decline in the offer rate. It turns out that signs of the comparative static effects for a decline in the mean of the offer distribution are the same as those with respect to δ_j. It should be noted that the real average pay for new Ph.D.s did not decline between 1987 and 1997, despite the weak academic markets of the mid 1990s.

[7] Later, it will be convenient for us to assume that submarket j is a prestige market that would attract elite applicants, but it is important to note that weakness in any submarket j will increase incentives to apply in other submarkets.

Constraint 3 is satisfied for submarket j increases, as does the probability that elite graduates enter submarket j. Generalizing, we would expect that job seekers from top programs would search more extensively in bust than in boom markets.

In all market conditions, graduates of lower perceived quality will have lower expected arrival rates and thus lower reservation compensation levels than will those from elite institutions. As a consequence, the inequality condition in Equation 3 is less likely to be violated in any given submarket; thus graduates from lower-ranked programs will be less likely to exclude markets. The exception is that as the arrival rate δ_1 of offers in prestige submarket 1 approaches 0, $G_1(w)$ approaches 1, the left-hand side of Equation 3 approaches zero, and search in submarket 1 becomes fruitless. This case is most likely to occur in bust markets as $\hat{n}_1$ rises relative to $\hat{v}_1$. Consequently, perceived lower-quality graduates have a higher probability of dropping out of prestige submarkets such as 1 during a bust.

Search by Employers

Because the number of applications to submit is a choice of job seekers alone, it was appropriate to model the number of applications submitted with a model of one-sided search. However, search outcomes such as the number of interviews, site visits, or job offers will reflect choices of both job seekers and employers. To evaluate search outcomes, we need to develop a model of two-sided search. Before tackling the equilibrium problem, however, we need to describe how employer strategies will differ in boom and bust markets.

We assume that each employer faces a distribution of applicants in each of K supply submarkets.[8] For simplicity, we assume that each employer is looking to fill one job, so search strategies are modeled in the context of a specific job and not the firm's overall hiring strategy for all personnel.[9] The incumbent's marginal revenue product, net of the precommitted compensation level, is $(q_k - w)$, which is determined by a draw from the distribution $Q(q_k - w)$. Each interview in submarket k results in an accepted offer with probability $\theta_k(\hat{v}_k,\hat{n}_k)$. We assume initially that the employer takes this probability as parametric in setting its interview strategy. θ_k will be higher in years when fewer employers are perceived to be competing for applicants (low $\hat{v}_k$) and when they perceive a higher number of seekers, $\hat{n}_k$. An interview will generate zero net revenue with probability $(1 - \theta_k)$. Hence, the distribution of returns to interviews in the kth submarket is

$$R_k(q_k) = (1 - \theta_k) + \theta_k Q(q_k - w). \tag{4}$$

Upon receipt of applications in each of the k submarkets, the employer must decide how many to interview and from which submarkets. The best interviewee across all markets will generate $\bar{q}$, the highest marginal product. The cost of evaluating an applicant in supply submarket k is h_k. The probability that I_k interviews will generate an applicant who can produce $\bar{q}$ is $[R_k(\bar{q} - w)]^{I_k}$. The cumulative distribution of finding a best marginal product of $\bar{q}$ across K submarkets is designated

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[8] Examples of supply submarkets are the elite graduates of elite programs, other graduates of tier 1 and top graduates of tier 2 programs, and other graduates.

[9] We do not have any information on employers directly, so our information on the job is restricted to that obtained from the survey of applicants. A richer model could embed the firm's search strategy for new Ph.D. economists in the context of their complementarity or substitutability with other types of employees. Examples would include tradeoffs between hiring economists versus MBAs, temporary instructors, accountants, public policy school graduates, or finance Ph.D.s.

as $P(\bar{q} - w)$ with associated density function, $\rho(\bar{q} - w)$. As shown in the Appendix, the employer's best strategy is to set a reservation marginal revenue net of wage, ε, given by

$$\varepsilon = B\left\{\int_{\varepsilon}^{\infty} (1 - P(q - w)\mathrm{d}q + \varepsilon\right\} - \sum_{i=1}^{K} h_k I_k \geqq 0. \tag{5}$$

Equation 5 shows that the firm will set a common level of ε across all supply submarkets. Workers with net productivity below that level will not become employed. The remaining K first-order conditions set the number of interviews to set up for each market:

$$-B\int_{\varepsilon}^{\infty} P(q)\ln R_k(q)\mathrm{d}q \geqq h_k; \qquad k = 1, 2, \ldots, K. \tag{6}$$

If Condition 6 is violated for all positive values of I_k, the employer will avoid interviewing in that market. Therefore, the number of employers opting to recruit in supply submarket k, $\hat{v}_k$, will be those for whom Condition 6 is satisfied for at least one interview.

We can illustrate the partial equilibrium response of an employer to a bust market as follows. Suppose as before that the bust is submarket specific so that no vacancies are announced in prestigious employer submarket 1 ($\hat{v}_1 = \delta_1 = 0$). By Equation 3, seekers will unambiguously increase their intensive and extensive search in all other markets, implying that in any given submarket k, θ_k will increase. By Equation 5, employers in k will respond by raising the minimum net productivity standard that all seekers would have to meet. This means that either wages have to fall, expected productivity has to rise, or some combination of the two. If employers cannot adjust the wage level from its precommitted level, then the rising net productivity standard also means a rising absolute productivity standard, and so weaker applicants will find it more difficult to get interviews in the bust market.[10]

Equilibrium

In equilibrium the distinction between the number of employer and seeker submarkets disappears. Let L be the number of submarkets that is populated by both seekers and employers in equilibrium, and let the subscript ℓ denote an individual equilibrium submarket.

To make the characterization of equilibrium tractable, we need to assume that all of the applicants to a submarket of employers are *ex ante* identical. To do this, we assume that in each year, the process of sorting applicants across submarkets results in a pool of applicants within a submarket who have an identical probability of success. Furthermore, all employers within the submarket are *ex ante* identical in expected productivity.[11] In other words, after the initial announcement of vacancies and the initial receipt of applications, *ex ante* substandard applicants in terms of expected productivity are dropped by the market, as are *ex ante* substandard employers. The remaining v_ℓ employers and n_ℓ seekers meet the *ex ante* quality standard. This process is driven by Equations 3 and 5, where notional $\hat{v}_\ell$ is substituted by true v_ℓ and notional $\hat{n}_\ell$ is substituted by true n_ℓ. Substandard applicants find that the

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[10] This leaves open the possibility that a firm may have several different wages for the same job, depending on the expected productivity of each seeker. Legal and internal labor market restriction on that practice may force employers to offer the same wage to all seekers, so that Equation 5 prevents low-quality seekers from gaining employment by accepting a lower wage. Later on, we will have to assume that all seekers in a given submarket have the same productivity *ex ante*, so there will be a single offered wage.

[11] To our knowledge, there are no existing equilibrium search models that allow multiple sectors, multiple applicants per job, and *ex ante* heterogeneity among searches and employers.

actual realization of δ_ℓ is 0, and so Condition 3 is violated, prompting their withdrawal. Substandard employers find that the realization of θ_ℓ is 0, and so Condition 5 is violated, prompting their exit. The number of qualified vacancies, v_ℓ, equals the number of employers for whom Condition 5 holds, and the number of qualified job seekers, n_ℓ, is the number of candidates for whom Condition 3 holds.

The assumption that sorting results in *ex ante* identical employers and seekers oversimplifies the empirical context, in that the various Ph.D. submarkets undoubtedly have considerable heterogeneity across employers and job seekers that will affect observed outcomes. Nevertheless, there are some useful insights that can be extracted from the simplification.

A job match will occur if both the employer and the job seeker are satisfied that their union will generate sufficient surplus to meet each of their respective reservation requirements. A representative firm in submarket ℓ requires enough productivity to pay for $\varepsilon_\ell + w_\ell$, whereas the seeker requires enough to generate ξ_ℓ. The minimum acceptable match would generate exactly $q_\ell^m = \varepsilon_\ell + \xi_\ell$. The matching function that determines the probability of finding a successful match in the ℓth submarket is

$$u_\ell = P(q_\ell^m)^{M(\delta_\ell, n_\ell)}. \tag{7}$$

The function M determines the number of interviews, which increases in the number of qualified applicants, n_ℓ, and in the arrival rate of job offers, $\delta_\ell = v_\ell / n_\ell$. Because all seekers in a submarket are *ex ante* identical, they will have the same probability of obtaining an interview or of obtaining a match, but *ex post* some will land multiple offers while others come up empty. With probability u_ℓ, a seeker will fail to land a match. When an interview occurs, a draw is made on the revenue distribution. The only acceptable matches will be those for which $q_\ell > q_\ell^m = \varepsilon_\ell + \xi_\ell$, which occurs with probability $[1 - P(q_\ell^m)]$. With M interviews, the probability of a successful match is $1 - [P(q_\ell^m)]^M$.[12]

A second equation necessary for equilibrium in submarket ℓ is the equilibrium wage equation, as the firm is no longer constrained to its precommitted compensation package. The rents from the match, $q_\ell - q_\ell^m$, must be divided between the employer and the worker so that

$$\begin{aligned} w &= s(q_\ell - q_\ell^m) + \xi_\ell \\ \pi &= (1 - s)(q_\ell - q_\ell^m) + \varepsilon_\ell, \end{aligned} \tag{8}$$

where w is the worker's wage, π is the firm's net revenue, and s is the worker's share of the rent, $s \in [0, 1]$. If the firm can dictate pay, it will set $s = 0$, then workers will get back only their reservation wage $w = \xi_\ell$.[13] If the worker has complete market power, $s = 1$, then the firm will only be paid the value of engaging in another search $\pi = \varepsilon_\ell$.[14]

The equilibrating process works as follows: Suppose initially that $q_\ell < q_\ell^m$ so that no firm would be willing to pay the reservation wage. Employers will withdraw vacancies from the market. As they do, δ_ℓ falls, workers will lower their reservation wages, and employers will raise their reservation revenue level. In the limit, vacancies will continue to be removed until $q_\ell = q_\ell^m$. When $\varepsilon_\ell < \xi_\ell$ and $\delta < 1$, both employers and workers will expect to earn rents from the match. In that case, additional seekers have an incentive to enter and more employers will have an incentive to offer vacancies.

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[12] In essence, substandard employers are those for whom all draws on q_k would fail to generate q_k^m, the minimum acceptable match.

[13] Note that because we take random draws from the distribution of q_k, there will be heterogeneity in wage outcomes, even if expected wages are equal across seekers *ex ante*.

[14] Pissarides (2000) model assumes that employers can continue hiring until expected returns from an additional search is driven to zero ($\varepsilon_k = 0$). That condition is unlikely to hold in our application because employers generally cannot add additional Ph.D. vacancies within a year. In multiple-year settings, it would make sense to impose the zero expected profit condition.

Equilibrium Sorting in Boom and Bust Markets

Our concern is limited to the question of how employers and job seekers respond to a decrease in labor demand. A complete analysis of the properties of the model is beyond the scope of this paper, although it would be possible using simulation methods. We begin as before, supposing that the bust occurs in the relatively prestigious submarket 1 so that $v_1 = 0$. Both high- and low-ability job seekers will lower their reservation wages across all submarkets, including the less prestigious submarket ℓ. The resulting rise in θ_ℓ will cause employers in ℓ to raise their reservation net productivity level ε_ℓ. The minimum acceptable match productivity level may not change, however, as the increase in ε_ℓ is accompanied by the decline in ξ_ℓ, leading to an ambiguous change in $q_\ell^m = \varepsilon_\ell + \xi_\ell$.

The downward sorting of high-quality seekers into submarket ℓ creates difficulties for the lower-quality seekers normally in ℓ. Because the sorting leads to *ex ante* homogeneous job seekers in ℓ, the increase in expected quality will cause *ex ante* lesser-quality applicants to drop out of ℓ as for them, δ_ℓ drops to zero in the bust.

The bust will induce an increase in search intensity in ℓ, and so n_ℓ rises. The matching function increases in n_ℓ but decreases in v_ℓ/n_ℓ, and so the impact of the bust on the probability of matches (interviews, site visits, and job offers) is uncertain. Consequently, the probability that a seeker in ℓ will search unsuccessfully in ℓ may rise or fall in the bust.

Similarly, using Equation 8, we cannot predict if wages in ℓ will rise or fall. There are two reasons. First, the average quality of applicants in ℓ rises, so the match rent $q_\ell - q_\ell^m$ may rise, even if the minimum acceptable match productivity q_ℓ^m rises. Consequently, there may be more surplus to distribute between the employer and the worker. Second, while the reservation wage for all seekers falls, the seekers in submarket ℓ during the bust are not the same seekers in submarket ℓ in the boom period. It is possible that the reservation wages for high-quality seekers in the bust are higher than the reservation wages for low-quality seekers in ℓ during the boom. In fact, average starting salaries in the Ph.D. economics market do not seem to fall in bust periods, presumably due to some combination of sorting on quality and rising match capital in the bust market.

What then helps the lower-quality applicants in bust markets who have been displaced from submarket ℓ? There is a residual submarket R whose employers do not bother seeking Ph.D. economists in boom conditions because Condition 3 is violated for all job seekers at all application levels. With $n_R = 0$ and $\theta_R = 0$, Condition 6 will be violated at any positive level of interviews, and so employers in submarket R would not pursue applicants from submarket R in the boom. In the bust market, the decrease in ξ_R for seekers in R increases the likelihood that Condition 3 is satisfied, raising the probability that $n_R > 0$, that $\theta_R > 0$, and that Condition 6 is satisfied for employers in submarket R. Consequently, some employers interview in the Ph.D. market only in bust conditions.

At the risk of caricaturing the market, the prestige employer submarket in our empirical application might include highly ranked Ph.D.-granting institutions. An example of a less prestigious submarket would be liberal arts colleges with heavy teaching loads or lower-tier Ph.D.-granting institutions. An example of submarket R could be state and local governments or small private employers that normally do not seek to employ Ph.D. economists. Our theory suggests that when there is a bust in the prestige Ph.D.-granting market, higher-quality applicants will shift into less prestigious markets such as teaching colleges or lower-tier Ph.D.-granting institutions, potentially displacing lower-quality applicants. Meanwhile, employers who do not normally hire large numbers of Ph.D. economists such as private employers or state agencies may enter the market to take advantage of the opportunity to hire Ph.D. economists from lower-ranked schools. The main predictions of the theory and our empirical findings are summarized in Table 2.

Table 2. Summary of Predictions and Findings Regarding the Impact of Bust Submarkets on Search Strategies and Outcomes

In a bust, we expect	Finding
• Extensive Search	
○ Elite seekers will search in more, less prestigious submarkets	Confirmed
○ Low-tier seekers will drop more prestigious submarkets	Weakly confirmed
• Intensive Search	
○ All seekers will submit more applications in nonbust submarkets	Confirmed
○ Uncertain effect on applications in bust (academic) submarket	Elite seekers submit more, low-tier seekers submit fewer
○ Uncertain effect on total applications	All seekers submit more
• Matches (Interviews, Site Visits, Offers)	
○ Matches in bust submarkets decrease	Confirmed, but definitional
○ Matches in nonbust submarkets will increase	Confirmed, especially for low-tier visits and offers
○ Elite seekers will gain share in the more elite bust submarkets	Women and U.S. residents gain market share in the bust academic market

4. Data

As discussed previously, Table 1 shows that the U.S. labor market for new Ph.D. economists was relatively strong in 1987 and relatively weak in 1997. To examine how search strategies and outcomes differ across these markets, we surveyed new Ph.D.s in 1987 and 1997 utilizing the same survey instrument in each year.

The 1987 survey was based on the summary listings of new Ph.D.s provided annually by the placement directors at Ph.D.-granting economics departments. In March 1987, placement directors at 70 of the then top 92 ranked Ph.D. programs received a packet of questionnaires to distribute to their students who had entered the Ph.D. market. In total, 308 of the surveys were returned with no apparent relation between institution quality and the response rate.[15] Of those, 294 had responses that were sufficiently complete to use for this study.

The 1997 survey was administered to first-time job seekers at the ASSA meetings in New Orleans, Louisiana (January 2–5, 1997). Individuals were approached at the meetings and asked to participate. If they agreed, the surveyor briefly explained the survey and solicited responses from the participant. This procedure provided 193 completed surveys. Although the universe of the two samples differs, in practice the two samples are similar in that 96% of the 1987 respondents attended the ASSA meetings that year, which also happened to be in New Orleans.[16]

Our surveys solicited responses on applicant characteristics, search strategies, and success at the ASSA meetings. Similar to past studies (e.g., Barbazet 1992; Broder 1993; Formby, Gunther, and Sekano 1993; Singell and Stone 1993; Kahn 1995; Siegfried and Stock 1999), applicant char-

[15] Five schools refused to distribute the survey, with no apparent relation between school rank and willingness to cooperate.

[16] We replicated our results deleting those 11 job seekers who did not attend the ASSA meetings in 1987. Results were not sensitive to their inclusion or deletion, so we used the larger sample.

Table 3. Variable Definitions

Variable	Definition
Age	Age of individual
Resident	1 if citizen or permanent resident of United States, 0 if not
Male	1 if male, 0 if not
Publication	1 if individual has a publication, 0 if not
Scholarship	1 if individual has a scholarship or assistantship, 0 if not
Tier 1	1 if individual from top 19 Ph.D. program, 0 if not[a]
Tier 2	1 if individual from Ph.D. program ranked 20–49, 0 if not[a]
Tier 3	1 if individual from Ph.D. program ranked 50–100, 0 if not[a]
Region	1 if individual excluded from search any region, 0 if not
Town <10K	1 if individual excluded from search cities with populations less than 10,000, 0 if not
Federal	1 if individual excluded from search federal government jobs, 0 if not
State/local	1 if individual excluded from search state or local government jobs, 0 if not
Private employers	1 if individual excluded from search industry/business jobs, 0 if not
Research institute	1 if individual excluded from search research institute jobs, 0 if not
International agency	1 if individual excluded from search international agency jobs, 0 if not
Undergraduate	1 if individual excluded from search undergraduate institutions, 0 if not
Graduate	1 if individual excluded from search graduate institutions, 0 if not
Full-time teaching	1 if individual excluded from search full time teaching institutions, 0 if not
Academic	Number of academic applications submitted by individual
Business	Number of industry/business applications submitted by individual
Government	Number of government applications submitted by individual

[a] Rankings of institutions obtained from Scott and Mitias (1996). The top 19 schools are Harvard, Chicago, Penn, MIT, Northwestern, Stanford, Princeton, Michigan, Berkeley, UCLA, Yale, Columbia, NYU, Rochester, Wisconsin, Carnegie-Mellon, Cornell, Duke, and Illinois, respectively.

acteristics include such factors as age, resident status, gender, graduate institution, whether the candidate has published, and whether the candidate obtained a scholarship to help defray his/her graduate education expenditures. Search strategy questions deal with whether or not the candidate excluded from search any jobs (on the basis of location or type of job) and number of applications submitted to different job types.

Regarding search outcomes, the number of interviews obtained at the ASSA meetings, the number of on-site visits, and the number of job offers are measures of successful search. For the March 1987 survey, interview, visit, and offer counts were obtained from the initial survey, whereas for the 1997 survey, interview, visit, and offer counts were obtained via a follow-up e-mail survey in March of that year. Table 3 provides empirical definitions of the key variables.

Applicant characteristics across the two market years are reported at the top of Table 4. The sample means are similar in magnitude to those reported by Siegfried and Stock (1999) except that our sample had more women. We report a higher proportion of U.S. residents than their reported proportion of U.S. citizens, as would be expected, as citizens are a subset of residents. The age of first-time Ph.D. recipients grew by 2.2 years on average from 1987 to 1997. The proportion of job seekers that are nonresidents rose, as did the proportion with publications at the time of the meetings. The proportion of men among job seekers increased 1 percentage point, whereas the proportion on scholarship increased 2 percentage points from 1987 to 1997. These trends closely mimic the trends in available data on earned doctorates reported by Siegfried and Stock (1999), except that their numbers suggest a slight increase in the proportion of women Ph.D.s over time.

Table 4. Sample Statistics

Applicant Characteristic	Means[a] 1987 (294)	1997 (193)	Test[b]
Age	29.5	31.7	5.1***
Resident	0.75	0.63	−2.8***
Male	0.72	0.73	0.2
Publication	0.25	0.42	3.7***
Scholarship	0.80	0.82	0.5

	Tier 1 Means[a]			Tier 2 Means[a]			Tier 3 Means[a]			
Search Strategy	1987 (159)	1997 (42)	Test[b]	1987 (99)	1997 (40)	Test[b]	1987 (27)	1997 (40)	Test[b]	Comparative Static[c]
Probability of Excluding:										
Region	0.48	0.29	−2.2**	0.41	0.33	−0.9	0.41	0.23	−1.5	−0.39***
Town <10K	0.27	0.24	−0.4	0.22	0.28	0.7	0.22	0.10	−1.3	−0.02
Federal	0.35	0.32	−0.3	0.36	0.38	0.2	0.30	0.20	−0.9	−0.36**
State/local	0.73	0.49	−2.6***	0.60	0.58	−0.2	0.52	0.13	−3.5***	−0.60***
Private employers	0.52	0.17	−4.5***	0.42	0.40	−0.2	0.33	0.18	−1.4	−0.62***
Research institute	0.42	0.15	−3.5***	0.31	0.33	0.2	0.37	0.08	−2.8***	−0.58***
International agency	0.49	0.22	−3.2***	0.52	0.35	−1.9*	0.48	0.30	−1.5	−0.57***
Undergraduate	0.20	0.07	−2.3**	0.12	0.08	−0.7	0.11	0.13	0.2	−0.26
Graduate	0.02	0.02	0.1	0.05	0.00	−2.3**	0.11	0.15	0.5	−0.11
Full-time teaching	0.52	0.22	−3.6***	0.32	0.23	−1.1	0.22	0.13	−0.9	−0.43***
Applications:										
Academic	37.0	42.0	0.8	49.0	49.5	0.1	43.2	35.0	−1.2	−5.51
Business	2.4	4.7	1.8*	2.6	5.7	1.9*	1.3	17.7	2.7***	4.78***
Government	2.4	2.3	−0.2	2.8	2.4	−0.5	2.5	4.3	1.2	−0.38

[a] Numbers in parentheses refer to the respective sample size. Note that the sum of the sample sizes for tiers 1 through 3 fall short of the totals for each year. The discrepancy is accounted by individuals who graduated from institutions below the top 100.
[b] Test of difference in means.
[c] Coefficient of dummy variable for 1997 (=1 for 1997, 0 for 1987) from probit or ordinary least squares regression, holding constant age, residency, gender, publications, scholarship, and tier rank of Ph.D. granting institution. Complete results are available upon request.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

5. Search Strategies for Applicants

Our data on the number of applications submitted by submarket reflect supply-side search strategies only, given seeker perceptions of the strength of labor demand. Our theoretical model suggests that as labor market demand weakens, reservation wages should fall and the incentives to exclude a given market should decrease. Because those from premier institutions (tier 1) would have the greatest incentive to exclude sectors when demand is strong, we should find the greatest increase in extensive search among elite graduates during a bust market. The results in Table 4 support this premise: Tier 1 graduates were more likely to exclude sectors in the stronger 1987 market compared to the weaker 1997 market. Indeed, for tier 1 graduates, the exclusion probability fell in every submarket except one. Elite graduates were significantly less likely in bust than in boom markets to exclude a region of the country, state or local government jobs, private employers, research institutes, international agencies, and schools that require more teaching. Furthermore, although graduates of second- and third-tier programs

tend to apply to more jobs overall than tier 1 graduates, similar to tier 1 graduates they also generally chose less exclusive search strategies in 1997 relative to 1987. Nonetheless, the changes were often smaller numerically and not significantly different from zero.[17] The theory also raises the possibility that weaker applicants would exclude prestige markets in a bust as δ_j approaches 0. There is modest evidence that tier 3 graduates were more likely to opt out of undergraduate and graduate academic submarkets in the bust, although the change is small and not statistically significant.

Search strategies also include decisions on the number of applications to submit to different types of jobs. As the arrival rate of offers drops in the academic and government submarkets, search intensity should increase in the business sector.[18] This conjecture is confirmed by the data, as the number of business applications increases significantly in each of the tiers.[19]

Differences in unconditional means across 1987 and 1997 could be due to changes in applicant characteristics over time. To control for temporal discrepancies in applicant characteristics, we report a comparative static estimate, which is taken as the estimated coefficient on a dummy variable for 1997, holding constant age, resident status, male, publication, scholarship, and tier ranking of graduate program in the final column of the bottom portion of Table 4. In all cases, the probability of excluding a market fell as the overall labor market weakened from 1987 to 1997. Furthermore, over the same time frame, the comparative static estimates indicate that business sector applications increased by 4.8, which is consistent with the predicted search intensity response.

Theory does not generate an unambiguous prediction of how weakening demand in academia and government affects search intensity in those sectors. Yet, if we take the numbers literally, graduates of top-tier schools appear to search more intensively in the academic sector as the academic market weakens, most noticeably by applying to undergraduate colleges and full-time teaching jobs that they avoided in the boom. Graduates of third-tier institutions reduced their academic applications and shifted in dramatic fashion toward business applications.

Interestingly, the average search intensity by sector for top-tier graduates in the 1997 bust market is similar to the search intensity of third-tier graduates in the 1987 boom market. Also, the exclusion strategies of first-tier graduates in 1997 are similar to those of third-tier graduates in 1987. In short, graduates of stronger programs search in weak markets much as graduates of weaker programs search in strong markets. This suggests that as the market weakens, stronger applicants shift their sights toward less prestigious outlets that were previously left to weaker applicants, displacing third-tier graduates from their normal markets. The third-tier graduates then seek submarkets that open because of the bust conditions in the prestige markets.

6. Search Outcomes

The search outcome indicators from our survey, which include the number of interviews, site visits, and job offers, are the result of the matching process between employers and seekers. The theory

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[17] Several individuals graduated from programs ranked below the top 100 (tier 4). Although their search strategies also differed between 1987 and 1997 because of the small sample size in 1987, we exclude this group from Table 3. We estimated all of our regressions with and without this group. Since the results were largely insensitive to the inclusion of tier 4, favoring degrees of freedom, we included these individuals in all regressions. Descriptive statistics for tier 4 individuals are available upon request.

[18] To make the subsectors large enough to evaluate, we include banking or finance, business or industry, and consulting or research under our aggregated business group. There was little change in the importance of these subcomponents between the two years. Consulting/research institutes made up 67% of the market in 1987 and 60% in 1997.

[19] Although there was little change between 1987 and 1997 in the percentage of respondents that applied for academic jobs (i.e., 95% applied for academic jobs in 1987, whereas 96% applied in 1997) as well as government jobs (i.e., 56% in 1987 and 47% in 1997), the percentage of respondents applying to business jobs increased from 39% to 62%.

Table 5. Job Search Outcomes Per Ph.D. Recipient, by Type of Outcome and Quality of Graduate Program, 1987 and 1997

	Academic		Business		Government	
Variable	1987	1997	1987	1997	1987	1997
Overall job search outcomes						
Interviews	11.98[a]	4.87[a]	0.86	0.93	1.64[a]	0.51[a]
Visits	3.02[a]	1.22[a]	0.31	0.29	0.44[a]	0.09[a]
Offers	1.56[a]	0.60[a]	0.15	0.16	0.35[a]	0.06[a]
Tier 1 job search outcomes						
Interviews	13.16[a]	7.32[a]	0.93	0.78	1.86[a]	0.51[a]
Visits	3.87[a]	1.56[a]	0.37	0.29	0.53[a]	0.12[a]
Offers	1.93[a]	0.73[a]	0.20	0.20	0.42[a]	0.05[a]
Tier 2 job search outcomes						
Interviews	10.91[a]	5.85[a]	0.94	0.60	1.50[a]	0.55[a]
Visits	2.27[a]	1.48[a]	0.29	0.40	0.36[a]	0.08[a]
Offers	1.28[a]	0.68[a]	0.08	0.23	0.25[a]	0.08[a]
Tier 3 job search outcomes						
Interviews	8.70[a]	3.08[a]	0.37[a]	1.35[a]	1.15[a]	0.43[a]
Visits	1.15	0.90	0.11	0.38	0.22	0.05
Offers	0.74	0.53	0.11	0.18	0.30[a]	0.05[a]

[a] Significant (at least 10%) difference between means for 1987 and 1997.

does not generate sharp predictions on the probability of success in the bust, but it does predict that employers would be raising the minimum quality level, potentially limiting opportunities for lower-quality graduates in the more prestigious submarkets. At the same time, some employers that avoid the Ph.D. market in a boom enter in a bust market, providing a new source of employment for lower-quality seekers. We focus on three sequential indicators of successful search in the primary market centered on the ASSA meetings: (i) initial interviews at the meetings; (ii) site visits; and (iii) job offers.

Summary statistics on search outcome for the three submarkets are presented in Table 5. Applicants in 1997 had less success on average, as the average number of interviews, visits, and offers were significantly lower in 1997 versus 1987 for graduates of all tiers. The exception is the business submarket, where success probabilities were roughly comparable in 1997 and 1987. Our conjecture about employer and applicant search strategies does appear consistent with the data. The ratio of tier 1 to tier 3 academic interviews rises from 1.5 to 1 in 1986–1987 to 2.4 to 1 in 1996–1997, indicating that tier 3 applicants are being atypically sorted out of the weakening academic market.

Furthermore, with respect to the academic submarket, graduates of the top two tiers averaged more than one academic offer in 1987, yet only 0.7 offers in 1997. Indeed, top-tier graduates received academic offers in the bust market at nearly identical rates to third-tier graduates in boom markets, consistent with the earlier finding that top-tier candidates in 1997 used search strategies that were similar to tier 3 job seekers in 1987.

All tiers had significantly less success in the government submarket in 1997. Government success rates for top-tier graduates dropped so much that they were indistinguishable from those of third-tier graduates.

The business sector took up the slack in the market. The top-tier graduates experienced no decline in average offers in the business sector, and lower-tier graduates had rising average numbers of site visits and offers in 1997.

Outcomes Conditional on Job Seeker Attributes

Table 5 estimates do not control for important factors such as gender, age, and applicant quality that may affect search outcomes between the two years. As the market goes from boom to bust, employers will raise their hiring standards. This subsection examines how the matching process, measured by the number of interviews, site visits, and offers, changes from boom to bust markets.

Referring once more to Equation 7, matches can be measured by their number, M, or by the probability of success, $1 - [P(q_\ell^m)]^M$. We opted to concentrate on the number of matches, M, as it provides additional heterogeneity in outcomes to explain. It also avoids complications associated with possible variation in the threshold output level, q_ℓ^m, across employers that we cannot control, as our data set does not identify the attributes of the employers. We require an econometric specification that can accommodate the count nature of our match success indicators. Let $M_{i\ell}$ be the number of matches for job seeker i in submarket ℓ, and X_i be the seeker's demographic and productive characteristics. A convenient option is the negative binomial distribution, given by:

$$\text{Prob}(Y = M_{i\ell}|u) = \frac{e^{-\lambda_i \exp(u)} \lambda_i^{M_{i\ell}}}{M_{i\ell}!}, \tag{9}$$

where $\ln \lambda_i = \beta' X_i$, $M_{i\ell}$ and X_i are as defined above, β is a vector of estimable parameters, and where $\exp(u)$ has a gamma distribution with mean 1 and variance α. If $\alpha = 0$, Equation 9 reduces to the Poisson regression. In our applications, the restriction that $\alpha = 0$ was rejected in all specifications, so we report only results from the negative binomial specification. The coefficients are monotonically related to the predicted number of matches, and so a positive sign implies more matches. The marginal effect of a unit increase in X_i can be shown by the incidence rate $\exp(\beta_i)$, which equals the expected number of matches when X_i increases by one relative to the number of matches when X_i does not change, all other variables held constant.[20] An incidence rate greater than one implies that the variable raises the number of matches, whereas an incidence rate below one implies that the variable lowers the number of matches.

Interviews

Table 6 presents the estimation results for interviews in the academic, business, and government submarkets. We could not reject the hypothesis that the coefficients were equal across tiers, and so we report only the regressions that pool across tiers. However, the null hypotheses that the coefficients were equal across submarkets or equal across boom and bust periods were easily rejected. Thus, we estimate the model for each submarket and time period separately.

The first two columns of Table 6 report the impact of demographic and qualification variables on the number of academic interviews. Below the coefficient, we report the corresponding t-statistic in parentheses and the implied incidence rate in brackets. In comparisons across the boom (1987) and bust (1997) years, a decrease in the magnitude of the coefficient or the incidence rate would suggest a decrease in the arrival rate of interview matches associated with a weakening academic labor market.

Men have a significant disadvantage in getting academic interviews compared to observationally identical women. The coefficients imply that male interview arrival rates were 18% less than otherwise comparable female seekers in the boom.[21] The male disadvantage in garnering academic

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[20] Cameron and Trivedi (1998) present a review of regression methods for count data.

[21] This is computed by $100 \times (1 - 0.82)$ where 0.82 is the incidence rate implied by the coefficient –0.20. Other incidence rates reported in brackets can be interpreted in like manner.

Table 6. Determinants of Academic, Business, and Government Interviews Received by Ph.D. Recipients, 1987 and 1997[a,b]

	Academic		Business		Government	
Variable	1987	1997	1987	1997	1987	1997
Constant	3.37*** (7.92)	2.43*** (4.51)	0.59[c] (0.50)	2.23**[c] (2.03)	−0.33 (1.44)	−2.39** (2.07)
Demographics						
Male	−0.20**[c] (2.07) [0.82][d]	−0.53***[c] (3.16) [0.59]	−0.06 (0.23) [0.94]	0.78** (2.05) [2.18]	0.04 (0.2) [1.04]	0.58* (1.66) [1.78]
Age	−0.04* (3.30) [0.96]	−0.03* (1.70) [0.97]	−0.08** (2.39) [0.92]	−0.09*** (2.70) [0.92]	−0.08*** (3.00) [0.93]	−0.03 (1.17) [0.97]
Resident	−0.10 (0.99) [0.91]	0.12 (0.71) [1.12]	0.60** (2.07) [1.82]	0.12 (0.35) [1.13]	2.90*** (7.5) [18.2]	3.39*** (4.58) [29.6]
Individual qualifications						
Tier 1	0.28**[c] (2.01) [1.33]	0.69***[c] (3.61) [1.99]	0.98**[c] (2.15) [2.66]	−0.43[c] (1.01) [0.65]	0.47 (1.56) [1.60]	0.02 (0.05) [1.02]
Tier 2	0.19 (1.26) [1.20]	0.48** (2.45) [1.62]	1.09**[c] (2.31) [2.97]	−0.57[c] (1.28) [0.57]	0.39 (1.24) [1.48]	−0.12 (0.33) [0.89]
Publication	0.28***[c] (2.86) [1.32]	−0.10[c] (0.61) [0.91]	0.21 (0.80) [1.24]	−0.13 (0.35) [0.88]	−0.15 (0.74) [0.86]	−0.30 (0.99) [0.74]
Scholarship	0.28** (2.57) [1.33]	0.01 (0.03) [1.01]	0.27 (0.92) [1.31]	−0.19 (0.44) [0.82]	0.02[c] (0.10) [1.02]	−0.72**[c] (2.17) [0.49]
Log likelihood	−999	−502	−350	−227	−452	−153
Sample size	294	193	294	193	294	193

[a] Dependent variable is number of interviews. Estimates are from the negative binomial regression estimator.

[b] *t*-statistics in absolute value are in parentheses below the coefficient estimates.

[c] Indicates significant difference in coefficient estimates of respective variable between 1987 and 1997 (at the 10% significance level). Global tests of the difference in all coefficient estimates between 1987 and 1997 were also performed. In each case, at the 10% significance level or better, the null of identical coefficients was rejected.

[d] Estimates of the incidence ratio, interpreted as the expected count from a unit increase in the variable relative to the count when all variables held fixed, are reported in brackets.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

interviews increases significantly to 41% in the bust market. Older applicants obtain fewer interviews, but the impact is small numerically. The disadvantage lessened in the bust market, but the numerical difference is insignificant. Residents had a small and statistically insignificant advantage in the bust market, a reversal from the boom.

Our theory suggested that academic employers will raise hiring standards and concentrate on elite school graduates in a bust market. This appears to be the case, with sharp increases in the arrival rate of academic interviews for tier 1 and tier 2 applicants relative to those from less prestigious programs. However, the advantage of having a publication or scholarship disappeared in the bust market, as the respective estimated coefficients are not significantly different from zero.[22]

In general, seeker attributes associated with a decline in relative academic interview matches were associated with stronger arrival rates of business interviews. Men were more than twice as likely to land business interviews in the bust market after failing to have an advantage in the boom market. In the bust market, tier 3 graduates who were losing relatively in the academic market had an increased probability of landing interview matches in business.

The government sector barely participated in the 1997 market, as all three search outcomes were much lower. Indeed, recall from Table 5 that the number of interviews held was just over half the number of business interviews, almost an exact reversal of the relative position of the two submarkets in the 1987 boom. In both boom and bust markets, resident status is critical for an interview match in the government sector, reflecting hiring restrictions on foreign nationals. The other attributes show evidence of sorting. The tier 3 disadvantage in interview matches found in the bust academic market does not appear in the bust government market. Likewise, men who lost relative position in the bust academic market faced a higher arrival rate of interview matches in the bust government sector.

Across the three subgroups, the story from Table 6 appears to be that when the labor market weakens for doctorates in economics, the graduates of elite institutions and women gain market share of interviews in the academic market. Graduates of lesser institutions and male seekers get crowded into other markets, gaining market share of interviews there.

Visits and Offers

We replicate the specification for our two other measures of matches, site visits and offers, in Table 7. For two main reasons, we confine our discussion to the academic market. First, because the academic market closes by the end of the academic year, our March survey results for that market are relatively complete. The other markets continue through the summer, and we do not observe decisions that late into the year for either 1987 or 1997. Second, in part due to that problem, our site visit and offer measures in the government sectors are dominated by a preponderance of zeroes. The formal test of the hypothesis of equal coefficients across boom and bust markets could not be rejected in those markets because most coefficients are imprecisely estimated. Although the results are not reported, the sign patterns for visits and offers in the business and government submarkets matched their respective signs in the interview regressions reported in Table 6. Consequently, similar patterns of matching across boom and bust markets appear to hold across all three search outcomes.[23]

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[22] One could rationalize the drop in importance of self-reported publications as an indication of the proliferation of low-quality journals, but we have no information on the quality of the publications. The sharp increase in the proportion reporting publications in the bust market suggests that the definition of "publication" differed across the two markets.

[23] Note that our interview information in the business and government sectors will be less subject to truncation than our site visit and offer measures, and so our interview regressions will be subject to less measurement error.

Table 7. Determinants of Academic Visits and Job Offers Received by Ph.D. Recipients, 1987 and 1997[a,b]

	Site Visits		Job Offers	
Variable	1987	1997	1987	1997
Constant	1.28** (2.12)	2.38*** (3.53)	1.42**[c] (2.14)	1.85**[c] (2.35)
Demographics				
Male	−0.31**[c] (2.44) [0.73][d]	−0.71***[c] (3.76) [0.49]	−0.37***[c] (2.72) [0.69]	−0.97***[c] (4.68) [0.38]
Age	−0.04** (2.28) [0.96]	−0.06*** (3.06) [0.94]	−0.06*** (2.88) [0.95]	−0.07*** (3.13) [0.93]
Resident	−0.24*[c] (1.81) [0.78]	0.49**[c] (2.45) [1.63]	−0.49**[c] (3.52) [0.61]	0.81***[c] (3.30) [2.25]
Individual qualifications				
Tier 1	1.10***[c] (5.09) [3.02]	0.38*[c] (1.73) [1.47]	0.95*** (3.81) [2.59]	0.35 (1.40) [1.43]
Tier 2	0.72*** (3.15) [2.06]	0.30 (1.32) [1.35]	0.71*** (2.73) [2.04]	0.14 (0.55) [1.15]
Publication	0.51***[c] (3.94) [1.66]	−0.34*[c] (1.77) [0.71]	0.52***[c] (3.84) [1.68]	−0.20[c] (0.91) [0.82]
Scholarship	0.39**[c] (2.50) [1.47]	−0.25[c] (1.08) [0.78]	0.34** (2.00) [1.40]	−0.07 (0.27) [0.93]
Log likelihood	−631	−275	−473	−183
Sample size	294	193	294	193

[a] Dependent variable is number of academic visits and offers. Estimates are from the negative binomial regression estimator.
[b] *t*-statistics in absolute value are in parentheses below the coefficient estimates.
[c] Indicates significant difference in coefficient estimates of respective variable between 1987 and 1997 (at the 10% significance level). Global tests of the difference in all coefficient estimates between 1987 and 1997 were also performed. In each case, at the 10% significance level or better, the null of identical coefficients was rejected.
[d] Estimates of the incidence ratio, interpreted as the expected count from a unit increase in the variable relative to the count when all variables held fixed, are reported in brackets.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

Because the regressions for site visits and offers tell similar stories, we will discuss both pairs of estimates simultaneously. In both boom and bust markets, men experience significantly greater difficulty obtaining academic visits and offers compared to otherwise comparable women, and the advantage held by women in the academic submarket is even larger at the offer stage than at the visit and interview stages. However, results in Table 6 suggest that men make up for their big disadvantage in the bust academic market by doing better in the bust business and government submarkets. U.S. residents have no advantage in academic interviews and actually do worse than nonresidents in site visits and offers during the boom period. In the bust market, residents still do not have a significant advantage in academic interviews but have a clear advantage in academic visits and job offers. Nonresidents cannot make up the gap in the government submarket and do not fare better in the bust business submarket either (see Table 6). This suggests that nonresidents face a disproportionate difficulty in finding a match in the bust period.[24]

The top-tier graduates continue to enjoy an advantage in academic site visits and offers in the bust market, but the coefficients fall in magnitude and precision between the boom and bust periods. This is consistent with the results in Table 4, where elite graduates retain their advantage in academic market outcomes in the bust market, but they face the greatest proportional decrease in visits and offers compared to their boom market levels. The peculiar disadvantage for publications found for interviews in the bust academic market follows through to site visits and offers, although the precision of the estimates is suspect.

Compared to the results for interviews in Table 6, the results in Table 7 reveal less crowding out of the academic market on the basis of quality. The difference reflects the fact that elite graduates in boom markets average multiple site visits and offers, whereas third-tier graduates average less than

[24] Consistent with our finding, Siegfried and Stock (1999) report a sharp increase in the proportion of Ph.D.s finding employment outside the United States between 1987 and 1996.

a single academic offer in the boom. In the bust, third-tier applicants still do less well, but the largest decline in matches during the bust is for the first-tier graduates who, on average, have gone from multiple offers to less than one.

Those graduates who were not matched in the academic market generally find employment in other submarkets, even in the bust market of 1997. Siegfried and Stock (1999) report that elite graduates were more likely to find employment in the academic market and to be satisfied with the job they found. Their findings are consistent with our result that tier 3 seekers get crowded out of favored submarkets in the bust and end up searching in submarkets they may not have expected to enter.

7. Concluding Remarks

This paper shows the importance of job market conditions on the search strategies and outcomes for first-time job seekers in the economics Ph.D. labor market, both in theory and in the data. In bust markets, graduates at all quality tier levels are less likely to exclude markets. However, the changes are most noticeable for elite graduates who search more intensively at weaker academic institutions. Employers raise hiring standards in bust markets, which means that weaker schools concentrate more intensively on graduates from higher-ranked schools. This serves to crowd graduates from lower-tier schools into less favored sectors such as business.

Left unexplored is whether graduates who are crowded out of their favored markets during the bust ultimately reenter the market to seek a more favorable match later in their careers. If so, we should find more job switching for bust year graduates than for boom year graduates. On the other hand, those placed in the academic market during bust years should be atypically productive, as they had to meet a higher hiring standard to be employed. This would be particularly true for men and for nonresidents hired in bust years who seemingly faced greater difficulty being matched in the bust market relative to otherwise comparable women and residents. If this reflects a tendency to set higher threshold hiring levels for men and nonresidents, then we would expect that men and nonresident academicians hired in bust years to be even more productive on average.[25] These questions could be explored with longitudinal data on the careers of boom and bust graduates.

Finally, we must acknowledge that differences between the two periods may reflect factors other than the differences in the strength of the labor market between years. Although we believe the empirical results are convincing that job seekers and employers do alter their strategies in response to strength or weakness in the market, a definitive conclusion would require replication in other settings.

Appendix

Applicant Job Search

The offer distribution in market j is given by $G_j(w)$ in Equation 1 in the text. The probability that A_j applications will generate one top offer of $\bar{w}$ is $[G_j(\bar{w})]^{A_j}$. The density function associated with getting a top offer of $\bar{w}$ in the jth market is

[25] This also demonstrates why studies of discrimination that look only at those in the academic market can yield invalid inferences. Suppose, for example, that women face discrimination in the business sector. This will cause women to lower their reservation wages across all markets relative to men. It will also cause women to search more intensively in sectors other than business. Other things equal, more women will be matched in the academic market than men, but with their lower reservation wages, women are likely to end up being paid less on average than men. An earnings function estimated in the academic market will find that women are paid less than men, but the source of the discrimination is in the business sector and not in academia.

$A_j g_j(\bar{w})[G_j(\bar{w})]^{A_j-1}$. The seeker will pick the best offer among the J potential submarkets. This implies that the cumulative distribution function for receiving a top offer of $\bar{w}$ across J submarkets is

$$\Gamma(\bar{w}) = \prod_{j=1}^{J}[G_j(\bar{w})]^{A_j}, \tag{A1}$$

with associated density function

$$\gamma(\bar{w}) = \left\{\sum_{j=1}^{J}\frac{A_j g_j(\bar{w})}{G_j(\bar{w})}\right\}\prod_{j=1}^{J}G_j(\bar{w}). \tag{A2}$$

Given search costs c_j, the discounted expected return from searching in the Ph.D. market net of search costs is

$$V = \beta\left\{\int_{\xi}^{\infty} w\gamma(w)\mathrm{d}w + \Gamma(\xi)V^*\right\} - \sum_{j=1}^{J}c_j A_j, \tag{A3}$$

where ξ is the reservation compensation level. The first term in brackets is the expected value of the best offer received, whereas the second term is the probability that no offer of at least ξ is received across the J submarkets, multiplied by V^*, the expected value of searching again next year. The second term is the aggregated search costs across J markets. Setting $\xi = V = V^*$ generates the optimum formula for the reservation wage 2 in the text.

Firm Search Strategies

The distribution of net marginal products in submarket k is given by Equation 4 in the text. The probability that I_k interviews will generate a top net marginal product of $(\bar{q} - w)$ in submarket k is $[R_k(\bar{q} - w)]^{I_k}$ with associated density function $I_k r_k(\bar{q} - w)[R_k(\bar{q} - w)]^{I_k - 1}$. Interviewing across K submarkets, the cumulative distribution for a top net marginal product outcome of $(\bar{q} - w)$ is

$$P(\bar{q} - w) = \prod_{k=1}^{K}[R_k(\bar{q} - w)]^{I_k}, \tag{A4}$$

with associated density function

$$\rho(\bar{q} - w) = \left\{\sum_{k=1}^{K}\frac{I_k r_k(\bar{q} - w)}{R_k(\bar{q} - w)}\right\}\prod_{k=1}^{K}R_k(\bar{q} - w). \tag{A5}$$

With evaluation costs of h_k, the employer's expected discounted return from the interview process is

$$\mathrm{v} = B\left\{\int_{\varepsilon}^{\infty} q\,\rho(q - w)\mathrm{d}q + P(\varepsilon)\mathrm{v}^*\right\} - \sum_{k=1}^{K}h_k I_k, \tag{A6}$$

where ε is the reservation net marginal revenue for the employer and v^* is the expected value of searching again next period if no one is hired. The first term in brackets is the expected net marginal product of the best interviewee, whereas the second term is the probability that no qualified applications with net productivity above ε are interviewed across the J submarkets, multiplied by v^*, the expected value of searching again next year. Setting $\varepsilon = \mathrm{v}^* = \mathrm{v}$, we can derive the reservation net productivity Condition 5 in the text. Differentiating Equation 5 with respect to I_k and setting $\mathrm{d}\varepsilon/\mathrm{d}I_k = 0$ for all k generates the remaining K conditions reflected in Equation 6 in the text. Complete static derivatives are available from the authors on request.

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