Can the Job Market for Economists be Improved?

Sarbartha Bandyopadhyay *University of Maryland*
Fedor Iskhakov *University of Technology Sydney*
Terence Johnson *University of Maryland*
Soohyung Lee *University of Maryland*
David McArthur *University of Maryland*
John Rust *University of Maryland**
Joel Watson *University of California San Diego*
John Watson *Watson Education*

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Abstract

This chapter describes the operation of the job market for PhD economists and the effort to improve the market's operation via the creation of the non-profit organization *EconJobMarket.org* (EJM), a web-based service designed to serve as an "information clearinghouse" to facilitate the exchange of information between applicants and recruiters. EJM does not attempt to fundamentally alter the *decentralized* "endogenous 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, 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, such as the computerized matching systems that have been used in the market for medical residents, or possibly even *position auctions* as a means of matching candidates to positions. It is already difficult to obtain sufficient coordination to avoid market fragmentation, and the problems confronting the the establishment of a centralized matching mechanism are even more daunting if participants cannot be compelled to use such a system. We discuss whether marginal improvements to the existing, fundamentally decentralized operation of the economics job market are "sufficient" and whether they are likely to deter or help pave the way for the adoption of more ambitious and potentially more efficient centralized matching systems in the future.

Keywords: job markets, economics job market, labor market intermediation, market fragmentation, information clearinghouse, market making, matchmaking, centralized market, market unravelling, Gale Shapley algorithm, position auctions, field experiments

JEL classification: J2, J44, L14, L32, L84, L86

*Corresponding author: John Rust, Department of Economics, University of Maryland, 3105 Tydings Hall, College Park, MD 20742, phone: (301) 404-3489, e-mail: jrust@gemini.econ.umd.edu. Note that while all authors of this chapter have an affiliation with EconJobMarkt.org (EJM), not all of them are officers or members of the board of directors, and none of the statements or views expressed herein should be taken as being endorsed or approved by EconJobMarkt.org, Inc.

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

This chapter discusses 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 will 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 eventually use some of the data in this central repository to support research that can improve our understanding of the operation of our 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 including our own. By facilitating the collection of more complete and detailed data on the operation of the economics job market, EJM will likely help improve our understanding of the economics job market, leading to new insights on ways to further improve its operation (and the operation of other markets) in the future.

We view EJM as a *labor market intermediary* whose entry into the economics job market is a relatively modest innovation, done with the primary goal of *reducing transactions costs* to market participants. Thus, EJM does not reflect any sort of radical new vision of how the economics job market should operate. Instead, EJM respects and accepts the fundamentally *decentralized search and matching process* that has characterized the operation of economics job market since its inception. Examples of more radical changes to the operation of the market include computerized matching services, such as that used in the market for medical residents that has been extensively analyzed by Roth and others (see, e.g. Roth [1984] and Niederle and Roth [2003]), or *position auctions* proposed by Johnson [2010].

[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 board members or all officers of EJM.

Even though EJM does not represent a radical transformation in the way the economics job market operates, the entry of market intermediaries similar to EJM have been shown to have important effects on market outcomes in markets that are similar to our own. One such service is called *Alma Laurea*, 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 recently by Bagues and Labini [2009] and will be discussed further below. Their main 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).

Though the topic of this *Handbook* is *market design*, in many cases there is no single person or organization that owns or controls the market, and this typically limits the scope for market design in a practical sense. This is certainly true in the market for academic economists, so the effort to found EJM was motivated by the more limited goal of trying to *influence* the economics job market in a welfare-enhancing way. Nonetheless, we discuss a promising alternative design — computerized matching systems — in the context of considering whether EJM's entry, even if deemed to be a success, either fails to solve certain problems or creates new problems that leave substantial scope for future innovations (such as various types of computerized matching systems) that improve the economics job market even further. We believe that if EJM is successful, it can move the profession one step closer to being able to implement more ambitious changes, since EJM can provide the technological infrastructure that more ambitious market designs could be built on. On the other hand, improvements in the *status quo* may also reduce the incentive to embark on more radical changes in the way the market works.

Section 2 describes the economics job market, some of the problems in this market, and various labor market intermediaries and efforts that have been made in recent years to make it operate more efficiently. We discsuss a paradoxical effect of unrestricted entry of labor market intermediaries that we refer to as *market fragmentation:* when there are too many intermediaries vying for the role of *market maker* the effect can be to increase search and transactions costs and therefore potentially *worsen* market outcomes.

Section 3 describes EconJobMarket.org and its impact on the economics job market and individual job search behavior so far. This section also discusses the economic and software design philosophy underlying EJM's non-profit organization. EJM's objective is to reduce market fragmentation and therefore search and transaction costs to market participants, while at the same time to promote competition among intermediaries along avenues where it results in beneficial rather than harmful effects.

In particular, in our view it is appropriate to promote *data sharing* and *data interchange* among competing intermediaries so that market participants can access information about job postings and candidates regardless of which intermediary is used to post an advertisement or apply for a job. If this can be successful, it is no longer necessary for candidates and recruiters to have accounts on many different sites and services in order to obtain full coverage of all relevant market opportunities. Instead, their decisions can be based on which intermediary provides the best software interface and services at the lowest prices.

Thus, EJM's objectives may be compared to the role that the non-profit organization ICANN plays in managing private competition in the provision of registered domain names for Internet. According to its website (`www.icann.org`) "ICANN was formed in 1998. It is a not-for-profit public-benefit corporation with participants from all over the world dedicated to keeping the Internet secure, stable and interoperable. It promotes competition and develops policy on the Internet's unique identifiers." In the case of economics job market, we believe the concept of *interoperability* may also be the key to enabling competition to exist while avoiding or minimizing the negative side effects of market fragmentation.

Section 4 describes several models designed to illustrate the problem of market fragmentation and to formalize conditions under which free entry of competing intermediaries may not lead to efficient outcomes. We discuss 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 (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.

Section 5 presents a stylized model of decentralized search and matching in the economics job market to address this question. Though the results depend in important ways on model assumptions and parameter values (which we are still experimenting with), we find this *application effect* but we also find that

the increased number of applications tends to *benefit recruiters*. In particular, recruiters get larger choice sets with better quality applicants, forcing applicants to broaden their search downward. In markets where institutions have highly idiosyncratic tastes, the benefits from intermediaries such as EJM of reducing the cost of applications can be large.

However, we do not take these preliminary findings to be definitive and we acknowledge that an intermediary such as EJM may still have limited ability to solve many other problems that challenge the efficient operation of the economics job market. An example is the problem of *market congestion* that occurs when a small number of the most attractive job candidates receive multiple job offers and then delay deciding on which offers to take. These delays slow the recruiters' process of making offers to their lower ranked candidates and can cause distortions as the second group of candidates accept offers from other organizations.

Section 6 discusses some of these problems and the potential role for other more radical *centralized mechanisms* for operating the economics job market such as computerized matching algorithms or position auctions. 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.* Namely, it is impossible to compel individuals or organizations to use such mechanisms and they generally will not use them unless they find it advantageous. In some cases there can be problems of *market unravelling* that are akin to the problem of adverse selection in insurance markets, if groups of recruiters and candidates choose not to participate in a proposed centralized market mechanism. 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.

Section 7 provides some concluding comments and ideas for future research as well as ideas for some future market experiments that can build on the steps taken by EJM, assuming that EJM continues to remain a viable entity and there are resources and support for undertaking more radical types of market experiments.

2 The Economics Job Market

Compared to many other labor markets, the economics job market already seems to function pretty well. 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 Asso-

ciation (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.

However, services such as JOE use the web only to publicly *advertise* the existence of jobs, but they don't provide additional *online application and reference letter transmittal services.* At a fundamental level, the operation of the economics job market, perhaps more than many other job markets, requires large information transfers over a relatively short span of time. 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 ads.

Each application typically involves the transmission of the following information 1) the candidate's vitae (resume), 2) his or her job market paper or other writing samples, and 3) 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 designed 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 surface mail. Applicants needed to copy their vitae and writing samples, and physically mail these 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 ads 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, 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 non-trivial. Further, there is substantial additional secretarial effort necessary to maintain and file paper-based applications, since many recruiters may receive 500 or more applications to each job ad they post.

2.1 Online Labor Market Intermediaries

It is not hard to see that with the advent of the Internet and the web, many of the transactions costs associated with the simple transmission of the application materials and references could 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* there are several companies, such as *AcademicKeys.com* which started taking online job applications in 2002, and similar intermediaries such as *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* and *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 systems 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 reference letter submitters — generally have to establish accounts and upload materials separately for every different online system that recruiters use to collect application materials. Thus, when many labor market intermediaries function in the market, candidates and recommenders have to duplicate their efforts by the number of competing web sites. The duplicative tasks include establishing accounts, submitting applications, uploading documents, and uploading reference letters.

When the costs of market fragmentation from the marginal intermediary exceed the benefits that inter-

mediary brings in terms of further reducing transaction costs, then there is *excess entry* of intermediaries. It could be argued that any more than one intermediary is excessive, as long as that one intermediary's system can integrate all the cost-reducing features that other intermediaries could bring. If there were a single online system then the market participants would need to visit only one site to make an application, post an ad, or upload a recommendation letter, and tasks of establishing accounts, uploading documents, and creating biographical profiles would be done just once.

This problem of excess entry of intermarries is already present to an extreme degree in a closely related market: the market for 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, and find or request the requisite account and password, then to go to the site, login, and enter and re-enter contact information, fill out extended questionnaires about the student they are recommending, and then finally 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 grad school becomes immediately apparent. Of course students who are applying to grad schools face these costs as well, and 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 grad school applications will start to spread to the next level up, to the job market for new PhDs. Indeed we are already 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. For example, John Siegfried, Secretary-Treasurer of the American Economics Association and the Director of the JOE since 1997, notes 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." Nancy Rose expresses similar frustration in her perspective

as placement officer at MIT, particularly for recruiters that use "employer-specific URLs" which she feels have become "a complete nightmare." Rose concludes 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."

2.3 Timing of the Economics Job Market

We now describe the sequential process by which the primary market in economics operates in order to describe more precisely the role played by various intermediaries, and also because it motivates the timing of stages in models of the job market such as the one we present in section 5. Coles et al. [2010] also provide a step by step description of the operation of the primary market, though with a different focus.

The primary market for economists is highly *synchronized* and most of the activity — the placing of applications, interviews, flyouts, and job offers — occurs between October and March in each job market "cycle." While our discussion below focuses on the primary market in North America, increasingly the rest of the world is also adapting to this same cycle — at least for the primary market.

The logistical demands of conducting thousands of in-person interviews at the ASSA meetings in early January of each year require that recruiters must be able to make preliminary evaluations of the applications they receive well before these meetings so they can decide which subset of their applicants to interview. In recent years job advertisements start appearing on sites such as JOE at the end of August and run typically through the end of the year or into the early part of the following year. However, most job applicants have an incentive to delay their applications while they are refining their job market papers and receiving final advice from their thesis and job-placement committees. As a result, candidates typically submit applications from the beginning of November until the first week of December, close to the application deadlines. While there is no central coordination or single set schedule, many recruiters screen most of their applications starting in late November through early December, and by mid December most recruiters have contacted the candidates they wish to interview. Thus, over a relatively short period from end of October until early December, many thousands of job applications are being made by the several thousand job applicants who are vying for several thousand job positions posted on sites such as JOE.

Following the job interviews at the ASSA meetings, the next stage is for the recruiters to decide which of their interviewees to invite for *flyouts* that, for academic institutions, constitute full day or even multiple day visits and a seminar presentation of the candidate's job market paper. After the flyouts, there is a period

starting in February and sometimes extending until early May during which recruiters make a series of job offers to their top-ranked applicants.

Note that the primary function served by intermediaries such as JOE and EJM is to assist the dissemination of information and transfer of information in the first phase of the economics job market during the period from October to December just prior to the interviews in early January. Once candidates have applied to the available ads and their application materials and reference letters have been transmitted to recruiters, these intermediaries no longer play a significant role in the second interview, flyout, and offer phase of the job market. Instead, a second set of intermediaries play a role in this second phase to transmit information about which candidates are being interviewed and flown out to which recruiters. One such service is *EconJobRumors.com* that posts often unfiltered and unverified comments and rumors but is nonetheless highly visited. Coles et al. [2010] also discuss the *AEA Job Scramble* website where candidates "who have not secured a position by late April may continue to explore the nonacademic job market; seek temporary academic employment as one-year visiting assistant professors, lecturers, and research associates (non-tenure-track, soft money positions)". (p. 189). In addition, the AEA operates a *job market signaling service* that allows a candidate to transmit signals to a maximum of two recruiters that is intended to indicate the candidate is especially likely to accept an offer from them.

We will discuss these and other ideas for new intermediaries and services to help enhance information flows, reduce costs, and improve efficiency and quality of matching in this critical second phase of the economics job market in greater detail in section 6.

2.4 Strategic Considerations for Candidates and Recruiters

While the focus of intermediaries such as EJM is on facilitating the transmission of information in the first phase of the primary market, most of the interesting decisions are actually made by recruiters at three key stages: 1) which applicants to interview, 2) which interviewees to schedule for flyouts, and 3) what job offers to make. Indeed, virtually all of the most costly aspects of the operation of the economics job market — information processing and learning — occur *after* the initial application materials have been transmitted from applicants to the recruiters.

Prior to the job interview, there is a huge amount of work involved in evaluating hundreds of applications, including reading candidates' job market papers, vitas, and reference letters and deciding on which candidates to interview. During this period there is additional information being communicated by placement directors at the various degree-granting institutions about their own internal ranking of their

candidates. Many recruiters, especially those at top-ranked educational institutions, rely on this information as a means of focusing their evaluative effort to a subset of the candidates.[2]

Speaking in broad terms, recruiters often follow a *cutoff strategy* to identify candidates to interview. Recruiters make quality cutoffs in terms of the candidates' degree-granting institutions, and the quality of candidates themselves, taking into account information provided by the candidate, his/her reference letters, as well as additional information provided by placement officers, and advice from trusted colleagues at other institutions. Of course, there is often disagreement among different members of a recruiting committee about the quality of different candidates, and how to weigh various factors and account for other considerations such as "field needs/preferences" and the likelihood that the candidates would accept an offer. Various types of internal collective-decision processes are used to mediate disagreements, including voting, ranking, and delegation of decision making to subcommittees and members of different fields. Typically if an applicant is not interviewed, there is very little chance they will subsequently receive an offer from the recruiter.

After the interviews have occurred, an organization's recruiting committee, or possibly the organization as a whole will meet again to aggregate the views of the members about the various candidates who were interviewed. This will result in choosing a subset of interviewees being invited for *flyouts*. At this stage, recruitment committee members consider not only the additional information gained during interviews, but also take into account information learned about each candidate's set of interviews with other recruiters and any information obtained from candidates about locational preferences, including any AEA job signals. This additional information is important for recruiters in assessing their likelihood of success in attracting any given candidate.

The flyout stage involves additional complications. Roughly speaking, there is a more or less well-defined pecking order in terms of the *quality* or desirability of different recruiters from the candidates' perspective. While the ordering may to some extent differ by subfield and differ by candidate when idiosyncratic locational preferences are also factored in, recruiters that are ranked lower in the overall pecking order will be reluctant to flyout or make offers to candidates that they perceive are very likely to receive offers from higher-ranked recruiters that would therefore dominate them. Generally speaking,

[2]For example, in the 2010-2011 job-market season, recruiter such as the University of Maryland and the University of California, San Diego received about 500 applications. At the same time, their recruiting committees surveyed the placement directors at many of the top ranked economics departments world wide, asking for the names of the top two or three best candidates, possibly with restriction to certain fields, or for good candidates meeting other criteria (e.g. "targets of opportunity"). This information helped the search committees focus on a smaller subset of 100 to 200 candidates in various fields of interest. Of these, the recruiting committees chose to interview several dozen candidates over multiple days at the ASSA meetings.

preferences of candidates are lexicographic; they typically prefer a job offer from the highest-ranked recruiter, and then consider other factors such as location, salary, and other aspects of the job. Since wages are generally not highly variable or negotiable in the primary market for economists, they are typically not an important factor in candidates' decision, except on the margin when a candidate has several offers from approximately equal-ranked institutions.

Recruiters typically have a fairly well-defined budget constraint on the number of candidates they are allowed to hire. Their objective is to make a sequence of job offers in order to fill these slots with the highest-quality candidates. For some recruiters, over-hiring (hiring more candidates than there are available positions) leads to severe penalties. Over-hiring can happen if the recruiter adopts a strategy of *over-offering*, i.e. making more offers than the number of available positions on the expectation that some of the offers will be declined. There are typically less severe penalties if the recruiter fails to hire the desired number of people, or hires candidates whose quality is not as high as was originally desired.

Recruiters often mitigate the risk of over-hiring by adopting a *sequential offer strategy.* They often make an early set of offers to a set of the highest-ranked candidates, sometimes with a short deadline on the offer. This allows the recruiter to try for higher quality candidates whom they have lower probability of attracting, while retaining a fall-back option to make a second or possibly even a third wave of offers to other lower-ranked candidates. For this reason, it is clear that the offer stage of the economics job market is not a one shot game. There are many complicated decisions that recruiters make about the timing and sequencing of offers, offer deadlines, as well as additional incentives (release from teaching, higher salary, research funding, etc) they can provide to attract candidates on the margin. These decisions are often conditioned on the latest available information about which other offers their various candidates have or are likely to receive.

Candidates have an equally difficult strategy at this stage. While at earlier stages it is nearly a dominant strategy for every candidate to interview with all recruiters that invite them and go for flyouts everywhere they are invited (unless the candidate is so attractive that he/she is virtually certain to get dominating offers). When candidates receive offers with deadlines, they face a complicated stopping problem of whether to accept an early offer from a less highly ranked recruiter or reject the offer on the expectation that they will subsequently receive an offer from another more highly-ranked recruiter.

In many cases the most attractive candidates receive multiple offers, and there is a period of time where some recruiters are unable to make further offers to their next best choices while these candidates are deciding which of their offers to accept. The tendency of the best candidates to receive multiple offers

creates a problem of *congestion* since delay in deciding by the most attractive candidates causes many recruiters to delay in making offers to their next best choices. These delays, together with the constraint that it becomes infeasible for most recruiters to continue to make offers much later than May of each year, limit the number of offers recruiters can make in any given job season. As a result, there is a significant chance that some recruiters and job applicants will come up empty handed. We believe that this could be one of the most important inefficiencies in the operation of the economics job market.

2.5 The role of wages as a market clearing mechanism

Perhaps the most puzzling aspect of the primary market for academic economists, particularly as it has evolved in the United States, is that the wage is not really a crucial instrument for "clearing the market" (i.e. equating the quantities of various categories of candidates supplied and demanded). Wages for new assistant professors are relatively uniform. Some of the most sought-after candidates may receive multiple job offers by leading economics departments in the U.S. and other countries, but typically the wage is not the only or even the main avenue along which bargaining occurs and a decision is made. While one might wonder whether explicit or tacit collusion is at work, we believe the main explanation for the lack of importance of wages is the much higher importance that candidates and recruiters place on "quality."

Particularly in the case of academic positions, the offered salary is often not the primary criteria that makes one job offer more attractive to a candidate than another. Instead, candidates are typically most attracted to jobs at the most prestigious institutions. Especially in the new PhD market, candidates are very focused on taking jobs that maximize the development of their human capital. We believe that for many candidates this verges on being a lexicographical preference ordering where the quality of the job is the primary criterion for deciding among alternative job offers. The result is an informal pecking order, where the highest-quality recruiters generally seek to hire the highest-quality candidates, and less-highly-ranked recruiters seek to hire the remaining less-highly-ranked candidates, and there is substantial *rationing* by the highest-quality recruiters (e.g. the "top 5" ranked departments in the U.S. and elsewhere).

In this chapter we have taken the limited role of wages as a market-clearing mechanism as a given, particularly since it seems to us that there is nothing to prevent different institutions to compete on the basis of wages and other working conditions and not just on quality. As a result, to a large extent the efficiency of the economics job market should be judged on the extent to which it maximizes the *quality of the matching between recruiters and candidates.*

3 EconJobMarket.org

As we noted in the introduction, the objective of *EconJobMarket.org* (EJM) is fairly modest: to serve as an "information clearinghouse" that posts online ads from recruiters, accepts online applications to these ads from job candidates, and additionally provides an efficient service for automatic delivery of letters of recommendation provided by their authors to job positions that the candidate who names them as thier references applies to on the EJM system. We describe the factors motivating EJM in section 3.1, then briefly discuss the design of the site and the services that EJM offers in section 3.2. In section 3.3 we document the rapid growth of EJM, which is doubling in size each year along virtually ever measure of its "size", and we document the effect of EJM on candidates' application decisions and the number of applications received per ad. Overall we are finding that as EJM grows, candidates are making more applications using EJM and the number of applications received per ad posted on the EJM site are also growing very rapidly, more than doubling between 2009 and 2010. In section 3.4 we discuss "market design" issues, particularly how it might be possible to promote competition among intermediaries without the adverse side effects of market fragmentation if intermediaries agree to abide by the principles of 1) data sharing and 2) a minimal degree of interoperability.

3.1 Origin and motivation for EJM

Prior to EJM there was only one other service that provided similar functionality to the economics job market, *AcademicJobsOnline.org.* This service came online in August 2006 as an outgrowth and generalization of *MathJobs.org,* a site developed at the department of mathematics at Duke University. EJM came online in the following year in August 2007. While *AcademicJobsOnline.org* is a high quality site and service, it is not widely used in the economics job market. For example as of March, 31 2011 there were 5 job ads posted on this site, compared to 50 ads on EJM and 90 listings on the newly released April 2011 JOE.

Prior to founding EJM, the three co-founders (Martin Osborne, John Rust and Joel Watson) had independently developed their own web-based application and candidate evaluation systems for the internal use on their respective departments. It was clear to each of them (and to the overwhelming majority of their colleagues who used these systems in their respective departments) that computerized candidate evaluation systems were vastly superior to the paper-based systems for evaluating candidates that their recruiting committees had used in the past.

In particular, it is much easier to search and evaluate large numbers of candidates using a web-based system. Under the paper-based regime, secretaries had to prepare manilla folders containing the application materials for each applicant. These folders were typically distributed to various members of the recruiting committee or other faculty for evaluation and as noted in section 2, these evaluations had to be performed over a relatively compressed period of time — typically in the last week of November and the first week of December. Because of the large volume of applications and the large amount of material in each application, the secretarial staff would typically prepare only a single copy of each application folder to be shared among the various faculty members evaluating candidates. If faculty member A had checked out a folder on applicant B when another faculty member C wanted to also look at that same applicant, there would typically be a delay until faculty A could return the folder or give it to faculty member C. This created a logistical problem akin to a library where a secretary needed to keep track which faculty members had "checked out" files on various candidates. Since time to evaluate candidates is quite scarce during this busy period of time, if a folder on a candidate happened to be checked out by faculty member A when faculty member C wanted to look at it, chances were good that faculty member C would not get the applicant's folder in time to provide an independent reading and signal on the candidate.

When the application materials are available online, via a secure, password protected and searchable web interface, there is no longer an issue of a particular application file being "checked out". Additionally, faculty can search and look at files from wherever they happen to be, whether in their office, at the airport waiting for a flight, or at home, provided they have web access and laptop. The ability to look at applications quickly, on short notice during brief periods of "dead time" also contributes to a greater chance that multiple faculty members will actually read and provide feedback on applications to the recruiting committee. The web based systems have additional tools for assigning reviewers and sending reminders when reviews are due, and for incorporating other information such as surveys of placement officers that can greatly increase the amount of information faculty have at their fingertips to help evaluate, sort and rank applicants and to do so much more quickly than they were able to under the previous paper-based mode of recruiting.

Thus, one of the ideas motivating the creation of EJM was to make systems similar to these available to other departments to improve their productivity in recruiting. However it became apparent to the co-founders that if every department and recruiter were to adopt their own web-based application system and use their own website and URL to receive applications from candidates and reference letters from faculty, while this would increase the productivity of the recruiting committees that adopted this information tech-

nology, doing this across the board at hundreds or thousands of universities and recruiters would place an unacceptable burden on both candidates and recommenders who would have to negotiate dozens of different web sites to submit applications and upload reference letters. As we noted in section 2, Coles et al. [2010] report that a typical job market candidate applied to approximately 80 job ads in 2008. Further we noted that it can take anywhere from 15 to 20 minutes to submit an online application and perhaps nearly as long to upload a reference letter, particularly the less well designed sites.

It is clear that there is a potential for a tremendous collective time burden placed on candidates and faculty recommenders if the economics job market were to adopt online appplication and evaluation systems in a haphazard and uncoordinated fashion. This is the essence of the market fragmentation and the source of so much frustration to faculty recommenders as we noted in section 2.2. The private economies to individual recruiters from using online application and evaluation systems come at the cost of large external diseconomies to the economics profession as a whole unless these systems are designed in a coordinated and intelligent fashion. However we cannot naively trust in unfettered operation of the "invisible hand" to produce a well designed, coordinated, and collectively intelligent system. Instead, as we noted in section 2.2, the invisible hand has lead to a highly inefficient and fragmented system in the market for applications to grad schools, and recent trends indicate that a similar development appears to be happening in the economics job market as well.

At the same time, it is equally clear that we cannot just wave our hands and "design" an intelligent system, even that only has the modest objective of efficiently disseminating the critical information necessary to operate the economics job market. Nobody, and certainly not the founders of EJM, owns or controls the economics job market, so there is no way to force market participants to behave in an intelligent, coordinated fashion (even if we could agree on what an intelligently designed market should look like). Rust and Watson independently approached the American Economic Association to argue that by virtue of its key role in operating the JOE site that it would be very well placed to take on the additional information clearinghouse function. However in both cases, despite support from past AEA Presidents Thomas Sargent and Daniel McFadden, the Executive Committee of the AEA evidently did not see a compelling case for for JOE to take on the information clearinghouse function that Rust and Watson had proposed.

The idea to form EJM originated in 2006 and at the ASSA meetings in Chicago in 2007, Osborne, Rust and Watson agreed to found the organization that has ultimately become EJM. A private firm, *Watson Education* founded by Watson's brother (which also developed the system used by the University of California at San Diego), was chosen to develop the EJM software. Since 2009, the EJM website and responsibility

for operation of EJM was transferred to *Techno Luddites, Inc.* (co-founded by Bandyopadhyay and Rust). The EJM software and site were developed at a total cost of less than $50,000. The site was granted non-profit (charity) status by the U.S. Internal Revenue Service in 2009, and EJM relies on a combination of volunteer programming effort (including by several coauthors of this chapter) and voluntary donations by recruiters posting ads on the EJM site to cover operating costs and enable continued development and improvement of the software.

3.2 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, 2011. As noted above, there are three types of user accounts on EJM: 1) recruiters, 2) candidates and 3) recommmenders. All of these accounts are free, though there is provision in the EJM software for recruiters and candidates to make voluntary contributions. Virtually any organization wishing to recruit economists is allowed to have a free account on EJM, though account applications are reviewed and any recruiter who posts ads requiring skills that are not deemed to be sufficiently close to economics can be prohibited from using the site.

When a recruiter is granted an account, it is ordinarily a permanent account and designated staff from the recruiter are allowed to post new job ads at any time. The job ads can either be a purely informative and not use the internal application machinery in the EJM website to accept electronic applications, or the ad can be set up to receive all applications electronically from candidates who have EJM accounts. When a job candidate obtains a free account they are allowed to "pre-load" key information including their vita, teaching evaluations, and writing samples, including copies of their "job market paper" or other published or unpublished research papers. When logged into EJM, a candidate can search or browse the available ads and apply to any ads for which recruiters accept online applications via EJM with a simple mouse click. Any pre-loaded materials such as the candidate's vita or job market paper can be easily included as part of the application. In addition the candidate is prompted for any additional information or files that the recruiter wants from applicants. EJM has a flexible application creation interface that allows recruiters to either select one of several standardized application templates, or have full freedom to design a completely custom ad with whatever questions or files the recruiter seeks to obtain from applicants.

As applications are made to open job postings, recruiters are able to search and view the application files of indvidual candidates interactively by logging into their accounts and selecting a search/view applicants function. However recruiters are also allowed to download an Excel-compatible file listing the

name, organization, degree and other key information on its applicants and a zip file that expands to a sub-directory containing individual folders containing all vitas, job market papers, reference letters and other files uploaded by applicants as part of their applications. 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. These are the equivalent of the "file folders" that were prepared for candidates under a paper-based recruiting system. However unlike the paper-based system, the PDF virtual application folders can be sent to different recruiting committee members simultaneously, and thus do not involve the manual xeroxing and filing that was required under paper-based recruiting systems.

When a candidate applies to an ad that takes online applications via EJM, they also specify their references. Existing references are notified every time when new candidate name them, or if a person named as a reference does not already have a recommender account on EJM, a new free account is automatically created and the new recommender is notified of his/her login information by email. As described below, EJM provides a great deal of flexibility to recommenders as to how the reference letter they provide on a candidate is to be distributed to the applications the EJM system.

EJM also allows recommender to specify other individuals to serve as their *proxy.* When this is done, the proxy (who may be a placement secretary at the university where the recommmender is located) receives their own account and is allowed to manage the recommendation requests for the recommender on his/her behalf. A single individual can serve as proxy to many different recommenders, and can manage recommendations for any or all candidates recommended by each recommmender. EJM is currently in the process of upgrading its recommender interface to provide more control over current reference requests and flexible archiving of previous reference requests, and options regarding circumstances under which the recommenders/proxies are notified or reminded by email of new or outstanding reference requests. Candidates are also able to see when their references have uploaded letters and this provides a much greater sense of assurance to candidates to see confirmations that their applications have been filed and all reference have been received.

Below we summarize the sequence of events starting from the creation of a new recruiter account, to the placing of an ad on the site and the receipt of applications and reference letters, through the retreival of files containing all of the applications received.

- Recruiter creates an account and posts an ad describing the position being advertised. If necessary,

recruter designs their own web questionary for the applicants. Data generated by this questionary is transferred to the recruiter as part of the application materials package.

- Information about the open position is posted on publicly accessible space of `econjobmarket.org` to be indexed by the search engines, and is advertised elsewhere.

- Candidates create their free accounts on the system and fill in generic survey providing basic information about themselves (mostly purely voluntary, such including questions about gender, race and ethnicity), upload their vita, job market paper, and other files such as a photo of themselves (if they choose to) and other relevant documents.

- Candidates search for job openings on the public space of the system, and apply to ads by clicking an "Apply Now" link and providing any required information or documents by simply check-marking any pre-loaded items. If any additional materials are required by a particular application, they can be also uploaded from within the application stages.

- In connection to job opening candidate calls for external reference letter providers among those already registered on the system or suggests new ones. In case a recommender is not yet registered, contact information is stored in a separate area and a manual screening is performed by the administrator of the system to verify the identity of the newcoming recommender, and a letter of invitation to join `econjobmarket.org` is sent out to passing recommenders.

- Alternatively, candidates may appoint reference letter providers in advance before replying to any ads to speed up subsequent applications, especially if their recommenders would have to go through manual screening. This design allows for some burden of EJM activity to be spread through the year away from the rush time in the end of autumn.

- Recommender logs in to the system (account is automatically created once the screening is passed) and uploads reference letters. Recommender pages of `econjobmarket.org` are designed in such a way as to make submission of letters as fast and effortless as possible. In particular, the system is compatible with a common scenario when a recommender uploads one generic letter for each candidate, and if the option is chosen this letter is automatically delivered to all applications candidate has made and/or will make in the future. In the same time, the system is flexible enough to allow for several typical letters to be uploaded and submitted for different recruiters a candidate applies (on

recommender discretion). As a limiting case, separate letter can be uploaded for each application a candidate makes.

- When recommenders appoint an assistants (proxy) to manage the letter submission process on their behalf, they are able to adjust the frequency of notifications send by the system to their inbox in various situations independently from the managing staff, which facilitates a flexible amount of control. Proxies have identical interface to recommenders with the only difference that they are able to upload letters for the candidates (and different applications candidates make) linked to several different recommenders they manage. Notifications and reminders are sent by EJM for the events which require more or less immediate attention of the recommenders and their proxies, such that new applications submitted, new incoming reference requests, dismissing of reference requests, etc.

- Candidates have the opportunity to log in to the system at any time to check the status of her applications, including to verify whether reference letters have been transmitted on their applications.

- At various times designated staff from the recruiter can log into the EJM system and download all available applications including the files submitted by the candidate and the reference letters submitted by the recommenders independent from the candidates. This information may also be automatically transferred to other compatible third party "back-end" systems for evaluating applications discussed above (for example, *Head Hunter editorialexpress.com/hh/*, provided by *Techno Luddites, Inc.* or *Faculty Tools, Recruiter* provided by *Watson Education*), or the applications can be downloaded as Excel and zip files or as a bundle of PDF-formatted "virtual application folders" as described above.

- In the end of the job market season (usually in June) all submitted documents and created ads are retired to the archives.

EconJobMarket.org is based on a relational database that is maintained on multiple servers in a secure data certain with strong protocols to guarantee confidentiality and data security. In particular, all connectioins to the EJM server use encrypted connections and strict monitoring is enforced to ensure unathorized parties are unable to access confidential information, which consists mainly of the reference letters as well as the applications made to specific job ads which receive applications via the EJM site.

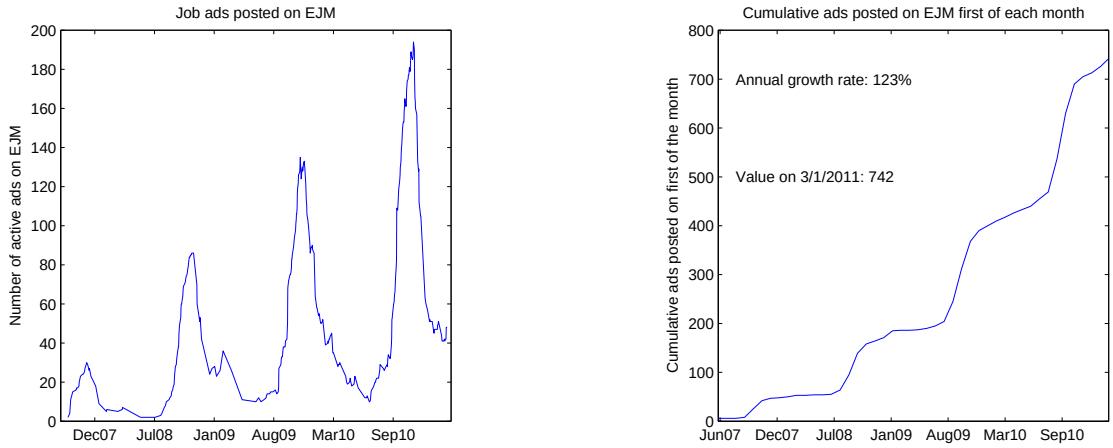

Figure 1 Current and Cumulative Numbers of Job Ads on EJM

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

The first year EJM became operational, in the 2007/2008 job market season, the number of job ads was deliberated restricted since the EJM site was still considered to be in "beta test mode" and the EJM officers were reluctant to take the risk of fully scaling up the site until it has 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 during the last three job market seasons. Over the last three years the growth in virtually all measures of the size of EJM as been exponential, with nearly every aspect of the site and service more than doubling each successive year.

The left hand panel of Figure 1 plots the number of job ads 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 ads during the period November to December in each year, the period of maximum activity in the primary economics market. Generally the spring and summer are the slow season for EJM and the number of ads falls off considerably during these periods. At the peak there were nearly 200 ads posted on EJM in this most recent 2010/11 job market season. In comparison the December 2010 JOE had 302 job listings and the November JOE had 504 job listings. Thus, EJM has grown very rapidly and already accounts for a significant share of all job ads posted in the primary market for economists (most often ads are posted on both EJM and JOE).

The right hand panel of figure 1 plots the cumulative number of job ads posted on EJM as of the first of each month. By March 1, 2011 a total of 742 ads had been posted, and the annualized growth rate in the number of ads on the site was 123%. The undulations in the curve correspond to the annual job cycle,

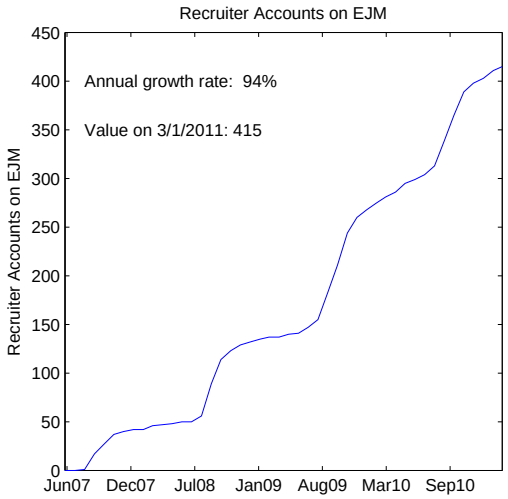

Figure 2 Number of Recruiters with Accounts on EJM

where new ads 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.

Figure 2 plots the cumulative number of recruiter accounts on EJM. As of March 31, 2011 there were a total of 418 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 recruiters is growing at nearly 100% per year also. 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 ads were posted by the highest ranked economics and business schools worldwide including Cambridge, Oxford, Unversity College London, MIT, Harvard, Penn, Columbia, Berkeley, and Stanford 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, Banque de France, and Congressional Budget Office have established accounts and posted ads on the site.

From the beginning, the most rapid growh in EJM was in the number of candidates using the service. Figure 3 plots both the number applicants and the number of applications made using the EJM website. These have grown at nearly 200% per year with a particularly large jump in the number of applications during the most recent 2010/11 job market season. By March 1, 2011 there were more than 10,000 candidate accounts on EJM and over 50,000 applications had been processed by the EJM website.

Figure 4 plots the growth in the number of recommmenders and recommmendation letters that have been transmitted by the EJM website, While the number of recommenders with accounts on EJM is grow-

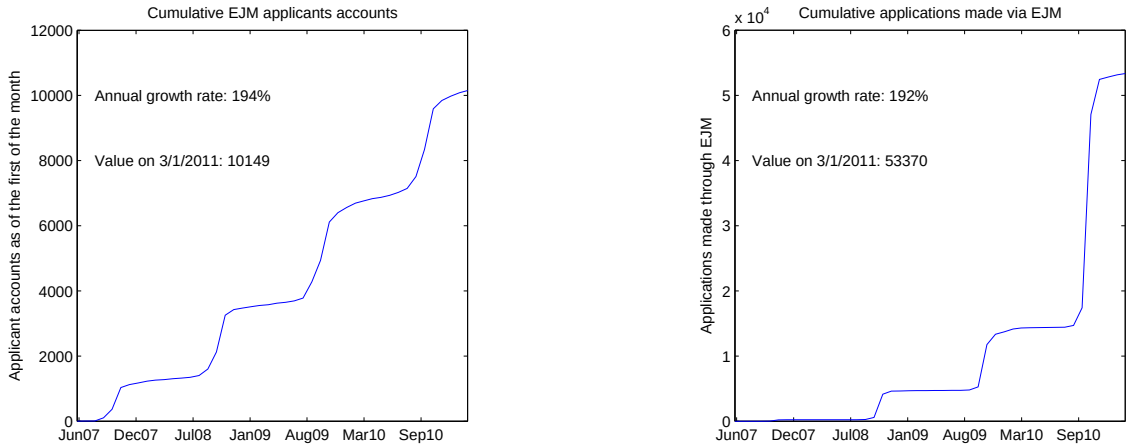

Figure 3 Cumulative Numbers of Applicants and Applications made via EJM

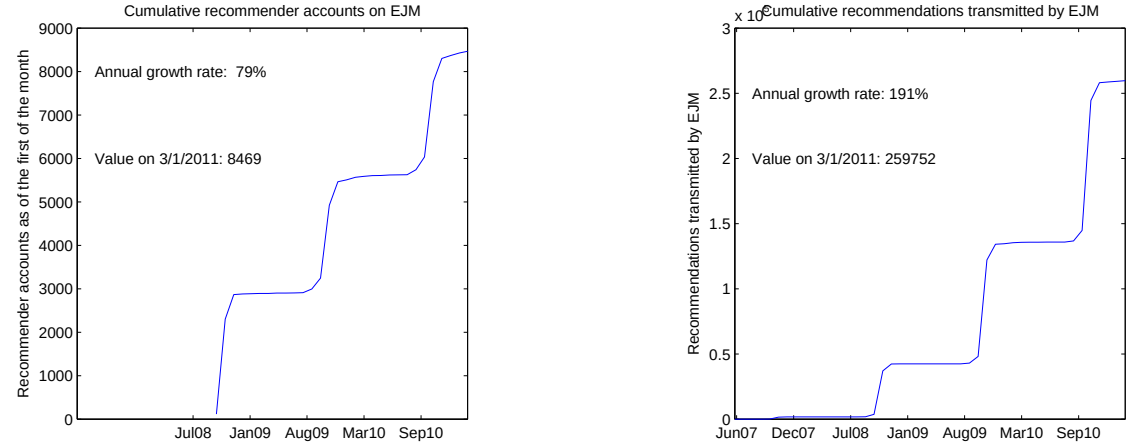

Figure 4 Cumulative Numbers of Recommenders and Recommendations tranmitted via EJM

ing at nearly 80% per year, the number of recommmendations that have been transmitted by the EJM system is over 190% per year and by March 1, 2011 more than 250,000 letters had been delivered to recruiters by the EJM system.

These rapid growth rates indicate that EJM is serving a need that is not well met by other existing labor market intermediaries operating in the economics job market. The numbers also are suggestive of strong positive self-reinforcing feedback effects: 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 as adoption of EJM starts to become universal or nearly universal among recruiters as well. Fortunately, this growth has been accomplished entirely by word of mouth since EJM does not have the resources to afford any significant amount of advertising. The main recent boosts to EJM were the endorsements it obtained from the Econometric Society and the European Economic Association.

We now turn to a preliminary 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 shows the number of candidates who used EJM in each academic year and the composition of their characteristics. The number of candidates who used EJM increased from about 1000 in 2008/2009 to 3000 in 2010/2011. About 86 to 88 percent of the candidates are expecting to earn or already have a PhD. Over time, we find that candidates in EJM is becoming more diverse in terms of geographical location. For example, the fraction of candidates from Europe (excluding U.K.) was about 9 percent in 2009/2010, and increased to 15 percent in 2010/2011. Similarly, more and more candidates from U.K. and Asia and Pacific regions are using EJM over time. Table 2 shows the composition of candidates based on their primary research area. Generally, there exist no clear changes across years but we find that more candidates specializing in Finance use EJM.

Table 3 shows 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 recruiters increased from 134 in 2008/2009 to 300 in 2010/2011. In 2010/2011, about 64 percent of institutions searched for professors — either tenured or untenured. The fraction of recruiters that aimed to fill other academic positions such as lecturerships increases from 7 percent in 2008/2009 to 17 percent in 2010/2011. Like 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 is due to the endorsement by the *European Economic Association*.

Table 4 shows the distribution of research fields that recruiters search for. 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 major among recruiters suggests that the market for “Finance"

Table 1: Composition of Candidates

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
No. Candidates	1144	1607	2739
Panel A: Distribution-Geographical Location(%)			
US	75.52	69.20	64.29
Canada	7.26	6.53	6.21
UK	4.63	4.92	6.86
Europe (excluding UK)	8.65	13.32	15.33
Australia & New Zealand	0.70	0.75	1.57
Asia	1.40	2.43	2.52
Latin America	0.35	0.81	0.62
Others or N.A.	1.49	2.05	2.59
Panel B: Distribution-Degree(%)			
PhD or expected PhD	85.93	86.81	87.55
Masters (excluding MBA)	11.10	10.58	9.49
MBA	0.26	0.81	0.55
Bachelors	0.96	0.37	1.10
Others or N.A.	1.75	1.43	1.31

major is becoming more competitive for candidates relative to other fields.

Tables 5 and 6 present the average number of applications that a job seeker sent via EJM and that an employer received from EJM, respectively. Table 5 shows that regardless of geographical location or primary field of research, the use of EJM for job applications increased over time. For example, the average number of applications of job seeker through EJM increased from 4 in year 2008/2009 to 16 in 2010/2011. Depending on primary fields, the use of EJM in application varies. For example, candidates who specialize in International Trade and Law and Economics on average sent 20 applications, whereas those who specialize in Industrial Organization and Theory sent less than 7 applications.

Like our findings from candidates' side, the number of applications received by recruiters increased over time. For example, the average number of applications that an employer receives to fill one position rose from 88 in 2008/2009 to 193 in 2010/2011. The increase in number of received applications shows in nearly all geographical locations and primary research fields.

The fact that the average number of received applications per position is large supports the mentioned above concern that it can be costly for an employer to review all applications and the employer may have multiple applications from job seekers who ex ante appear to be similar to each other in terms of, for example, their primary field of research, ranking of their degree program, and geographical location. In

Table 2: Composition of Candidates

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
No. users	1144	1607	2739
Panel C: Distribution-Primary Field (%)			
Behavioral Economics	1.66	2.30	2.15
Business Economics	0.00	1.49	1.02
Computational Economics	0.00	0.12	0.26
Development; Growth	6.99	9.02	8.14
Econometrics	7.95	5.79	7.27
Economic History	0.96	1.00	0.99
Environmental; Ag. Econ	4.98	4.67	7.19
Experimental Economics	1.31	1.37	1.83
Finance	4.55	6.41	12.08
Health; Education; Welfare	0.26	4.36	4.38
Industrial Organization	9.27	7.53	6.79
International Finance/Macro	6.38	6.04	4.75
International Trade	6.64	5.04	4.75
Labor; Demographic Econ	9.35	8.34	7.56
Law and Economics	0.35	0.56	0.55
Macroeconomics; Monetary	15.12	13.75	10.88
Microeconomics	11.63	10.08	7.85
Political Economy	0.00	0.00	1.72
Public Economics	6.47	6.10	4.16
Theory	2.62	2.36	2.30
Urban; Rural; Regional Econ	0.09	1.62	1.53
Other, Any field or N.A.	2.80	1.87	1.83

Table 3: Composition of Recruiters

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
No. recruiters	134	254	300
Panel A: Distribution-Job Titles(%)			
Professors	74.63	64.17	64.33
Post-Doc	1.49	12.20	10.67
Lecturers and other academic positions	6.72	10.24	14.67
Non academic	12.69	12.99	10.33
N.A.	4.48	0.39	0.00
Panel B: Distribution-Geographical Location(%)			
US	57.89	36.25	37.67
Canada	17.29	9.56	9.00
UK	4.51	8.76	8.00
Europe (excluding UK)	14.29	39.44	40.00
Australia & New Zealand	2.26	2.79	3.00
Asia	3.01	1.59	1.33
Latin America	0.75	1.20	1.00
Others or N.A.	0.00	0.40	0.00

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 embedded this idea. Each job seeker has the opportunity to send signals of particular interest to two employers via an AEA website. In theory, an equilibrium can be generated where job seekers send signals based on their unobserved preference over employers and the employers can infer the job seekers' preferences based on signals. Coles et al. [2010] provides 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] compare 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] provide a field experiment suggesting that signaling can improve search outcomes. Coles et al. [2009] theoretically examine the welfare implication of introducing a signaling mechanism in a labor market.

Table 4: Composition of Advertised Research Field

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
No. advertised fields	329	659	734
Composition(%)			
Behavioral Economics	3.95	4.10	4.09
Business Economics	7.60	7.59	8.72
Computational Economics	2.13	1.52	1.36
Development; Growth	6.38	3.34	3.81
Econometrics	1.22	1.97	1.77
Economic History	7.60	6.37	6.95
Environmental; Ag. Econ	6.08	5.77	5.72
Experimental Economics	5.78	5.01	2.45
Finance	5.47	4.25	3.81
Health; Education; Welfare	4.56	5.31	4.77
Industrial Organization	3.04	2.43	2.45
International Finance/Macro	7.90	8.35	5.99
International Trade	7.60	7.28	7.36
Labor; Demographic Econ	5.47	5.16	5.59
Law and Economics	1.52	2.12	2.04
Macroeconomics; Monetary	2.13	2.58	3.13
Microeconomics	13.68	11.53	13.35
Political Economy	0.00	2.88	2.32
Public Economics	0.00	3.49	4.63
Theory	0.00	3.19	3.54
Urban; Rural; Regional Econ	0.00	0.76	1.36
Others, Any field, N.A.	7.90	5.01	4.77

3.4 Potential Roles that EJM plays

As Section 3.2 shows, EJM allows candidates and recommenders to submit application documents to multiple employers and the marginal cost of an additional application is minimal once they deposit all the relevant files on EJM. Therefore, one role that EJM plays is reducing application costs for candidates and recommenders compared to the case that candidates and recommender need to send application materials to each recruiter. This reduction in transaction costs does not necessarily imply for improvement in efficiency because a large number of applications due to the reduction in application costs may cause recruiters to spend more resources to review the application materials.

Moreover, given the presence of various organizations providing comparable services, the entry of EJM may further fragment the economics job market. As discussed in section 2.2, when excess entry is present

market participants — especially candidates and references — may have to perform duplicate tasks of establishing accounts, submitting applications, uploading documents, and uploading reference letters. Yet, if EJM becomes a dominating place for information exchange, tasks of establishing accounts, uploading documents, and creating biographical profiles would be done just once; the system would automate the duplicative tasks of copying and transmitting materials to various recipients.

In Sections 4 and 5, we examine these two issues in detail and discuss the potential impacts of EJM on participants of the economics job market.

4 Excess Entry of Intermediaries and Market Fragmentation

There are several existing theories which at least partially capture the intuition that unrestricted entry of the trade intermediating firms — *middlemen* — does not always lead to good outcomes, and can actually increase search and transactions costs. This phenomenon we have referred to 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 as buyers and sellers in the market. A fragmented market place is a situation where there is 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 incentive to incur these costs and they will delay trade while conducting costly search to find the best opportunities.

Neeman and Vulkan [2010] have argued that there are strong dynamics that lead to a consolidation of separate market places into a single *central market place* where all trade occurs. The consolidation not only reduces search and transactions costs, they showed that the consolidation of trading to a central market place leads to the best terms of trade for participants (i.e. highest welfare gains). 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 heterogenous group of privately-informed traders who each wish to buy or sell one unit of some homogenous 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 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 dentralized 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.

However if these dynamics are so strong, why hasn't Neeman and Vulkan's unravelling result lead to a consolidation to all trading in a single marketplace in the economics job market so far, eliminating the problems of market fragmentation that we noted above? 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 extend 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 described 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 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 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 simple static model that is better adapted to the economics job market to illustrate 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 aleviate 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 to submit each application to a recruiter if it is posted on one of the web sites of the intermediaries. 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 adopt an electronic system from firm 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. So from their perspective it is optimal to have a single, centralized 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.[3] 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

[3] The ability to price discriminate can be important in some settings, but here it is not needed to get the efficient outcome. Non-linear pricing is also not necessary for the result here.

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 intermediaryy 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.

While none of these models succeed in capturing the full richness and complexity of the economics job market or the complicated dynamics of competition between intermediaries, they do 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 models suggest 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.

However as we noted in section 3, the *status quo* in the economics job market is one with a reasonably fragmented market place and relatively high search costs. While the JOE serves as a central intermediary that publicly availability of jobs, it does not provide the additional services of matching candidates and jobs or transmitting applications from candidates to recruiters. We have shown how in recent years a number of web-based labor market intermediaries including EJM have entered the market in an attempt to provide these additional services that JOE has chosen not to provide to the market. It is still unclear how the competitive dynamics will play out, and whether the Neeman and Vulkan "unravelling" prediction will ultimately prevail and a single central market place will come into existence where all recruiters and job candidates will go to advertise and apply for positions.

We do note that to the extent that there are efficient, low cost non-profit intermediaries such as EJM competing along side for-profit intermediaries such as *Econ-jobs.com* it is difficult to see how the for-profit

intermediaries can survive in the long run unless they are substantially more efficient than the for-profit firms and can succeed to undercut the non-profits in Bertrand-like price commpetition, or provide superior software or services.

However as we suggested in section 3, if it were possible via some sort of market regulation or coordination to obtain an agreement on *data sharing* and *interoperability* between competing intermediaries, it may be possible for competition between intermediaries to result in beneficial outcomes. The intuition is that when there is an agreement to have data sharing and interoperability between job market intermediaries, any job candidate would be able to see the full set of job ads no matter which intermediary he/she chooses, and similarly for recruiters when they choose an intermediary where to post their job ad. In such a case recruiters and candidates will choose an intermediary that offers them the best possible service at the lowest possible price, so unrestricted competition under these circumstances ought to result in efficient outcomes while avoiding the higher search and transactions costs due to market fragmentation.

Essentially, we argue that if there is sufficient coordination or exogenously imposed market regulation that enforce data sharing and interoperability, it should be possible to get what effectively is a "single central market place" even though there are many intermediaries competing in this market. While we have not yet developed a model and provided a proof that such types of competitive outcomes would indeed obtain, we have already pointed out to a practical example in the introduction — the role of the organization ICANN as serving to set ground rules to enable many competing domain name registration services (intermediaries such as *godaddy.com* or *domainspricedright.com* or *networksolutions.com* etc. etc.) to compete with each other to provide IP name/address mapping services to individuals in a decentralized yet highly competitive marketplace.

5 A Model of Strategic Application and Acceptance

To evaluate how information technology impacts both candidates and recruiters, it helps to have a model of how transaction costs affect the matching process. Consider a candidate's decision over which recruiters to send applications in a strategic framework. Sending each application is costly, and every candidate knows there is competition from other candidates for every job. Recognizing that the best candidates are more likely to get the best jobs, high-quality candidates may economize by not applying to the lowest quality jobs, and vice-versa. We look at how lowering the cost of sending an application would affect candidates of different qualities, and how, through their application decisions, it would affect outcomes for different

qualities of recruiters.

Suppose there are N_a candidates and N_u recruiters. Each candidate has a publicly-known signal s_i, and each recruiter has a publicly-known quality q_j. A candidate can apply to an recruiter at a cost of c, which puts them in consideration for the job. The payoff to candidate i from matching to recruiter j is $s_i q_j$, while the payoff of recruiter j hiring candidate i is $s_i q_j + \varepsilon_{ij}$, where ε is an idiosyncratic shock to the recruiter's perception of the candidate's value beyond the candidate's public signal. The shock is privately known by the recruiter, and represents the recruiter's tastes and specific needs for candidates. The timing of the game is that the candidates submit their applications, the recruiters review the received applications, and then they hire candidates.

The timing of the game is that the candidates simultaneously submit their applications, the recruiters review the applications they've received, and then recruiters make offers to candidates. Since the candidates have the same preferences over recruiters, we can let the best recruiter choose from his applications first, followed by the second-best, and so on. This timing can be interpreted as a version of the Gale-Shapley algorithm where the candidates propose to the universities, and the university's uncertainty about candidates is resolved when their turn to choose arrives. If all candidates apply to all jobs, it would be straightforward to find the probability of a given match.

However, candidates may not apply for every job. Moreover, each candidate does not know where all the other candidates have applied, and there are likely many equilibria to such a game. In particular, we solve computationally for a set of strategies where no candidate can profitably send another application out nor any candidate profitably withdraw an application. This is chosen so that the higher quality players can "threaten" to apply to a given recruiter, but if the profitable entry of other agents deters them, this threat is rendered non-credible and they withdraw the application. Since the addition of marginal candidates reduces the value of applying to a recruiters, this leads to sorting, where the best applicants focus on the top schools, average applicants focus on middling recruiters, and so on. Once such a profile of application strategies is found, it is then checked that no additions or withdrawals are profitable, showing that it is an equilibrium.

If there were no shock to the recruiter's preferences, there would be a unique stable match. Instead, candidates are uncertain about whether a given recruiter will pick them, so they apply to a portfolio of recruiters. Since a sequence of shocks might give an average candidate access to a better-than-average job, it might be worth the risk and cost to apply. Likewise, better candidates will submit applications to worse recruiters to ensure that they get a job if they receive unfavorable evaluations at their preferred recruiters.

Then an *application equilibrium* is a set of strategies $A_i \subset N_u$ so that no candidate can add an recruiter j to her set and receive a higher payoff in expectation. Fix a portfolio of applications $A_i \subseteq K_u$ for candidate i, and consider the payoff, where p_i^ℓ is the probability that ℓ picks i, given that i has not yet been picked given i's application strategy, and $p_i^{\ell,\ell+1,...,\ell+k}$ is the probability that i has been picked by some firm $\ell, \ell+1, ..., \ell+k$.

$$\begin{aligned}\mathbf{E}[u_i(A_i, A_{N_a \setminus i})] &= p_i^\ell s_i q_\ell - c + p_i^{\ell+1}(1-p_i^\ell) s_i q_{\ell+1} - c + p_i^{\ell+2}(1-p_i^{\ell,\ell+1}) - c \\ &+ \ldots + p_i^{\ell+k}(1-p_i^{\ell,\ell+1,...,\ell+k-1}) s_i q_{\ell+k} - c \end{aligned} \tag{1}$$

So adding a marginal recruiter $\ell+k+1$ is worthwhile only if

$$\begin{aligned}&\mathbf{E}[u(A_i \cup \{\ell+k+1\}, A_{N_a \setminus i})] = p_i^\ell s_i q_\ell - c + p_i^{\ell+1}(1-p_i^\ell) s_i q_{\ell+1} - c + p_i^{\ell+2}(1-p_i^{\ell,\ell+1}) - c \\ + \quad &\ldots + p_i^{\ell+k}(1-p_i^{\ell,\ell+1,...,\ell+k-1}) s_i q_{\ell+k} - c + p_i^{\ell+k+1}(1-p_i^{\ell,\ell+1,...,\ell+k}) s_i q_{\ell+k+1} - c \end{aligned} \tag{2}$$

is greater than $\mathbf{E}[u_i(A_i, A_{N_a \setminus i})]$, or or

$$s_i \geq \frac{c}{p_i^{\ell+k+1}(1-p_i^{\ell,\ell+1,...,\ell+k}) q_{\ell+k+1}}$$

This implies that a number of conditions must be met for it to be worthwhile to apply to the marginal recruiter: (i) The cost cannot be too high, (ii) The probability the agent is still on the market, $(1 - p_i^{\ell,\ell+1,...,\ell+k})$, cannot be too low, (iii) The probability that the agent is actually picked by recruiter $\ell+k+1$ must be high, given the choice set facing that recruiter, and (iv) The quality of recruiter $q_{\ell+k+1}$ cannot be too low.

Let H_{j-1} be the set of candidates hired by the first $j-1$ recruiters. When it comes time for recruiter j to make its decision over their remaining candidate set $\tilde{A}_j = A_j \setminus H_{j-1}$, suppose that the shocks ε_{ji} are distributed type one extreme value with parameter σ, so that the probability that k is chosen given the remaining candidates $\tilde{A}_j$ is

$$pr[k|\tilde{A}_j] = \frac{\exp\{s_k q_j/\sigma\}}{\sum_{m \in \tilde{A}_j} \exp\{s_m q_j/\sigma\}} = \frac{\exp\{s_k/\sigma\}}{\sum_{m \in \tilde{A}_j} \exp\{s_m/\sigma\}}$$

The magnitude of σ governs how idiosyncratic the decisions of the recruiters are: For a large σ, it becomes less certain that an recruiter will simply pick the candidate with the highest public signal. This also allows the welfare of the recruiter facing choice set $\tilde{A}_j$ to be written

$$V(\tilde{A}_j) = \sigma \log\left(\sum_{i \in \tilde{A}_j} exp\left\{\frac{s_i}{\sigma}\right\}\right)$$

This is an important feature of the model — when recruiters are uncertain about their preferences, having more options raises their utility. For this reason, there can be positive welfare effects to recruiters, even if they are merely picking their favorite option from the pool of remaining candidates by the time their turn comes.

There are two obvious drawbacks to this framework: First, the likelihood of recruiter k picking a particular candidate m from a set A is the same as an recruiter k' picking m from A — so all recruiters have essentially the same idiosyncratic decision-making process. This would be false if some recruiters are good at finding "diamonds in the rough", or if higher-quality recruiters are also the ones who are more accurate in their evaluation on of candidates. But this could be remedied by allowing recruiter-specific σ_j, since this is a only question of precision. Second, we model the recruiters' shocks as being uncorrelated. Since this noise is meant to include things like how well the candidate presents herself, or what kind of impression an in-depth reading of the job-market paper leaves on evaluators, the ε_{ji} might be correlated across j, which is not considered here.[4]

In principle, this model could be solved analytically: first note that since all candidates would accept an offer from the best recruiter, the decision to apply there depends only on the likelihood of being chosen. This likelihood is a function of which other candidates are applying, so start by seeing if the best candidate finds it profitable to apply, then to check if the second best finds it profitable (given that the first-best does), and so on. However, things get trickier when considering the strategy choosing whether to apply to lower-quality recruiters. The candidates' strategies will depend not only on the likely competition, but also the probability that their portfolio will have already yielded a better match. If all the candidates apply to all the recruiters, then there are $K_s!$ ways that the recruiters might pick, leading to 3,628,800 possible outcomes. This makes studying how a reduction in c or σ changes the application strategies of the candidates essentially impossible.

Instead we focus on simulating the terms

$$p^{\ell+k}(1 - p^{\ell,\ell+1,\ldots,\ell+k-1})$$

In future work, the distributions of candidate and recruiter quality could be observed from the data provided by EconJobMarket.org as well as from the CV's and public placement information posted on recruiter

[4] In a more comprehensive approach, these problems could be solved by making the signal attached to candidate i a function of observables, such as their advisors, their previous publications or working papers, the co-author network of their advisor with the faculty at a given institution, and so on. Also, adding an outside option for recruiters might make sense — perhaps the value of matching to an average candidate next year with a discount rate of δ: $\delta q_j \bar{s_j}$.

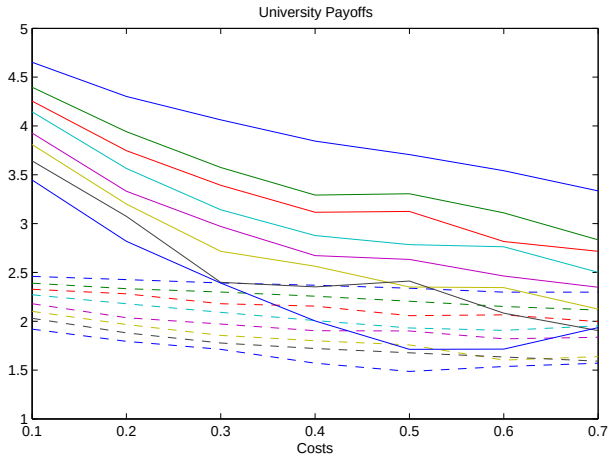

Figure 4 recruiter Payoffs

websites, and recruiter quality could be measured by the productivity and success of faculty or more tangible measures such as salary, location, and benefits to faculty. Since these data are not yet available, we simulate the model making some simple assumptions. We chose manageable numbers of participants, $N_a = 30$ and $N_u = 15$, with the candidates' signals and recruiter qualities equally spaced on the interval $[1,2]$. We compare match results for various values of c to see the effect of lowering application costs on all the different participants in the markets.

5.1 Model Results

Figure 4 plots the payoffs to the recruiters when their idiosyncratic tastes σ have low variability (dashed lines) or high variability (solid lines). In equilibrium, high variability encourages more candidates to apply since they have a better chance of "sneaking" into better jobs. This provides a larger choice set to the institutions, which in turn gives them a higher payoff. Low costs of application clearly benefit markets in which institutions suffer from more taste uncertainty, since they have more options over which to choose.

The payoffs to candidates has the reverse welfare implication with respect to σ. Figure 5 shows the payoffs of the candidates, including their application costs. candidates typically benefit from lower costs of applying, with the opposite welfare pattern of the recruiters: the best candidates benefit the most from cost reductions since when they have a good idea of how the recruiters will make decisions (low σ), since they can reduce the size of their application portfolios and still be sure of getting a good partner. For low-quality candidates, the change in payoffs is less dramatic, since their application strategy doesn't tend to change as there is less competition at the bottom in this framework.

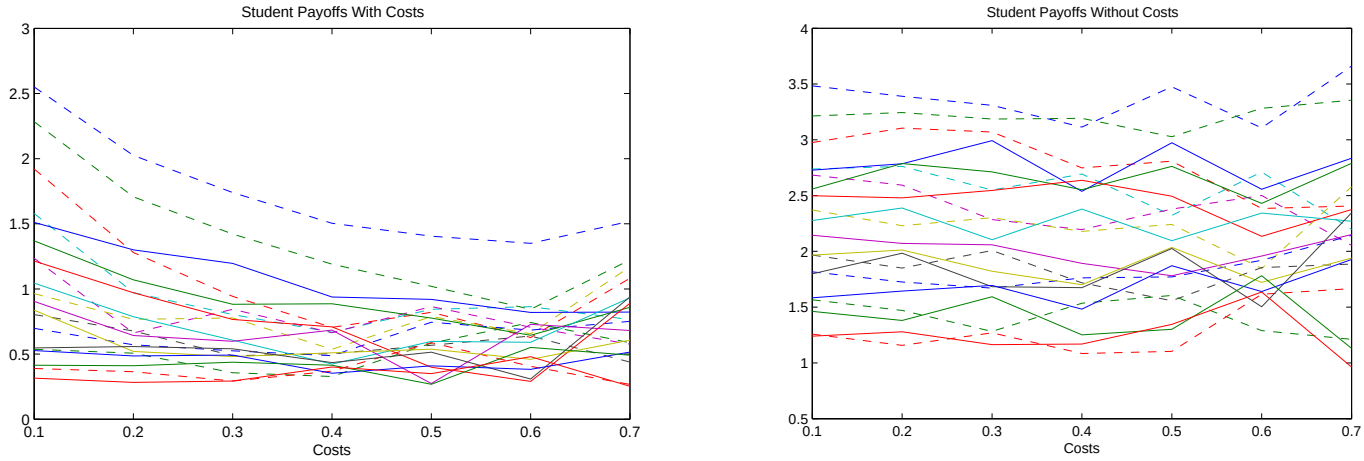

Figure 5 Candidate Payoffs (with and without costs)

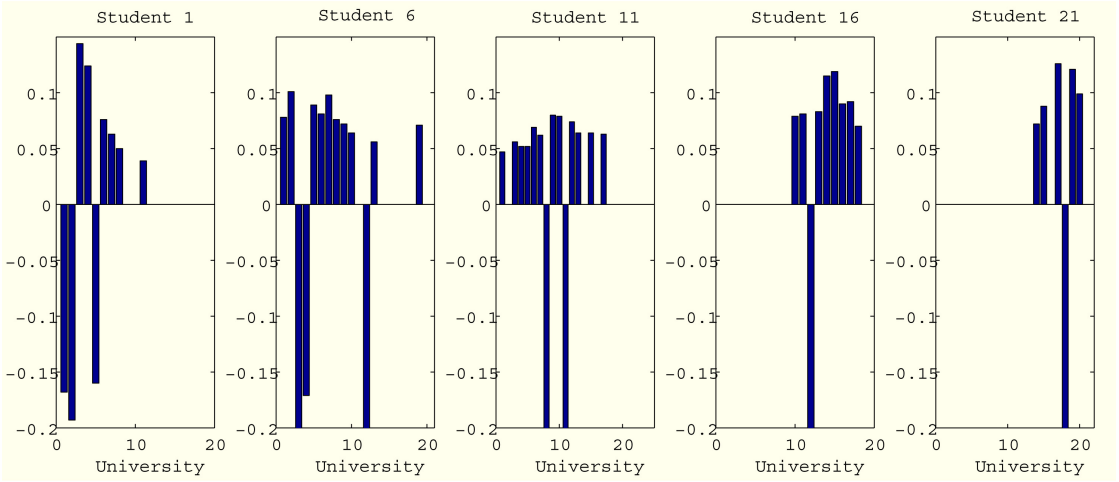

Figure 6 Changes in Match Probabilities ($c_1 = 1$ to $c_0 = .1$)

The right hand panel of Figure 5 neglects costs, and shows that variability tends to shift player payoffs down, but doesn't necessarily change the values of the match as costs increase. The reason match values tend to be lower for the candidates is because the best candidates are increasingly matched to lower-quality recruiters, bringing their payoff down.

Figure 6 shows the effects of a reduction in application cost from 1 to .1. In particular, the best candidate is likely to match with the best institutions as lower-quality candidates increase the size of their portfolios. This tends to squeeze the top and bottom candidates, since competition "broadens" in the middle, and trickles down to adversely impact the low-quality candidates who now face competition from candidates hoping to set up "safety" positions.

In conclusion, this model shows that by reducing costs, candidates broaden their search, sending more applications to potential recruiters. This tends to benefit the institutions at the candidates' expense: recruiters get larger choice sets with better quality candidates, forcing candidates to broaden their search downward. In markets where institutions have highly idiosyncratic tastes, the benefits are large.[5]

6 Alternative Search Mechanisms

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 three potential alternative search mechanisms: Guided Search, Centralized Matching, and Pricing Mechanisms.

6.1 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. For instance, 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, it can make credible recommendations to the recruiters. Using data from an online matchmaking service, Lee [2009] finds evidence that supports this hypothesis. She finds that the probability of a person accepting a first date with another user

[5] In the economics job market, the benefits of this effect might be debatable: if candidates are already applying to almost every job that they qualify for, it might even be argued that further lowering costs will overwhelm institutions. In this case, an intermediary might play an important role by enabling application fees to reduce congestion, or allow institutions to request additional references or solicit more working papers in evidence of an candidates' quality. A computerized system, especially, could be of great use in sorting applications based on the criteria of the institution, making the burden of reviewing applications and finding candidates who satisfy particular criteria less demanding.

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.

6.2 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, e.g.,Roth [1984], Roth [1991], Roth and Xing [1994], Niederle and Roth [2003]).

There are a growing number of studies that empirically examine market outcomes under decentralized matching compared with centralized matching. Niederle and Roth [2003] find 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] infer mate preferences of individuals based on their dating history and use the estimated preferences to compute stable matchings using the Gale-Shapley algorithm. Hitsch et al. [2010] and Banerjee et al. [2009] find that overall the sorting pattern generated by the Gale-Shapley algorithm is comparable to that observed in their decentralized marriage markets (e.g., U.S. online dating market for Hitsch et al. [2010] and Indian marriage market for Banerjee et al. [2009]). In contrast, using a South Korean dataset, Lee [2009] finds 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.

6.3 Pricing Mechanisms

The reduction in application costs may generate a large increase in the number of applications to a recruiter, who bears the burden of evaluating all the candidates. One way to address this issue is to introduce mechanisms like auctions or application fees which can be used to reveal information about the participants. Studies such as Damiano and Li [2006], and Johnson [2010] examine how to design such mechanisms. Johnson [2010] examines two-sided position auctions as a matching mechanism. In his setting, agents on each side of the market compete for ranks by placing bids. The intermediary then matches the two sides

on the basis of their rankings. He finds that profit-maximizing intermediaries may be tempted to deviate from assortative matching, as well as refuse to arrange some socially valuable matches. Damiano and Li [2006] studies a mechanism where, instead of bidding, agents pay a fee for access to a segment of agents for a match. The entry fee for each segment gives agents incentives to sort themselves by quality, resulting in a higher likelihood of finding a suitable partner.

7 Conclusion

This chapter has posed the question, "can the economics job market be improved?". While it is already a comparatively well-functioning market relative to many other labor markets (thanks in large part due the role of the American Economic Association and its efforts to promote the job interviews at the ASSA meetings and the Job Opportunities for Economists web site), we have nevertheless identified a number of areas where we think the job market can be improved and made practical suggestions about how these improvements might be achieved.

The main practical change to the economics job market that we have analyzed in this chapter is the entry of the new labor market intermediary *EconJobMarket.org* (EJM). This is a non-profit organization with a fairly modest objective: to play the role of an "information clearinghouse" in order to help reduce search and transactions costs in the important first stage of the market where job candidates apply to recruiters who post job ads. Prior to the entry of EJM the economics job market had operated in a predominantly "paper based mode" that has obvious drawbacks and inefficiencies.

While the adoption of information technology and particularly online ad posting, application, and reference letter delivery services seems to be a "no-brainer" with respect to reducing some of unnecessary costs of a paper-based application system, we have discussed a paradoxical effect of information technology on the market, namely *market fragmentation.* This occurs when there is excessive entry of uncoordinated labor market intermediaries vying to play the role of market maker. When this happens (and we have shown that this is aleady a significant problem in the placement market for graduate students) 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.

If this is the case, then could it be that the entry of EJM is contributing to market fragmentation or amerliorating it? We think it is too soon to know the answer to this question, however the fact that EJM is a very efficient and low cost operation (depending mostly on volunteer effort and voluntary donations

from candidates and recruiters) suggests that its entry could make life very difficult for the various for-profit intermediaries, and possibly eventually drive them out of business. Further, we documented in section 3 that EJM is growing at exponential rates, more than doubling in size each year and gaining a significant share of the market in a very short amount of time.

These facts suggest that EJM is serving a need that is not well met by existing intermediaries and that it does have a chance of establishing itself as a dominant "market maker". 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 happen in the economics job market remains to be seen.

While we have quoted other studies that have shown that labor market intermediaries such as 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), we have admitted that even if EJM is successful, it is unlikely to 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. Though we did document that web-based candidate evaluation systems are significantly easier to use and that they make it easier to search and evaluate candidates compared to previous paper-based technology, nevertheless the dominant cost 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.

However though our model is still very tenative and our results are by no means definitive, we have provided an example where the reduction in application costs actually improves match quality and results in unambiguous gains to employers as candidates respond to the reduction in application costs by applying to more employers. This finding is driven, however, by the assumption that employers can costlessly eval-

uate the applications they receive. We do not yet know if the result will continue to hold when evaluation of applications is sufficiently costly.

Finally we have considered several other strategies for improving the economics job market. These strategies ranged from 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 position auctions.

We have defined the latter types of mechanisms to be "centralized approaches" since either of them may require a high degree of coordination and possibly even "compulsion" to implement. While these mechanisms are potentially of the most interest (and potentially could yield the greatest improvements in match quality) we do need to keep in mind the practical constraint that in many cases we do not have the power to *design* markets since no one individual or organization owns or controls the market, which is more akin to a public "commons".

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. As a result, 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.

However we do believe the market design perspective is a very fruitful one intellectually, and hope that any success we might have in improving the economics job market via more modest innovations such as EJM could represent a starting point for more ambitious changes to the market that could yield much greater improvements. While we have suggested that EJM, if successful, might constitute a technological infrastructure from which more ambitious "market experiments" might be attempted, it is also possible that by making sufficient though less radical improvements to the *status quo* (i.e. the fundamentally decentralized way the economics job market currently works) it could dissipate the need for and the incentive to make the radical changes necessary to adopt a "centralized" mechanism.

This will depend on how efficient the *status quo* decentralized search and matching process is (or can be made to be via less radical innovations such as EJM or adoption of guided search strategies). For example, Hitsch et al. [2010] find that decentralized, privately determined matching outcomes from a dating service are close in many respects to the matches produced by a centralized approach — the Gale-Shapley matching algorithm.

We conclude that more empirical 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 nearly efficient matching outcomes in the economics job market or whether significant inefficiencies exist that would provide a strong case for adopting more ambitious mechanisms such as matching algorithms or position auctions to further improve the operation of the economics job market.

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Table 5: Avg. No. of Applications Sent by Candidates

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
All	3.93	6.01	14.24
Panel A: Geographical Location of candidates			
US	3.95	6.14	15.92
Canada	4.42	6.09	12.69
UK	3.34	6.51	12.23
Europe (excluding UK)	3.83	5.99	11.85
Australia & New Zealand	3.63	2.42	4.05
Asia	2.56	3.26	5.32
Latin America	2.75	4.31	10.76
Panel B: Primary Field of candidates			
Behavioral Economics	4.05	6.74	15.20
Business Economics	4.48	6.30	14.89
Computational Economics	5.09	4.88	11.85
Development; Growth	2.35	4.15	8.36
Econometrics	3.53	7.86	16.86
Economic History	2.81	3.42	7.52
Environmental; Ag. Econ	3.78	6.26	15.22
Experimental Economics	3.78	5.71	12.11
Finance	3.92	7.96	17.16
Health; Education; Welfare	3.98	7.32	17.70
Industrial Organization	2.00	2.56	5.00
International Finance/Macro	4.55	7.03	19.22
International Trade	4.26	6.95	20.07
Labor; Demographic Econ	3.85	4.57	13.82
Law and Economics	5.07	7.26	20.13
Macroeconomics; Monetary	3.74	3.84	14.42
Microeconomics	1.11	4.15	8.62
Political Economy	1.00	2.92	8.14
Public Economics	3.00	5.37	11.98
Theory	-	4.38	6.29
Urban; Rural; Regional Econ	-	1.50	1.86

Table 6: Avg. No. of Applications Received by Recruiters

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
All	88.10	87.12	193.05
Panel A: Geographical Location of recruiters			
US	90.48	192.26	262.17
Canada	75.40	186.00	185.28
UK	228.67	65.80	265.63
Europe (excluding UK)	1.00	40.26	104.25
Australia & New Zealand			219.00
Asia	31.50		66.00
Latin America		30.75	95.50
Panel B: Primary Field of Search			
Behavioral Economics	67.50	114.20	275.89
Business Economics	34.75	74.33	245.76
Computational Economics	36.00	4.00	55.83
Development; Growth	84.71	77.92	253.89
Econometrics	56.00	44.88	278.60
Economic History	25.60	70.33	128.19
Environmental; Ag. Econ	45.00	101.38	238.41
Experimental Economics	91.75	85.50	173.67
Finance	90.70	126.33	279.11
Health; Education; Welfare	113.67	107.05	261.16
Industrial Organization	38.00	34.86	170.67
International Finance/Macro	67.50	103.95	217.26
International Trade	68.00	72.42	224.56
Labor; Demographic Econ	86.20	131.44	228.00
Law and Economics	56.00	59.40	292.80
Macroeconomics; Monetary	56.00	66.11	317.08
Microeconomics	114.16	160.75	253.86
Political Economy		54.20	119.20
Public Economics		103.43	199.88
Theory		22.00	90.00
Urban; Rural; Regional Econ		29.00	176.33

Table 7: Recommenders

	2008/2009 (1)	2009/2010 (2)	2010/2011 (3)
No. letter writers	2501	3366	6095
No of letters per recommender			
- Max	83	193	319
- Min	1	1	1
- Average	5.8	8.6	21.1