Can the Job Market for Economists be Improved?

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Abstract

In this chapter we describe the operation of the job market for PhD economists and an effort to improve the market's operation via the creation of the non-profit organization *EconJobMarket.org* (EJM), an online intermediary that serves as an "information clearinghouse" to facilitate the exchange of information between applicants, recommenders, and recruiters. EJM does not attempt to alter the decentralized search and matching process by which the economics job market currently operates. Since there is unrestricted entry of intermediaries similar to EJM and a number of for-profit and non-profit organizations are currently competing in this market in addition to recruiters with their own application systems, we discuss the problem of *market fragmentation* that can occur when too many organizations attempt to intermediate trade in the market. Contrary to conventional wisdom in industrial organization theory, we show that unrestricted entry and competition of intermediaries can result in suboptimal outcomes. We discuss conditions under which the market might be improved if there is sufficient coordination to promote information sharing, such as establishing a dominant information clearinghouse that operates as a non-profit public service — a role EJM is trying to fulfill. We also consider the benefits and impediments to establishing more ambitious centralized job matching mechanisms, including guided search or price-based alternatives to the current system.

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Well-functioning markets do not always spring up spontaneously. As economists, we are well-positioned to monitor and modify the market through which new members enter our profession. (concluding sentence, p. 205, from "The Job Market for New Economists: A Market Design Perspective" by Peter Coles, Philip H. Cawley, Phillip B. Levine, Muriel Niederle, Alvin E. Roth, and John J. Siegfried).

1 Introduction

In this chapter we discuss attempts to improve the operation of the job market for academic economists via the creation of *EconJobMarket.org* (EJM), which was launched in the fall of 2007.[1] While we shall define more precisely what we mean by the "economics job market" shortly, it consists primarily of the annual market for jobs for young economists who either recently completed or who are about to complete their PhD degrees. As stated on the EJM website (`https://EconJobMarket.org`), this service "seeks to reduce the costs of information flow in the economics job market by providing a secure central repository for the files of job-market candidates (including papers, reference letters, and other materials) accessed on line." A secondary goal of EJM is to use some of the data in this central repository to support research that focuses on the operation of the economics job market (subject to all restrictions necessary to preserve confidentiality of participants and comply with all relevant privacy laws and human subjects protections). We feel that lack of adequate data has impeded research on the operation of many labor markets, and a comprehensive database could prove invaluable to better understanding of our own.

The primary role for EJM is not research, however, but to serve as a *labor market intermediary* with the goal of reducing search and transactions costs to market participants. As such, we view EJM as a modest innovation that does not otherwise attempt to alter the basic *decentralized search and matching process* that has characterized the operation of economics job market since its inception. Examples of more ambitious and radical market designs include computerized matching services, such as those used in the market for medical residents, see, for example, Roth [1984] and Niederle and Roth [2003].

Even though EJM serves the limited role of online transmission of applications to reduce search and transactions costs, previous studies have shown that similar institutions can have large effects on labor market outcomes for both sides of the market. One such service, called *Alma Laurea,* was established by Italian universities in 1994 to improve the labor market for graduates of a consortium of Italian universities. The effect of this intermediary on this job market was analyzed by Bagues and Labini [2009]. Their main

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[1] Econ Job Market Inc was founded by Martin Osborne, John Rust, and Joel Watson. The views expressed herein are those of the authors and do not necessarily represent the positions or policies of Econ Job Market Inc. or those of Martin Osborne. The authors include some of those who have volunteered to help develop and manage EJM, and others who are interested in job matching and research on alternative job market mechanisms, but do not include all directors and officers of EJM.

conclusion is that "the adoption of the online labor market intermediary under study improved graduates' labor market outcomes three years after graduation" and their analysis suggests that "online labor market intermediaries may have a positive effect on matching quality." (p. 153).

Economic theories of market design often presume the existence of a central planner with the authority to impose virtually any chosen system of market rules on market participants. In reality, in most markets, no single person or organization has the authority to impose such changes, because most markets are *commons* that are not owned by any single organization. Various practical and legal obstacles, as well as coordination problems, make it difficult for individuals to significantly alter many markets, because any change in the market invariably has adverse welfare consequences for at least some market participants who may have strong vested interests in the *status quo.* This is certainly true in the market for academic economists: the creation of EJM offers a case study in the challenges confronting even modest attempts to improve market outcomes.

Despite these challenges, we show that the use of EJM has grown exponentially since its introduction in 2007, to the point where it is now handling a significant share of all job applications in the economics job market. This suggests that even modest interventions with the limited objective of reducing transactions costs may be able to alter the operation and structure of the market, making the information available to market participants more *centralized.* Further, EJM provides a technological platform that may facilitate more ambitious and useful changes to the market in the future, changes that would likely be much more difficult to implement in a completely decentralized market without EJM. In particular, we discuss a promising alternative design — computerized matching systems — that has the potential to further improve job market performance.

In section 2, we describe the economics job market and some of the problems that motivated the creation of EJM in order to operate more efficiently. While the idea of using information technology, and particularly the power of the web to transmit the information necessary for this market to operate is quite natural, we argue that uncoordinated, unrestricted entry of labor market intermediaries in a fundamentally decentralized market has the paradoxical effect of *increasing* search costs and *worsening* market outcomes, an outcome we refer to as *market fragmentation*.

In section 3, we describe how EJM attempts to achieve the key benefits of reduced search and transaction costs that modern information technology can provide, while avoiding the harm that can be caused from excess entry of labor market intermediaries and market fragmentation. EJM is a non-profit organization that provides a limited set of services to the economics market so inexpensively that long term survival

3

of for-profit competitors may be difficult in its presence. We argue that there is a natural monopoly aspect to the primary function that EJM provides, namely, its role as a *data repository* where most of the relevant data that market participants need can be accessed. If a single site such as EJM can emerge as a *market maker* that provides essentially all of the relevant data on jobs and job candidates, then the problem of market fragmentation can be solved and market efficiency can be significantly improved. However, to the extent that there is a natural monopoly aspect to this market making function, we argue that EJM needs to operate as a non-profit whose operation is *regulated* so that it serves the interests of the profession as a whole.

We discuss how various forms of beneficial competition can be encouraged once a dominant non-profit market marker is in place. In particular, there can be competition among various intermediaries that provide various "front end" and "back end" data connection services to the central data repository. The key participants in the economics job market are recruiters, applicants, and recommenders. A "front end" is a software interface to EJM that serves applicants and assists them in searching and applying for ads, or assists recommenders in uploading and transmitting reference letters to the central data repository. A "back end" is a software interface to EJM that transfers applications received by a specific recruiter from the central data repository to a separate secure computer database to permit further confidential analysis of applicants. EJM encourages competition among firms that provide these sorts of additional front and back end services, and we argue that unrestricted competition among such intermediaries will be beneficial (resulting in better software at a lower price) without the negative side effects of market fragmentation *provided they all have equal access to, and agree to be interoperable with, this single central data repository.*

EJM's objectives may be compared to the role that the non-profit organization ICANN (www.icann.org) plays in managing private competition in the provision of registered domain names for Internet. By centralizing the role of assigning domain names and allowing other intermediaries to compete on other service dimensions like price, ICANN has substantially centralized the market while fostering competition. ICANN has recently considered adopting auctions as a method of selling top-level domains, providing another example of how centralization can be the first step to institutions that incrementally improve their design over time.

In section 4, we present several models that illustrate how the entry of a non-profit intermediary similar to EJM can reduce market fragmentation and the associated search and transactions costs, and thereby improve overall market efficiency. A secondary efficiency question is whether an intermediary such as EJM,

by successfully reducing market fragmentation and search and transactions costs, would create incentives for candidates to make excessive numbers of job applications. Labor market intermediaries such as EJM operate primarily to reduce the cost of *transmitting* information but they may do relatively little to help recruiters reduce the cost of *evaluating* this information. One might wonder if an intermediary such as EJM could worsen market outcomes if recruiters, flooded with many more applications than they previously received, end up devoting less effort evaluating each application, thereby compromising their ability to identify the best candidates. One solution is for recruiters to set application fees, which EJM facilitates as contributions to support the service. But where fees are not required, there still is the question of whether the number of applications is excessively high.

In section 5 we discuss some of these problems and the potential role for more radical *centralized mechanisms* for operating the economics job market such as computerized matching algorithms or position auctions. We discuss recent contributions to the analysis of matching mechanisms from a mechanism design perspective, and the feasibility of implementing efficient outcomes via methods such as auctions. While these mechanisms have the potential to overcome problems that the more decentralized mechanisms cannot solve, the main challenge is that market participants cannot be compelled to use them. As we noted above, since there is no single individual or organization that "owns" the economics job market, the success in establishing these more ambitious types of market mechanisms is limited by *voluntary participation constraints.* Niederle and Roth [2003] have noted the problem of *unravelling* (akin to the problem of adverse selection in insurance markets) that can make more centralized designs unviable if groups of recruiters and candidates choose not to participate in a proposed mechanism.

Note that a completely different meaning for the term "unravelling" was introduced by Neeman and Vulkan [2010]. They proved that decentralized trade via matching and bilateral bargaining is also subject to unravelling in the sense that when traders can choose whether to engage in bilateral bargaining or to trade in a central market place there are strong forces that ensure that "all trade takes place in the centralized market." (p. 1). We believe the key insight underlying Neeman and Vulkan's sense of "unravelling" is the key to the rapid growth in EJM, at least to the extent EJM constitutes the "centralized market." However the Niederele–Roth sense of unravelling may also be the key explanation of why the adoption of more centralized designs such as computerized matching mechanisms may be a far more challenging objective.

In section 6 we conclude with comments and ideas for future research as well as ideas for future market experiments that build on the EJM platform, assuming that it continues to remain a viable entity with resources and support for undertaking more radical types of market experiments.

2   The Economics Job Market

In comparison with many other labor markets, the existing economics job market is actually quite organized. The American Economic Association (AEA) has facilitated the market for new PhD economists in the United States by supporting job interviews in hotel rooms during the annual Allied Social Science Association (ASSA) meetings (currently held annually, in early January), and creating the *Job Openings for Economists* (JOE) advertising service in 1974. In 2002 the JOE became an exclusively online service and, according to Coles et al. [2010], in 2008 over 1900 academic jobs and over 1000 non-academic jobs for PhD-level economists (both senior and junior) were advertised on JOE.

Services such as JOE use the web only to publicly *advertise* the existence of jobs, and fail to provide additional *online application and reference letter transmittal services.* Since each recruiter must review each job candidate in a relatively short time span, efficient information processing becomes a crucial feature of the market. Each year, roughly from late October until early December, thousands of recruiters advertise positions they seek to fill, and thousands of job candidates submit applications for these job advertisements. Each application typically involves the transmission of the candidate's vitae (resume), his or her job-market paper or other writing samples, and letters of recommendation from several references. Often, a candidate might specify three or more letters of recommendation in each application, and these must be transmitted to the recruiter separately since they are intended to be confidential and not seen by the candidate.

Prior to the entry of intermediaries, such as EJM, most applications in the economics job market were submitted in paper by traditional mail. Applicants needed to copy their vitae and writing samples, and mail these by post to dozens of different prospective employers — in many cases a hundred or more. (Coles et al. [2010] report that in 2008, several thousand candidates were applying to nearly 3000 job advertisements in the U.S. and North American region alone, and that a typical candidate might make 80 applications). If there are at least three references per application, then the operation of the job market also involves transmission of more than 500,000 reference letters. The collective time and other resources necessary to copy and mail all of this information in each job market season is, by itself, a potential source of significant economic inefficiency. In addition, there is substantial additional secretarial effort necessary to maintain and to file paper-based applications, since many recruiters may receive 500 or more applications to each job advertisement they post.

2.1 Online Labor Market Intermediaries

With the advent of the Internet and the web, many of the transaction costs associated with the simple transmission of the application materials and references can be greatly reduced by creating efficient web-based advertising and application services. EJM was not the first and is certainly not the only organization to provide such services, even within the economics job market. For example, one of the largest such companies *Monster.com* was founded in 1994 with the goal of facilitating digital recruiting in general labor markets.

In the narrower area of *academic recruiting,* several companies exist, such as *AcademicKeys.com* which started taking online job applications in 2002, and *HigherEdJobs.com* and *The Chronicle of Higher Education.* Within economics, there are several other for-profit and non-profit services that offer or previously offered approximately the same set of online services that EJM provides, including *jobmarketeconomist.com* (founded in 2005, merged with EJM in 2009), *AcademicJobsOnline.org,* (launched in 2006), *Econ-Jobs.com, econjobs.com, www.thesupplycurve.com* (founded in 2008) and *Walras.org* (founded in 2007 and began providing online application services in 2010).

In addition to the systems and organizations named above, there are other for-profit companies that are starting to capture a significant share of the *human resource (HR) administration market* that provide database tracking of all aspects of behavior and records for employees of large companies starting at the date of hire. One example is *PeopleAdmin.com*, founded in 2000 "to reduce the cost, risk, and time spent managing human resources for government, higher education, and non-profit organizations." PeopleAdmin's systems include online application components that are now used by many large universities, including Columbia, University of Pennsylvania, New York University, and the University of Maryland. These online application services can also collect letters of recommendation from references named by an applicant in their online application.

2.2 Excess entry and market fragmentation

Given all of the various organizations and new online systems providing online application and reference letter transmittal services, is there a need for yet one more entrant, such as EJM? Could additional intermediaries actually degrade the functioning of the market? When recruiters must choose among many intermediaries there is a danger of *market fragmentation*. The problem is that market participants — especially candidates and the recommenders who submit reference letters — generally have to duplicate their

efforts for each online system that recruiters use to collect application materials. These duplicative tasks include establishing accounts, submitting applications, uploading documents, and uploading reference letters.

A casual analysis of the situation suggests that a single intermediary could integrate all the cost-reducing features that other intermediaries provide and eliminate the inefficiencies associated with fragmentation, thereby leading to an efficient outcome. Due to the natural economies of scale of information centralization, a market where multiple intermediaries are operating can be said to suffer from *excess entry*. If there were a single online system then the market participants would need to visit only one site to make an application, then post an advertisement, or upload a recommendation letter, and tasks of establishing accounts, uploading documents, and creating biographical profiles would be done just once.

Such a casual analysis, however, ignores a number of issues. First, the services offered by different intermediaries offer different advantages and disadvantages, and this process of experimentation and innovation is potentially valuable. Second, competition and the threat of entry disciplines incumbent firms. For example, a monopolist may decide to restrict the focus of his service to increase profits, shutting some portions of the market out from access to more efficient intermediation. Finally, a market might pursue both competition and centralization by adopting policies that centralize the information, but encourage firms to compete on other service dimensions, such as their interface or algorithms that search for potential candidates.

The problem of excess entry of intermediaries is already present to an extreme degree in a closely related market: online applications to graduate schools. Faculty are now familiar with the various services such as *Embark.com, ApplyYourSelf.com, CollegeNet.com,* and dozens of other home-grown application systems designed by individual universities for taking applications by undergraduates for admission to graduate school and corresponding web sites that faculty must negotiate to upload letters of recommendation on the students who name them as references.

Because of poor software design and lack of standardization, many of these sites force faculty to hunt their email boxes for requests to provide letters of recommendation, to find or to request the requisite account and password, to go to the site to login to enter and re-enter contact information, to fill out extended questionnaires about the student they are recommending, and then finally to upload the letter of recommendation. All this must be done *per recommendation* and it can take between 15 to 30 minutes to negotiate a single form. A typical undergraduate student may apply to a dozen or many more graduate schools. Thus, the huge collective time burden on faculty of simply transmitting the reference information

on their students who apply to graduate school becomes immediately apparent. Of course, students who are applying to graduate schools face these costs as well, even more so, since in addition to the time burden they may have to pay an application fee ranging from $50 to $100 per application.

There is increasing concern that the problems we see in market for graduate school applications will start to spread to the next level up, to the job market for new PhDs. Indeed, we are starting to see the same sort of lack of coordination and excess entry of labor market intermediaries in the economics job market and this is already creating an unnecessary burden on faculty who write recommendations letters for their graduating PhD students applying for jobs. In a private communication John Siegfried, Secretary-Treasurer of the American Economics Association and the Director of the JOE since 1997, noted that "By far the most annoying part of the process is the unique websites adopted by the Human Resource Departments of various employers, and especially those that can detect that it is our departmental assistant who is pretending to be us, and block her from entering the data." Also, in a private communication, Nancy Rose expressed similar frustration from her perspective as placement officer at MIT, particularly for recruiters that use "employer-specific URLs" which she feels have become "a complete nightmare." Rose concluded that "I think this system is inefficient and much, much too burdensome for PhD granting departments with any sizable number of students on the market in a given year. Financial pressures at many universities (including MIT) have led to staff reductions that exacerbate this cost for faculty."

3   EconJobMarket.org

In this section, we provide a brief description of the EJM software/site and and some of the services it offers, and provides some data on the level of usage and rate of adoption of EJM by the market. In particular, section 3.2 describes the rapid growth of EJM, which has doubled in size each year since its introduction. In general, we see that candidates are making more applications using EJM and that the number of applications received per post have grown very rapidly. These findings suggest a number of interpretations and market design issues, which we discuss in section 3.2.

3.1   Functionality of EJM

The EJM software is undergoing continual development and improvement, but in this section we describe the state of the EJM software as of March 2012. As noted above, there are three types of user accounts on EJM: 1) recruiters, 2) candidates and 3) recommenders. All of these accounts are free, but there is provision in the EJM software for recruiters and candidates to make voluntary contributions. While virtu-

ally any organization wishing to recruit economists is allowed to have a free account on EJM, applications are reviewed, so recruiters that attempt to post advertisements requiring skills that are not deemed to be sufficiently close to economics can be prohibited from using the site.

Recruiters typically receive a permanent account, allowing their personnel to post new job advertisements at any time. A posted advertisement can utilize the EJM functionality for the transmission of application materials, or simply explain the details of the job and give candidates further instructions on how to apply elsewhere.

As applications are submitted for job postings, recruiters can search the application files of individual candidates interactively by logging in and selecting a search/view applicants function. Also, recruiters are also allowed to download an Excel-compatible file listing the name, organization, degree and other key information of the applicants and a zip file that contains the material submitted by candidates, as well as any reference letters. Recruiters can also download individual PDF-formatted "virtual application folders" consisting of a cover page, the vita, reference letters and all other files uploaded by the candidate as part of the application. This allows the authorized members of the recruiting organization to view the files at their convenience.

On the other side of the market, candidates obtain free accounts from which they can upload their vita, job-market papers, teaching or research materials, and other papers or writing samples. While logged into EJM, candidates can search or browse the available advertisements and apply to any for which recruiters accept online applications via EJM. Typically, different recruiters request different materials and candidates personalize their applications slightly to each job. A key feature of the EJM interface is that it provides recruiters great flexibility to design their application forms and required documents, and it gives candidates similar flexibility in applying to different job postings.

When a candidate submits an application through EJM, they also specify their references. Recommenders can select whether to be notified every time they are named by candidates, and a new, free account is created if a person named as a reference does not already have a recommender account on EJM. As described below, EJM provides a great deal of flexibility and confidentiality to recommenders concerning how their reference letters are distributed through the EJM system. Also, EJM allows recommenders to specify other individuals to serve as their *proxies*, allowing authorized individuals such as administrative assistants or placement secretaries to manage the recommendation requests on their behalf. Since all of this information is centralized, the system notifies candidates when letters have been submitted, which provides a greater sense of assurance to candidates that their files will not be discarded for being incomplete.

EJM also conducts *identity verification* of all references to ensure that letters of reference on each applicant are really written and uploaded by the reference, minimizing the chance that EJM could be used to transmit fraudulent reference letters. To our knowledge, none of the other commercial intermediaries serving the economics job market provides this functionality: instead the other services transmit applications, but not reference letters. Applicants may be able to name their references using the commercial sites, but make recruiters responsible for collecting the reference letters on their applicants separately, perhaps using a separate intermediary such as *Interfolio.com*. EJM provides a complete service: transmitting both the applications filed by applicants and the reference letters provided by references so that recruiters have all relevant information they need to evaluate the applicants to the positions they advertise on EJM.

3.2 Descriptive Analysis of the EJM growth, users, and application decisions

The first year EJM became operational, in the 2007/2008 job market season, it was running in "beta-test mode" and the number of job advertisements was deliberately restricted since the officers of EJM were reluctant to take the risk of fully scaling up the site until the software had been sufficiently tested. After the first year and after a number of minor bugs were discovered and fixed the EJM site was scaled up and allowed to operate on an unrestricted basis. As a result, we restrict our analysis to the subsequent four full "job market seasons" that EJM has served, over the period of time August 1, 2008 until now. We define a *job market season* to be from August 1st in year t to July 31st in year $t+1$, because job activity on the EJM site tends to be highest in the months of November and December and lowest in the months of July and August. Note that we only have partial data for the most recent job market season, for the period August 1, 2011 to February 1, 2012.

In figure 1 we plot the growth in various measures of EJM's size in the last four job market seasons. Overall, EJM has been growing exponentially fast, with annual growth rates for nearly all of the measures of EJM size and activity well in excess of one hundred percent per year. The top left hand panel of figure 1 depicts the number of job advertisements placed on the EJM on a daily basis since the site went live in August 2007. Notice the dramatic peaking in the number of job advertisements during the period November to December in each year, the period of maximum activity in the primary economics market. As we noted above, the summer is the slow season for EJM and the number of advertisements falls off considerably during these periods. At the peak there were over 220 advertisements posted on EJM in the most recent 2011/12 job market season that we have data on. By comparison, the December 2011 JOE had 315 job advertisements and the November JOE had 581 job advertisements. Thus, EJM has grown very

11

rapidly and already accounts for a significant share of all job advertisements posted in the primary market for economists (since JOE is widely known to be the main site where job advertisements for economists are placed, particularly for jobs in North America).

The top right hand panel of figure 1 plots the cumulative number of job advertisements posted on EJM as of the first of each month. By February 1, 2012 a cumulative total of 1099 advertisements had been posted on EJM, and the annualized growth rate in the number of advertisements on the site was 105 percent. We note that this unusually rapid growth occurred during "recession years" when the demand for economists was weak, and number of job advertisements significantly lower than what would be expected in normal economic times. The pronounced undulations in the number of cumulative job advertisements posted reflect the seasonality of the annual job market cycle, where new advertisements posted increase most rapidly during the fall and then increase much more slowly during the slow season in the spring and summer of each year.

The top right hand panel also plots the cumulative number of recruiter accounts on EJM. As of February 1, 2012 there were a total of 512 recruiter accounts. Further information on the types of recruiters and their nationalities will be provided shortly. However the main point is that the number of new recruiters registering to use EJM is growing at a rate of over 75 percent per year, and shows no obvious signs of slowing down. Of course, this growth must eventually slow if EJM continues to grow and capture a large share of all recruiters who are searching for economists with PhD degrees. Although it is difficult to estimate the number of all potential recruiters of PhD economists worldwide, we believe it to be be at least several thousand organizations. Thus, the rapid rate of adoption of EJM by new recruiters could continue for several more years.

In addition to the numbers of recruiters, the overall "quality" of the various recruiters has been steadily increasing as well. During the last job market season, job advertisements were posted by the highest ranked economics and business schools worldwide including MIT, Stanford, Harvard, Penn, Brown, Cambridge, Oxford, University College London, Columbia, Berkeley, and many others. Also leading private companies such as the RAND Corporation, Yahoo! and Microsoft Research as well as leading government organizations such as the U.S. Federal Reserve System, Banque de France, Sveriges Riksbank (National Bank of Sweden) and Congressional Budget Office have established accounts and posted advertisements on the site.

From the beginning, the most rapid growth in EJM was in the number of candidates using the service. The lower panels of figure 1 plot the number applicants and the number of applications made using the

12

EJM website. These have grown at 150 percent per year with a particularly large jump in the number of applications during the most recent 2011/12 job market season. By February 1, 2012 there were nearly 14,000 candidate accounts on EJM and over 150,000 applications had been processed by the EJM website.

The lower panels of figure 1 also plot the growth in the number of recommenders and recommendation letters that have been transmitted by the EJM website, The number of recommenders with accounts on EJM is growing at a somewhat slower but still high rate of more than 60 percent per year. This growth slowed somewhat in the 2011/2012 job market season since EJM adopted a policy of *mandatory identity verification* of all applications for new recommender accounts. However the number of recommendations that have been transmitted by the EJM system is increasing by over 170 percent per year and by February 1, 2012 nearly 270,000 recommendation letters had been delivered to recruiters by the EJM system.

These rapid growth rates suggest that EJM is indeed serving a need that was not well met by other existing labor market intermediaries operating in the economics job market. The numbers also suggest strong positive self-reinforcing feedback effects that are often observed in other "two-sided markets" (see, e.g. Rysman [2004]): The greater the number and quality of candidates with accounts on EJM, the greater the value of the site to recruiters, and vice versa. It is our impression that virtually all job market candidates from the top-ranked economics departments worldwide had candidate accounts on EJM during the last job market seasons, so the use of the service by candidates appears to be nearly universal already. There is still some distance to go in terms of recruiter accounts, and the number of recruiters and job ads placed on EJM could well double or triple before we start to see diminishing growth. Furthermore, this growth occurred entirely by word of mouth since EJM does not have the resources to afford any significant amount of advertising. EJM's visibility has also been increased following endorsements from the Econometric Society and the Canadian Economics Association, as well as an important collaboration with the European Economic Association.

We now turn to a descriptive analysis of the types of recruiters and candidates who have accounts on EJM, and an analysis of the application behavior by EJM candidates. Table 1 lists the number of candidates who used EJM in each academic year and the composition of their characteristics. The number of candidates who registered for new EJM applicant accounts increased from 2344 in 2008/2009 to 3466 in the 2011/2012 job market season. Not all of these account holders actually made online applications via EJM: some may not have found appropriate positions on the site, and some advertisements on EJM are links that redirect applicants to apply on another site (such as the recruiter's own application system) and the statistics below only refer to the subset of applications that were actually processed on the EJM

13

site. Thus, in 2008/09 only 1613 out of the 2344 new account holders actually submitted applications via the EJM system itself, but by 2011/12 2439 or the 3466 new account holders submitted applications using the EJM system. The higher fraction of candidates who actually submit applications via EJM no doubt reflects the larger number of advertisements that are posted on EJM and the increasing fraction that process applications via EJM instead of redirecting applicants to apply elsewhere.

Table 1 reveals that over half of EJM applicants are based in the U.S. although there is a clear trend toward "internationalization" of EJM over time, with significant share of candidates based in Europe, UK, and Canada. Panel B of Table 1 shows that nearly half of all EJM applicants are PhD students who are expecting to receive their degrees, and thus constitute what we refer to as the "primary market" for new PhDs. This was the primary market that EJM was created to serve, but we see that EJM is equally serving the "secondary market" for assistant, associate, and full professors who wish to change positions, and a significant component of non-academic economists looking for jobs.

In table 2 we list the percentage distribution of new applicants signing up for applicant accounts by their self-designated primary field. These distributions are fairly stable across the last four successive job market seasons that EJM has served, except that we see an increasing share of candidates in finance. We believe that this could be a consequence of loss of "Wall Street jobs" in the aftermath of the Wall Street crash in fall 2008, and subsequent downsizing in large Wall Street firms and banks. As a result, many individuals who sought employment in the financial sector might diversify their job search to include government and academic positions. Later we will also see this reflected in an unusually large increase in applications submitted for a decreasing number of positions in finance.

In table 3 we list the number of recruiters — institutions that posted their job openings on EJM — for each academic year and the composition of their characteristics. The number of job ads posted on EJM increased from 134 in 2008/2009 to 328 in 2011/2012. The most common type of position advertised on EJM was for Assistant Professors, accounting for 43 percent of all job advertisements on the site. However we also see a significant number of higher-ranked tenured and untenured associate professor advertisements, full professor advertisements, and advertisements for consultants and economists needed for non-academic positions.

Panel B of table 3 shows the geographic breakdown of where the advertised positions are located. The majority of the advertised positions are located in the U.S., though we see that over a third of all advertisements are for positions based in Europe and the UK. Similar to our findings related to candidates, recruiters from U.K. and Europe are increasingly represented in EJM over time, and the large increase in

the representation of European recruiters in 2009/2010 may have reflected the endorsement of EJM by the European Economic Association in 2009.

In table 4 we list the distribution of recruiter interest across research fields. The number of advertised fields in Table 4 is larger than the number of recruiters because one employer may list multiple research fields for its job advertisement. A noticeable pattern shown in this table is that the fraction of advertisements searching for "Development and Growth" and "Finance" decreased over this period. Although it is not conclusive, the increasing supply of candidates specialized in "Finance" shown in Table 2 and the relative decrease in the demand for finance PhDs among recruiters suggests that the market for "Finance" is becoming more competitive for candidates relative to other fields. We also observe a smaller number of job advertisements in the field "Macro and Money" and "International Finance/Macro" which may be a bitter irony given that macroeconomic problems seem largely responsible for the weak job market for economists in recent years.

In tables 5 and 6, we present the average number of applications that a job seeker sent via EJM and that an employer received from EJM, respectively. As we noted above, not all EJM applicant account-holders use EJM to apply for jobs, though the fraction who do submit applications via EJM has been increasing and exceeded 70% in the 2011/12 job market season. We see that the total number of applications processed per job season via EJM has quadrupled, from 12,869 in 2008/09 to 48,557 in 2011/12. This increase is a result of two main factors: 1) the increasing number of advertisements that are posted and which take applications via the EJM site, and 2) the increase in the number of applications made by each applicant. As we noted above, these effects are clearly interrelated since the greater number of job advertisements on EJM increase the chance that applicants will find suitable attractive opportunities to apply to. Thus, the average number of applications submitted per applicant via EJM increased from 8 in 2008/09 to 20 in 2011/12.

Panels B and C of table 5 illustrates that regardless of the current position or the geographical location or primary field of research of the applicant, all are making increasing use of EJM and submitting a higher number of applications through it over time.

Table 6 illustrates the average number of applications submitted by the primary field of applicants. We see that there is generally increasing use of EJM by candidates in all fields, with particularly strong growth (and a tripling of applications submitted per applicant) in fields such as finance, development, macro and industrial organization.

In table 7 we list the average number of applications received by recruiters who placed advertisements

15

on EJM. For example, the average number of applications that an employer receives per advertisement posted on EJM nearly doubled, from 134 in 2008/2009 to 242 in 2011/2012. The increasing trend in the number of applications received per advertisement is clearest for advertisements for jobs in U.S. and Canada, but more variable for jobs located in various other regions of the world. This effect is likely representing greater "sampling variability" to the greater heterogeneity in the type of positions offered and the smaller number of advertisements on EJM for jobs based outside North America.

Panel B of table 7 illustrates the average number of applications received per advertisement, by primary field of the applicant. These are *conditional expectations* since they are not averages of applications received over *all* advertisements on EJM, but rather only averages over the subset of advertisements to which candidates in a given field apply. For example, in 2008/09 there were 5 advertisements on EJM to which candidates whose primary field was "experimental economics" applied, and the total number of applications submitted was 16, or an average of 3.2 applicants per advertisement. Thus, these numbers can be viewed as a measure of the "supply/demand" imbalance that we observe on EJM, with generally far more applications received for any advertisement than the total number of positions that the recruiter can hire. Viewed from this perspective we see that some of the most competitive fields include macro, micro, labor, development, econometrics, and finance. In general, all of the fields appear to have become more competitive over the last four year, which is in part a reflection of the effects of the Great Recession. As a result, the economics job market appears to have been generally a "buyers market", but some part of this effect might also attributed to the relatively slower growth rate of advertisements placed on the EJM site relative to the number of applicants who are using EJM to apply for jobs.

The final table, 8, lists the number of recommenders who used EJM to transmit letters of recommendation over the last four job market cycles. We see that the number of recommenders has more than quadrupled, from 1638 in 2008/09 to 5023 in 2011/12. In addition, the number of recommendees per recommender has increased, though at a much slower rate: from 1.44 in 2008/09 to 1.62 in 2011/12. Besides the quadrupling of the number of recommenders using EJM, the reason for the explosive growth in the number of recommendation letters transmitted by EJM that we observed in the right hand panel of figure 4 is tht the number of recommendation letters transmitted per recommendee has increased by nearly 10-fold, from 2.3 letters per recommendee in 2008/09 to 21.4 letters per recommendee in 2011/12. As we noted above, average number of applications per applicant increased by a smaller amount, from 8 applications per applicant in 2008/09 to 20 applications per applicant in 2011/12. We believe that over time an increasing number of recruiters who place advertisements on EJM are requiring letters of recom-

16

mendation to be transmitted to them via EJM, and this explains why recommendations per recommendee has increased at a more rapid rate than the average number of applications per applicant.

4   Excess Entry of Intermediaries and Market Fragmentation

There are several existing theories which at least partially capture the intuition that unrestricted entry of firms that supply intermediation services — *middlemen* — does not always lead to good outcomes, and can actually increase search and transactions costs. We have referred to this phenomenon as *market fragmentation.*

Ordinarily, the term *market place* connotes a single location where all relevant information and items to be traded are readily available to the individuals participating in the market. A fragmented market place is one in which no single location where all of the information and traders are located, but instead there are many separate "islands" or places where bargaining and trade can occur, and the information on prices and items for sale in these other markets are not readily available unless one visits them. As a result, traders need to incur significant costs to travel or visit other markets to search and collect the information necessary to make good trading decisions. When the expected gains to searching in multiple market places (or over multiple intermediaries) is sufficiently high, traders in these markets have to compare the payoff from arranging a potentially sub-optimal transaction immediately with the discounted gains from continuing to search for better opportunities.

Neeman and Vulkan [2010] have argued that separate markets have a strong tendency towards consolidation into a single *central market place* where all trade occurs. They showed that consolidation not only reduces search and transactions costs, but improves the terms of trade for participants as the markets thicken. Neeman and Vulkan refer to their prediction that trade outside a single central market place should decline and ultimately disappear as the *unravelling of the decentralized market.* Specifically, they considered a model of trade in a homogeneous commmodity and considered the consequences of competition between two widely used exchange mechanisms: a "decentralized bargaining market", and a "centralized market". In their model, "In every period, members of a large heterogeneous group of privately-informed traders who each wish to buy or sell one unit of some homogeneous good may opt for trading through one exchange mechanism. Traders may also postpone their trade to a future period." (p. 1). Neeman and Vulkan's central result is that "*trade outside the centralized market completely unravels. In every perfect-like equilibrium, all trade takes place in the centralized market. No trade ever occurs through*

17

direct negotiations." (p. 1).

Self-reinforcing mechanisms very similar to network externalities are at play in Neeman and Vulkan's unravelling result: the more valuable a central market is to buyers, the more valuable it is to sellers, and vice versa, and both will expect to achieve higher gains from trade from participating in the central market than in the decentralized bargaining market. We expect this intuition carries over to the economics job market as well: when a central market arises where employers can place job ads, this is also the place where job seekers will want to search, and when this happens, there are strong self-reinforcing dynamics leading all buyers and sellers to participate exclusively in this central market.

While Neeman and Vulkan's argument is convincing in some cases, there are other markets where we fail to see the complete consolidation their model predicts, including the economics job market. Hall and Rust [2003] developed a different model that shows that a central market can coexist with a fringe of other intermediaries they call *middlemen.* Their model also captures the notion that market fragmentation drives up search and transactions costs resulting in allocative inefficiencies.

Hall and Rust extended Spulber [1996]'s model of search and matching where trade occurs via competing middlemen (intermediaries). Spulber's model can be viewed as a market that is completely fragmented: there are a continuum of buyers, sellers, and middlemen, and Spulber assumes that a buyer and seller can only trade with each other if they are matched by one of these middlemen. Buyers and sellers must engage in a costly search process to choose a middleman to buy or sell from. There is free entry of such middlmen who have heterogeneous costs of intermediating trades. Spulber established the existence of a heterogeneous price search equilibrium in which buyers and sellers have heterogeneous reservation values (depending on their privately known valuation for the commodity). Most buyers and sellers will eventually trade when they find a middleman whose bid (ask) price is lower than (exceeds) their reservation value (for buyer and seller, respectively).

We view Spulber's equilibrium as constituting a classic and extreme example of a fragmented market. There are no publicly posted prices at which individuals can trade at in this model. Instead, buyers and sellers are forced to engage in a costly search process to find a middleman that offers the most attractive price. Using this completely fragmented market as a point of departure, Hall and Rust showed how the equilibrium to Spulber's model changes when there is the possibility of entry by a monopolist market maker who posts *publicly observable* bid and ask prices. In that event the majority of the trade occurs via the market maker at the publicly posted bid and ask prices. Only a small fraction of residual traders choose to try to find prices that are better than the bid and ask prices posted by the market maker by searching in

18

a much smaller residual market populated by the most efficient surviving middlemen.

Compared to Neeman and Vulkan's result, the entry of a monopolist market maker in Hall and Rust's model does not always cause the search and matching market to completely unravel, but it does succeed in driving out the majority of the least efficient middlemen. Thus, the entry of a market maker, i.e. an intermediary who posts publicly observable prices, *reduces but may not eliminate market fragmentation.* However if the market maker is not a profit-maximizer but is rather a non-profit organization that only attempts to cover its operating costs, then in the event its marginal costs of intermediating trades is zero, then complete unravelling in the Neeman and Vulkan sense will occur and the entry of the non-profit market maker enables the market to achieve the fully Pareto-efficient Walrasian equilibrium solution.

We now consider a different model that illustrates how a natural contractual imperfection leads to market fragmentation and how the entry of a non-profit charity (i.e. an organization similar to EJM) can help to alleviate the market fragmentation and improve market outcomes.

Suppose that there are a continuum of recruiters arranged on the unit circle, with a unit mass in total. Let $r \in [0, 1)$ denote an individual recruiter. For simplicity, let candidates and references be modeled collectively and assume there is a unit mass of candidates. Finally, suppose there are n intermediaries competing to serve recruiters to attract candidates. The intermediaries are equally spaced on the unit circle, at points $0, 1/n, 2/n, \ldots, (n-1)/n$.

Each recruiter wants to hire a single candidate and makes a single job posting on one of the intermediaries "web sites". Every candidate wants to submit an application to every recruiter. Assume that by law, recruiters must accept applications by regular mail even if they use web-based systems. Thus, an individual candidate has a choice of sending an application on paper by regular mail or submitting it via the electronic system of the intermediary that the recruiter has chosen. Suppose that a candidate pays a cost c for each intermediary that the candidate uses to submit applications on line. A candidate also pays a cost dm per paper application, where m is the mass of recruiters to which he applies via regular mail. We assume $d > c > 0$ so that the cost of sending all applications by mail exceeds the cost of using a single electronic system to submit them all. Suppose the benefit to candidates of submitting applications exceeds these costs, so candidates will apply to every recruiter; thus, the issue is whether candidates use one of the web-based systems or submit paper applications.

To keep things simple, assume that if a recruiter has to deal with any paper applications then it pays a cost k. Also, a recruiter in location r that adopts the recruitment system of a firm in location x must pay a cost $\alpha(\min\{|x - r|, 1 - |x - r|\})^2$ due to the specifications of the recruitment system x being different

than the recruiter's ideal r. (Note that $\alpha \min\{|x - r|, 1 - |x - r|\}$ is the distance between x and r on the unit circle.) Thus, recruiter r would be willing to adopt an electronic system from a firm at location i only if it is offered at a price that does not exceed $k - \alpha(\min\{|x - r|, 1 - |x - r|\})^2$ and will induce all of the candidates to apply electronically. Suppose the firms can provide recruitment systems at no cost. Payoffs are all measured in transferable monetary units.

This model exhibits two opposing efficiency concerns. First, note that recruiters like specialized software. Thus, to maximize their welfare without consideration of other market participants, it is optimal to have all of the intermediaries in the market supplying recruitment systems. In particular, if α is small so that $\alpha/2n^2 < k$, then to narrowly maximize recruiter welfare all n intermediaries should supply online application systems and all recruiters should adopt such systems. If $\alpha/2n^2 > k$ then it is better to have a fraction of the recruiters use paper and regular mail. On the other hand, candidates (and the references they also represent in this model) benefit when recruiters use the same recruitment system.

Consider a three-stage game in which first the firms simultaneously select their contract offers. Second, the recruiters observe the firms' pricing policies and simultaneously choose whether to accept contracts for recruitment systems. Third, candidates observe the outcome of the first two stages and simultaneously submit applications, by paper or electronically. We consider the coalition-proof subgame perfect equilibria of this game. Coalition-proofness is applied to the recruiters' second-stage actions to deal with the fact that the recruiters are an atomless group (where an individual deviation would not directly affect the payoffs of the other parties).

We examine three scenarios:

Case 1: Full contracting.

Suppose that the intermediaries are able to obtain fees from both recruiters and candidates but, for simplicity, assume that intermediaries cannot price discriminate. Thus, intermediary i's contract offer is a pair (p_i, q_i), where p_i is the price charged to recruiters for use of intermediary i's system and q_i is the price per application charged to candidates. A candidate would then pay $q_i m$ to firm i to submit a mass m of applications using firm i's web site.

Proposition 1 *If α is sufficiently close to zero then, with full contracting, there is a coalition-proof subgame perfect equilibrium of the game in which a single, centralized recruitment system prevails in the market.*

Proof sketch:

Consider a strategy profile in which all of the intermediaries charge the same prices $p = c - d$ and $q = d - c$. In this case, the recruiters are supposed to coordinate by all selecting the recruitment system of firm 1, and then the candidates submit all of their applications via this system. It is clear that neither candidates nor any coalition of recruiters want to deviate from this specification. For instance, if a mass m of recruiters adopted one of the other intermediaries' systems then no candidate would use it because the candidate would have to pay an additional lump sum c to use the second system. This would entail a cost $m(d - c) + c$, which exceeds the cost dm of submitting applications by regular mail to these recruiters.

Note that all of the firms get zero profits if the game plays out as just described. If an intermediary were to deviate by picking different prices (p', q') then let we prescribe a continuation of the game that is sensitive to whether $p' < c - d$ and/or $q' > d - c$. If $p' < c - d$ and $q' \leq d - c$ then prescribe that the recruiters all adopt the system of the deviating firm and the candidates apply using this web site. If $p' < c - d$ and $q' > d - c$ then prescribe that the recruiters all adopt the system of a single non-deviating firm and the candidates apply using this web site. In this second case, if the recruiters were to coordinate on the deviating firm, then the candidates would all opt for paper applications. If $p' > c - d$ then prescribe that the recruiters coordinate by picking a single non-deviating firm. Thus, no intermediary can gain by deviating.

We argue that the setting just described is unrealistic because intermediaries typically cannot fully extract rents from candidates and references (the "candidates" in this model). In particular, we think that there are contractual imperfections that make it difficult to expropriate the benefit that references get from submitting letters through a centralized system. To understand the implications of this limitation, we look at the extreme case in which the intermediaries cannot exact payments from candidates.

Case 2: Partial contracting.

Suppose that the intermediaries are able to obtain fees only from recruiters, so intermediary i's contract offer is a single price p_i that is charged to recruiters for use of firm i's system.

Proposition 2 *If c is sufficiently close to zero and there is partial contracting, in all coalition-proof subgame perfect equilibria of the game, all n firms have recruitment systems in use. Thus, the market for recruitment systems is fragmented.*

Proof sketch:

Equilibrium prices must be non-negative since firms cannot extract rents from candidates. Assume that in equilibrium intermediary i's recruitment system is not in use. It must be that, for some $\varepsilon > 0$, recruiters within ε of intermediary i's location $(i-1)/n$ are obtaining a payoff no greater than $k - \frac{\alpha}{n^2} + \varepsilon$. But then intermediary i could offer a price close to zero so that the coalition of recruiters $[\frac{i-1}{n} - \varepsilon, \frac{i-1}{n} + \varepsilon]$ would prefer to purchase from firm i if they anticipate that the candidates would apply via intermediary i's system. A sufficient condition for candidates to behave in this way is that c is small. Thus, by offering such a price, firm i has positive sales and earns positive profit, contradicting that this intermediary has no sales (and zero profit) in equilibrium.

So we conclude that realistic contractual imperfections not only lead to inefficiency as standard models predict, they also lead to a particular form of inefficiency characterized by market fragmentation. An escape may come from the existence of an intermediary that internalizes the candidates' benefit of a centralized recruitment system.

Case 3: Partial contracting, non-profit.

In our view, some non-profit charities play an important role of internalizing externalities through the preferences of the directors, managers, and financiers. In our model, for instance, suppose one of the n intermediaries is formed as a charitable organization, whose managers seek to increase the welfare of candidates (and references). In the extreme case, this firm obtains a value equal to its monetary profit plus the welfare of candidates. Assume partial contracting as in case 2.

Proposition 3 *In the partial contracting setting with a charitable firm, and with α sufficiently small, if the charity's interests are enough aligned with that of the candidates then there is a coalition-proof subgame perfect equilibrium in which the charity runs a centralized recruitment system that all recruiters adopt.*

Proof sketch:

Suppose that the charity offers the price $p = -\alpha\frac{1}{4}$. If all recruiters were to adopt the charity's system then all candidates would apply electronically and the recruiters would all get payoffs of at least zero. No other firm could earn positive profits. If α is small then the charity's loss is also small and is dominated by the charity's satisfaction of serving the candidates.

This model is simplistic and merely suggestive; it does not capture the full richness and complexity of the economics job market or the complicated dynamics of competition between intermediaries. However,

it does succeed in illustrating circumstances where unrestricted entry of intermediaries can result in suboptimal outcomes, and even where competition among a fixed number of intermediaries (i.e. ignoring entry) results in market fragmentation. Further the model suggests that these inefficiencies can be reduced by establishing a single central market place operated by a market maker whose role is to provide information to market participants and match buyers and sellers. In the case where the market maker is a non-profit charity that can operate at nearly zero cost, the results indicate that nearly fully efficient outcomes can be achieved when all trade is conducted via this central market maker. Further, Neeman and Vulkan's unravelling results suggests that such an outcome should be stable: once a central market exists, there are no gains to individuals or even coalitions of buyers and sellers from trying to trade outside of the central market place.

Our discussion above considers how the presence of intermediaries in markets can affect welfare through fragmentation, but informational intermediaries can also have other, direct effects. Johnson and Rust [2012] considered a market where recruiters and candidates have publicly observable characteristics, but only learn their match value once a candidate has paid the cost of submitting an application and the recruiter has incurred a cost of reviewing it. Due to these costs, recruiters strategically choose which received applications to review, and candidates strategically decide where to apply. Once the reviewers have moved, the allocation is decided through use of the Gale–Shapley algorithm, where candidates are considered unacceptable by any recruiter who did not review an application from them. Such a game has a large number of Nash equilibria, so Johnson and Rust focus on the Perfect Bayesian equilibrium of a similar game in which the candidates and recruiters with better public signals are assumed to move first, creating a pattern of matching that is broadly assortative but incorporates some idiosyncratic tastes, similar to what is observed in the economics job market. This gives better candidates and recruiters a first-mover advantage and selects a particular equilibrium to study.

Johnson and Rust found that candidates and recruiters tend to optimally use safety strategies, where they focus their search in a certain quality range, but include some lower-ranked options in case their preferred outcomes fall through. By lowering the costs of applying or reviewing applications, the agents tend to broaden their search downward, resulting in fairly dense competition in the middle of the pack. This benefits both sides of the market, since more of the "true preferences" are passed into the Gale–Shapley algorithm, leading to better matches. However, if the cost of reviewing applications is held fixed while the cost of applying is further reduced, the efficiency gains reach a threshold where further reductions in application cost fail to improve welfare. So although intermediaries like EJM can reduce costs dramatically

on the applicant side, this only translates into efficiency gains in terms of match quality if the recruiting side is also optimally reviewing more applications.

5   Other Potential Designs and Improvements

EJM addresses many issues associated with the costs of applying, but other problems remain. For this reason, it is useful to consider how other markets and mechanisms overcome the transactional and informational challenges facing the economics job market. In this section we will study several potential additional or alternative search mechanisms: Job market signalling, guided Search, centralized matching, and pricing mechanisms.

5.1   Signalling

The fact that the average number of applications per position advertised is large raises the concern that it may be costly for an employer to review all applications, and the employer may have multiple applications from job seekers who are indistinguishable in terms of observable characteristics, such as primary field of research, ranking of their degree program, and geographical location. In this environment, the employer may be able to reduce its search cost if it can select those who are more likely to accept the job offer if an offer is given than the rest who ex-ante appear to be the same. The *AEA Signaling Mechanism* introduced in 2006/2007 attempted to resolve some of this uncertainty by allowing each job seeker to send a signals of particular interest to two employers via an AEA website. In theory, since these signals are scarce, they could be used to reveal information about the candidate's idiosyncratic preferences. Coles et al. [2010] provided the details of the AEA Signaling mechanism and suggestive evidence that job seekers who used signals had a larger number of interviews. There is a growing number of studies that examine the role of signaling mechanisms in two-sided matching environments. In the context of college admission, Avery et al. [2004] compared the admission outcomes of students who used early application (thus sending their special interest on the college) with those who applied for regular admissions. In the context of online dating, Lee et al. [2009] analyzed a field experiment suggesting that signaling can improve search outcomes. Coles et al. [2009] examined the welfare implication of introducing a signaling mechanism in a model of a labor market.

5.2 Guided Search

Rather than a simple central repository for information, an intermediary might provide tools for finding participants satisfying particular criteria, or even take an active role in making non-binding recommendations. This type of intermediation is often observed in dating service providers, such as eHarmony.com. Such "guided search" intermediaries could be useful in the economics job market as well. For example, suppose that intermediaries have better access to or lower costs of processing information about the pool of candidates, as well as a historical perspective on the search outcomes of recruiters. Then, by suggesting candidates who are especially suitable to a recruiter, the intermediary can assist the recruiters in focusing on candidates who are likely to meet their needs, instead of sifting through a large number of applications.

Second, applying in itself may be interpreted as a signal. A recruiter who receives an application from a candidate whom the recruiter perceives is over-qualified may conclude the candidate must suffer some hidden deficiency, rather than infer that the candidate has an idiosyncratic interest for that recruiter. If a intermediary has better information about these idiosyncratic preferences, then it can make credible recommendations to the recruiters. Using data from an online matchmaking service, Lee [2009] found evidence supportive of this hypothesis. She found that the probability of a person's accepting a first date with another user is significantly higher if the online matchmaker introduces the two to each other, as compared to the case where the other user directly ask the person out.

5.3 Centralized Matching

Many markets that share similar characteristics with the junior economics market have adopted some version of a centralized matching market. By centralized market, we mean that the participants report their preferences to a central authority who requests information about participants' preferences, then uses an algorithm to translate the preferences into a match. Notable examples include the matches between hospitals and gastroenterologists, and assignments of children to public schools, see, for example, Roth [1984], Roth [1991], Roth and Xing [1994], and Niederle and Roth [2003].

A growing number of empirical studies hhave compared market outcomes under decentralized matching with outcomes from centralized matching mechanisms. Niederle and Roth [2003] found that the likelihood of a medical student finding a residency in a hospital where he had no prior affiliation increased under centralized matching in the gastroenterology market. In the context of marriage markets, Hitsch et al. [2010], Banerjee et al. [2009], and Lee [2009] inferred mate preferences of individuals based on their

dating history and used the estimated preferences to compute stable matchings using the Gale–Shapley algorithm. Hitsch et al. [2010] and Banerjee et al. [2009] found that overall the sorting pattern generated by the Gale–Shapley algorithm is comparable to that observed in their decentralized marriage markets, for example, the U.S. online dating market for Hitsch et al. [2010] and the Indian marriage market for Banerjee et al. [2009]. In contrast, using a South Korean dataset, Lee [2009] found that marital sorting under the Gale–Shapley algorithm exhibits less sorting along geography and industry, compared to the sorting observed in actual marriages. These findings suggest that the extent to which the introduction of a centralized matching market will change outcomes may vary across the current market outcomes.

5.4 Price-Based Mechanisms

By reducing application costs, there is a substantial risk that candidates will reach "corner solutions" where they apply to all opportunities, and the informational signal generated by submitting an application is wiped out. Consequently, recruiters will be unable to infer anything from the receipt of an application about the candidate's likelihood of accepting an offer, leading to an *increase* in inefficiency. Moreover, since the recruiters bear the burden of evaluating the candidates, the bottleneck on efficiency is likely to be a lack of attention paid to many of the applications received.

One way to address this issue is to introduce price-based mechanisms like auctions or application fees which can be used to reveal information about the participants. Studies such as Damiano and Li [2006], Hoppe et al. [2009], and Johnson [2010] examined how to design such mechanisms. Hoppe et al. [2009] and Johnson [2010] examined environments in which agents bid competitively for partners to signal their quality, leading to assortative matching based on the intensity of the signals. Johnson [2010] showed that profit-maximizing intermediaries, however, may be tempted to deviate from assortative matching, as well as refuse to arrange some socially valuable matches. Damiano and Li [2006] studied a mechanism where, instead of bidding, agents pay a fee for access to a smaller *pool* of agents for a match. By charging an increasing fee schedule for access to the pools on each side of the market, agents are incentivized to sort themselves by quality, resulting in more efficient matching.

While it is unlikely that such "fine-tuned" mechanism would ever appear in the economics job market, the concept may be a useful one. A paper-based system imposes uniform cost per application that is uniform across all candidates and recruiters. Since a centralized market would allow recruiters to decide on an application fee, a substantial number of "spurious" applications could be avoided. Moreover, the informational content of receiving an application will be restored, since candidates will once again be

forced to think strategically about which opportunities to pursue. Rather than being wasted in the less informative signaling process of postal mail, this set-up could allow both sides of the market to better signal their intentions while still pursuing the goal of reduced inefficiency.

6 Conclusion

In this chapter we posed the question: "can the economics job market be improved?" Thanks to the efforts of the American Economic Association to promote the job interviews at the ASSA meetings and create the JOE web site, the economics job market already operates much more efficiently than most other labor markets. Nevertheless, we have identified several key areas where further improvements can be made to improve the operation and efficiency of the economics job market.

An important pre-condition for any well-functioning market place is that market participants have easy access to all the relevant information they need to make informed decisions. Prior to the advent of the web and online labor market intermediaries such as EJM and other services we have discussed in this chapter, assembling and transmitting this information to market participants was a major task that consumed substantial physical resources. The high cost of operation of paper-based systems caused market participants to operate on far less than the full set of available information.

While the adoption of information technology and the entry of intermediaries offering online advertisement posting, application, and reference letter delivery services has greatly reduced these costs, the proliferation of these competing labor market intermediaries has had offsetting negative effects. Each of these intermediaries offers only a subset of the full set of information that market participants would ideally like to have to make informed decisions. Since the competing labor market intermediaries do not generally share their information or attempt to be *interoperable,* we have argued that information technology has had a paradoxical negative effect on the operation of the economics job market, leading to an outcome we refer to as *market fragmentation.* When this happens search and transactions costs can be driven up rather than driven down by the use of information technology and this can worsen rather than improve market outcomes. We showed that the "market" for applications to graduate schools is already badly fragmented, and the inefficiencies this causes is a serious collective waste of scarce time of faculty and students, even if these systems do benefit admissions committees of graduate schools.

The creation of EJM was motivated by the concern that the economics job market could eventually become as badly fragmented as the market for applications to graduate schools. The goal of EJM is to

centralize the information to market participants and reduce or eliminate market fragmentation, resulting in a far more efficient market that benefits *all* participants, rather than primarily benefiting recruiters through electronic delivery of application files to their recruiting committees.

To the extent that EJM is just another intermediary, however, it is fair to ask whether the entry of EJM is contributing to market fragmentation or ameliorating it. Although we have shown that EJM is growing at exponential rates and currently intermediates a significant fraction of total number of job applications, it is too soon to know whether EJM will have a lasting, positive impact on the operation of the economics job market. We have shown that existing theoretical analyses, including the influential model of Neeman and Vulkan [2010], suggest that even in the absence of any explicit coordination, there are strong self-reinforcing dynamics at play that lead fragmented markets to "unravel" so that trade concentrates in a single central marketplace. Whether this will ultimately happen in the economics job market remains to be seen.

Although previous empirical studies that have shown that labor market intermediaries similar to EJM have resulted in significant improvements in other labor markets where the problem of market fragmentation can be managed (such as the *Alma Laurea* system operated by a consortium of Italian universities), it is unlikely that the current iteration of EJM will solve several other potential problems that we identified in the economics job market.

Perhaps the most significant problem is that even though EJM might drive down the cost of *transmitting* the critical information necessary at the first stages of the job market, it may have only a small effect on reducing the cost of *evaluating* this information. Although web-based candidate evaluation systems have a number of advantages over paper-based technology for recruiters, nevertheless the dominant bottleneck in market efficiency is the human time cost involved in reading applications and evaluating the information about the candidate to try to determine what the candidate's "true quality" is.

We have raised the possibility that technologies that reduce the cost of application may drive up the number of applications, and this could result in less "self-selection" by applicants, and cause recruiters to devote less time to evaluating each candidate. Indeed, we have documented a dramatic rise in the number of applications received by recruiters who use EJM. Once again this could produce a paradoxical result that an improvement in information technology could potentially worsen market outcomes.

These problems lead us to consider several other strategies for improving the economics job market, including the use of computerized "match-making" services as part of a "guided search" strategy that Lee [2009] has shown to be effective in producing better matches in online dating contexts, to much

more radical approaches, such as the use of computerized matching algorithms or price-based signaling mechanism.

Computerized matching and auctions are highly centralized approaches because they require a high degree of coordination and possibly even compulsory participation on the part of market participants to be successful. While these mechanisms are potentially of the most interest from a market design perspective (and potentially could yield the greatest improvements in match quality) we do need to keep in mind the practical constraint that our power to design markets is quite limited in practice, given that our market is more akins to a commons that no single individual or organization owns or controls.

In particular, we have emphasized the critical *voluntary participation constraint* that can make it hard to implement centralized solutions, particularly when they result in improvements in payoffs to one group at the expense of another. Consequently, our focus has been more on attempting to *improve* the economics job market via an innovation that might be voluntarily adopted rather than attempt to design the economics job market which would presume a level of control and influence that none of us possess.

The future evolution of the economics job market is likely to depend on how much improvement can be achieved by more modest interventions such as EJM that do not involve any compulsion or obligation in order to achieve wide scale use of the system by market participants. If these sorts of systems can ameliorate the most severe inefficiencies, then there may be much less need for more radical interventions that do require some degree of compulsion in order to be successful. As we noted in section 5, Hitsch et al. [2010] and Lee [2009] come to different conclusions about the extent to which decentralized, privately determined matching outcomes from a dating service approximate the matches produced by a centralized approach — the Gale–Shapley matching algorithm. The extent to which decentralized outcomes in labor markets with intermediaries that provide guided search and matching services approximate outcomes produced by centralized matching algorithms is an interesting open question.

We conclude that more experience and further empirical and theoretical research is necessary to determine whether the decentralized search and matching process — perhaps intermediated by systems such as EJM and guided search — could result in improving the efficiency of matching outcomes in the economics job market, or whether significant inefficiencies persist that would provide a strong case for adopting more ambitious mechanisms such as matching algorithms or price-based mechanisms to further improve the operation of the economics job market. However, the informational centralization of the economics job market provides a useful starting point, and suggests many avenues for future research.

References

C. Avery, A. Fairbanks, and R. Zeckhauser. *The Early Admissions Game: Joining the Elite*. Harvard University Press, 2004.

M. Bagues and S. Labini. *Studies in Labor Market Intermediation*, chapter Do Online Labor Market Intermediaries Matter? The Impact of *Alma Laurea* on the University-to-Work Transition, pages 127–154. University of Chicago Press, 2009.

A. Banerjee, E. Duflo, M. Ghatak, and J. Lafortune. Marry for what? mate selection in modern india. Working Paper, MIT, 2009.

P. Coles, A. Kushnir, and M. Niederle. Signaling in matching markets. Harvard Business School, Penn State University, and Stanford University., 2009.

P. Coles, J. Cawley, P. Levine, M. Niederle, A. Roth A., and J. Siegfried. The job market for new economists: A market design perspective. *Journal of Economic Perspectives*, 24(4):19, 2010. ISSN 187-206.

E. Damiano and H. Li. Price discrimination and efficient matching. *Economic Theory*, 30:243–263, 2006.

G. Hall and J. Rust. Middlemen versus Market Makers: A Theory of Competitive Exchange. *Journal of Political Economy*, 111:353–403, 2003.

G. Hitsch, A. Hortaçsu, and D. Ariely. Matching and sorting in online dating markets. *American Economic Review*, 100(1):130–163, 2010.

H. Hoppe, B. Moldovanu, and A. Sela. The theory of assortative matching based on costly signals. *The Review of Economic Studeies*, 76:253–281, 2009.

T. Johnson. Matching through position auctions. 2010.

T. Johnson and J. Rust. A two sided matching model of the economics job market. University of Notre Dame and Georgetown University., 2012.

S. Lee. Marriage and online mate-search services: Evidence from south korea. Working Paper, University of Maryland, 2009.

S. Lee, M. Niederle, H. Kim, and W. Kim. Propose with a rose? signaling in internet dating markets. University of Maryland and Stanford University, 2009.

Z. Neeman and N. Vulkan. Markets versus Negotiations: The Predominance of Centralized Markets. *The BE Journal of Theoretical Economics*, 10(1):6, 2010. ISSN 1935-1704.

M. Niederle and A. Roth. Unraveling reduces mobility in a labor market: Gastroenterology with and without a centralized match. *Journal of Political Economy*, pages 1342–1352, 2003. ISSN 0022-3808.

A. Roth. The evolution of the labor market for medical interns and residents: a case study in game theory. *The Journal of Political Economy*, 92(6):991–1016, 1984. ISSN 0022-3808.

A. Roth. A natural experiment in the organization of entry-level labor markets: Regional markets for new physicians and surgeons in the united kingdom. *American Economic Review*, 81(3):415–40., 1991.

A. Roth and X. Xing. Jumping the gun: Imperfections and institutions related to the timing of market transactions. *American Economic Review*, 84(4):992–1044, 1994.

M. Rysman. Competition between networks: A study of the market for yellow pages. *Review of Economic Studies*, 71:483–512, 2004.

D. Spulber. Market Making by Price-Setting Firms. *The Review of Economic Studies*, 63:559–580, 1996.
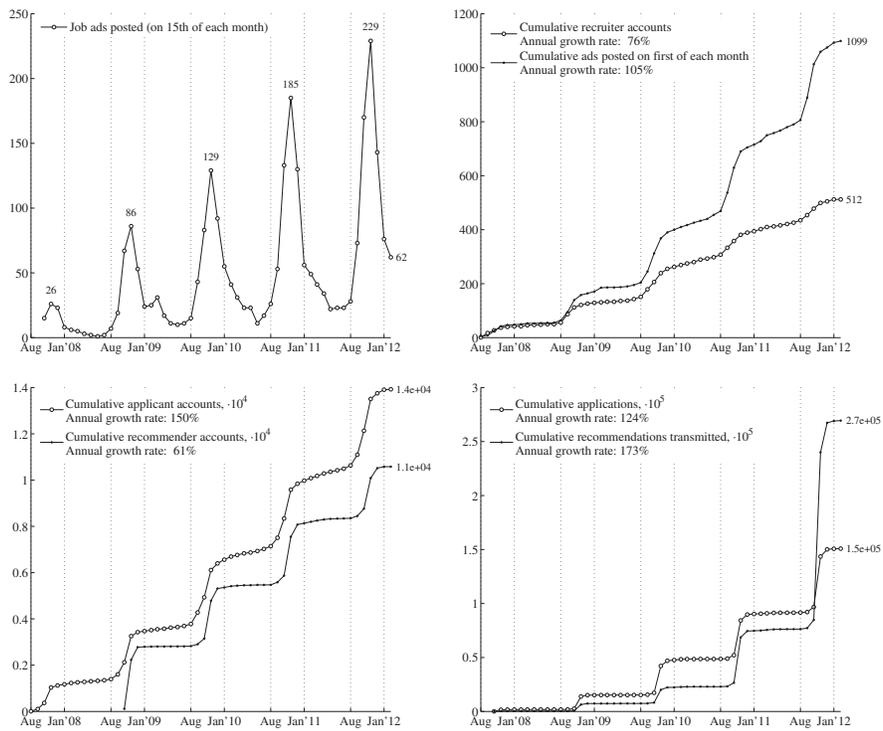
Figure 1 Growth in EJM Ads, Applicants, Recruiters and Recommenders

Table 1: Composition of Candidates

	2008/2009	2009/2010	2010/2011	2011/2012
Number of Candidates	2344	3330	3470	3436
Panel A: Geographical Location of Candidate (%)				
US	65.7	55.1	55.0	57.8
Europe (excluding UK)	10.2	18.0	19.2	19.4
Canada	10.6	8.2	6.6	5.7
UK	4.9	7.5	8.3	6.5
Asia	2.5	2.3	2.5	2.5
Indian subcontinent	0.8	2.4	2.4	2.0
Australia & New Zealand	1.9	2.0	1.9	2.5
Middle East	1.3	1.4	1.2	0.7
Latin America	0.6	1.1	1.0	1.4
Africa	0.3	1.3	1.0	0.7
Russia	0.0	0.3	0.1	0.2
Others or N.A.	1.2	0.5	0.6	0.6
Panel B: Existing Employment Status of EJM Candidates (%)				
Phd student/dissertator	47.9	43.8	46.3	49.8
Postdoc/visiting scholar	9.0	10.6	9.8	8.3
Assistant Professor	11.5	11.4	10.7	11.2
Associate Professor	3.6	3.3	3.5	4.0
Full Professor	2.8	2.6	2.9	2.2
Lecturer	5.0	4.9	5.1	4.6
Other Academic	6.1	6.6	6.4	6.5
Non-academic	8.8	10.3	9.5	8.0

Table 2: Distribution of Candidates' Primary Fields

	2008/2009	2009/2010	2010/2011	2011/2012
Behavioral Economics	1.7%	2.3%	2.2%	2.2%
Business Economics	0.0	3.3	2.9	2.7
Computational Economics	0.0	0.3	0.4	0.5
Development; Growth	7.6	8.8	7.8	7.7
Econometrics	8.0	6.3	7.1	6.4
Economic History	0.9	1.3	1.0	1.0
Environmental; Ag. Econ	4.8	5.7	7.2	6.0
Experimental Economics	1.1	1.1	1.7	1.3
Finance	10.8	11.6	12.5	12.0
Health; Education; Welfare	0.7	3.9	4.5	4.6
Industrial Organization	8.1	6.2	5.6	4.9
International Finance/Macro	6.1	4.7	4.3	4.2
International Trade	4.9	5.1	4.8	4.7
Labor; Demographic Econ	7.6	6.4	6.8	7.0
Law and Economics	0.6	0.9	0.6	0.4
Macroeconomics; Monetary	12.0	11.6	10.1	10.2
Microeconomics	9.6	8.0	7.0	7.8
Political Economy	0.1	0.2	2.4	2.3
Public Economics	5.4	4.6	3.9	3.6
Theory	2.4	1.8	2.2	1.5
Urban; Rural; Regional Econ	0.1	1.6	1.9	1.7
Other business/management	0.0	0.0	0.0	1.7
Other , Any field or N.A.	1.3	0.0	0.0	0.0

Table 3: Characteristics of EJM Job advertisements

	2008/2009	2009/2010	2010/2011	2011/2012
Number of advertisements placed on EJM	134	256	338	328
Panel A: Positions Advertised (%)				
Assistant Professors	51.5	42.2	36.1	43.0
Associate Professors	3.7	2.0	1.2	1.8
Full Professors	5.2	3.9	4.1	5.2
Assistant or Associate	0.0	0.0	4.1	6.7
Professor, any level	14.8	15.3	17.2	15.9
Post-Doc	2.2	12.5	10.9	7.3
Lecturers and other academic positions	7.4	10.5	15.1	8.9
Consultant	0.7	2.7	0.6	2.4
Non academic	9.7	10.5	10.4	8.8
N.A.	4.5	0.4	0.3	0.0
Panel B: Geographical Location of Job (%)				
US	56.7	41.0	40.2	52.7
Canada	12.7	7.4	8.0	7.0
UK	7.5	6.6	8.6	6.4
Europe (excluding UK)	13.4	36.3	34.3	27.1
Australia & New Zealand	0.8	2.3	3.3	3.4
Asia	3.0	1.6	1.2	1.5
Latin America	1.5	1.6	2.7	0.0
Others or N.A.	4.5	3.0	1.8	1.9

Table 4: Distributions of Advertised Research Fields				
	2008/2009	2009/2010	2010/2011	2011/2012
Number of advertised fields	326	667	734	854
Any Field	13.8%	11.2%	13.1%	13.6%
Behavioral Economics	2.1	2.8	3.0	2.7
Business Economics	0.0	3.0	3.7	2.1
Computational Economics	0.0	0.7	1.4	1.3
Development; Growth	4.0	4.0	4.3	4.3
Econometrics	8.0	7.6	8.4	7.5
Economic History	2.1	1.5	1.3	0.8
Environmental; Ag. Econ	6.7	3.6	4.0	3.5
Experimental Economics	1.5	2.1	1.9	2.0
Finance	8.0	6.3	6.7	7.3
Health; Education; Welfare	0.0	3.4	4.7	3.6
Industrial Organization	5.5	6.1	5.3	5.9
International Finance/Macro	5.8	4.8	2.9	3.7
International Trade	5.5	4.0	3.9	4.1
Labor; Demographic Econ	4.9	5.7	4.7	4.6
Law and Economics	3.1	2.2	2.5	2.7
Macroeconomics; Monetary	8.3	8.2	6.0	5.6
Microeconomics	7.7	7.3	6.7	7.4
Political Economy	0.0	0.0	1.9	1.8
Public Economics	5.5	5.1	5.3	5.6
Theory	1.5	2.2	2.2	2.1
Urban; Rural; Regional Econ	0.0	2.8	2.4	2.5
Others, N.A.	5.8	4.8	3.4	2.9

Table 5: Applications submitted by applicants

	2008/2009	2009/2010	2010/2011	2011/2012
Panel A: Statistics on applicants, job advertisements and applications				
Number who submitted applications	1613	1982	2254	2439
Number of job advertisements posted	134	256	338	362
Total number of applications submitted	12869	29711	36028	48557
Average number of applications per candidate	8	15	16	20
Maximum applications by a candidate	49	305	201	128
Std dev in average apps per applicant	0.2	0.6	0.5	0.5
Panel B: Average number of applications by employment status of applicant at time of application				
Phd student/dissertator	9.3	16.4	16.5	22.2
Postdoc/visiting scholar	9.0	18.2	20.3	25.3
Assistant Professor	8.4	18.2	22.3	22.3
Associate Professor	8.0	20.9	17.1	23.0
Full Professor	9.8	8.4	11.3	18.1
Lecturer	4.8	7.3	7.8	12.4
Other Academic	5.8	9.1	12.0	14.1
Non-academic	9.0	40.3	20.2	19.8
Panel C: Average number of applications by geographical location of applicant at time of application				
US	8.5	17.0	18.0	21.3
Canada	7.0	15.8	13.6	20.2
UK	7.6	12.5	12.7	19.3
Europe (excluding UK)	5.2	13.0	14.0	16.2
Australia & New Zealand	3.9	3.6	4.8	5.9
Latin America	1.6	4.7	10.2	11.8
Asia	3.4	3.4	7.2	6.9
Middle East	6.7	6.8	18.2	6.0
Indian subcontinent	5.0	23.3	3.7	6.3
Africa	2.0	19.1	1.8	3.5
Russia	0.0	25.0	9.5	5.0
Others or N.A.	0.0	0.0	3.4	18.0

Table 6: Average number of applications submitted by primary field of applicant

	2008/2009	2009/2010	2010/2011	2011/2012
Behavioral Economics	7.5	14.5	16.3	16.2
Business Economics	6.0	8.7	4.8	4.0
Computational Economics	11.0	1.4	1.9	6.3
Development; Growth	8.0	20.9	17.1	23.1
Econometrics	9.3	16.4	16.6	22.2
Economic History	9.8	8.4	11.3	18.1
Environmental; Ag. Econ	4.9	7.6	7.8	12.5
Experimental Economics	9.0	40.3	20.2	19.8
Finance	3.4	5.7	8.4	9.7
Health; Education; Welfare	6.2	12.0	12.6	15.9
Industrial Organization	8.7	15.5	19.8	25.2
International Finance/Macro	7.5	14.4	13.6	25.3
International Trade	8.4	18.2	22.3	22.3
Labor; Demographic Econ	9.0	18.2	20.4	25.3
Law and Economics	3.8	5.4	4.7	9.9
Macroeconomics; Monetary	10.4	21.8	20.7	27.3
Microeconomics	9.4	17.9	24.2	25.4
Political Economy	NA	10.0	17.5	21.2
Public Economics	8.1	13.4	16.6	23.2
Theory	11.7	19.0	24.3	33.6
Urban; Rural; Regional Econ	3.0	6.8	9.2	11.6
Other	5.2	6.9	7.0	3.2
Any field	1.9	6.6	7.0	10.9

Table 7: Applications received by recruiters

	2008/2009	2009/2010	2010/2011	2011/2012
Advertisements receiving applications via EJM	101	189	198	240
Mean applications per advertisement	134	152	203	242
Max applications	620	690	2758	775
Standard deviation	150	136	261	212
Panel A: Applications by geographical location of recruiter/position				
US	139	239	252	262
Canada	102	138	175	256
UK	184	125	238	393
Europe (excluding UK)	227	80	145	208
Australia & New Zealand	364	155	216	220
Asia	26	86	53	171
Latin America	44	39	154	124
Middle East & North Africa	1	47	41	62
Panel B: Average applications received per advertisement by primary field of research of applicant				
Behavioral Economics	2.5	2.7	6.9	5.2
Business Economics	0	1.8	1.8	1.4
Computational Economics	0	1.0	0.0	1.3
Development; Growth	5.6	7.5	14.9	23.7
Econometrics	7.0	8.0	11.9	19.6
Economic History	1.9	2.3	2.6	3.0
Environmental; Ag. Econ	3.9	3.8	10.7	12.5
Experimental Economics	3.2	2.9	6.2	5.0
Finance	4.0	4.9	11.2	17.6
Health; Education; Welfare	1.0	4.9	10.2	12.0
Industrial Organization	7.6	8.2	13.8	18.7
International Finance/Macro	5.6	7.6	8.1	14.9
International Trade	4.5	7.6	11.6	15.9
Labor; Demographic Econ	7.6	10.1	18.2	24.4
Law and Economics	1.0	2.3	1.3	1.5
Macroeconomics; Monetary	14.2	14.1	22.8	40.2
Microeconomics	9.2	11.2	19.0	27.8
Political Economy	0.0	0.0	6.3	6.6
Public Economics	5.3	4.6	8.7	13.1
Theory	4.3	3.5	10.0	9.7
Urban; Rural; Regional Econ	0.0	1.9	2.1	4.0
Other	1.9	1.6	1.9	1.5
Any field	1.0	1.5	1.6	2.7

Table 8: Recommenders, Recommendees and Recommendations

	2008/2009	2009/2010	2010/2011	2011/2012
Number of recommenders who provided letters	1638	2443	3322	5023
Average number of recommendees per recommender	1.44	1.44	1.47	1.62
Number of recommendations sent per recommendee	2.30	3.73	6.08	21.38