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DISSERTATION

Job Search on the Internet, E-Recruitment, and Labor Market Outcomes

Farrukh Suvankulov

This document was submitted as a dissertation in July 2010 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of James Dertouzos (Chair), Richard Neu, and Sebastian Negrusa.

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ABSTRACT

Over the past decade, Internet penetration rates have been on a sharp rise. The Internet has significantly changed the job application process and improved the channels of communication between employers and job-seekers. Yet despite significant interest in the topic, past studies offer little evidence on the role of the Internet in the job search process and its impact on labor market outcomes.

This study uses cross-sectional and panel data from the United States, Germany, and South Korea, as well as a U.S. Army personnel dataset. The first part of the dissertation builds a demographic and socio-economic profile of Internet job-seekers and assesses how this profile has evolved since late 1990s. Findings from the United States (1998–2003), Germany (2003–2007) and South Korea (1999–2006) indicate that use of the Internet for job search purposes has been correlated with a set of demographic and socio-economic observables: Internet job-seekers tend to be younger and to have higher incomes and levels of educational attainment. The study also finds that minority job-seekers in the United States and immigrant job-seekers in the United States and Germany are less likely to use the Internet.

The second part of this dissertation provides an estimate of the impact of job search on the Internet on the likelihood of finding a job and ending an unemployment spell. The analysis indicates that Internet use increases the likelihood of 12-month reemployment by 5.0–7.1 percentage points. The results from South Korea and Germany remain statistically significant in the models with instrumental variables. The effect on the reemployment probability is more prominent in earlier years (1998 in the United States, 1999–2000 in South Korea). Furthermore, use of the Internet significantly increases the hazard of ending an unemployment spell in Germany and South Korea.

The last part of the dissertation focuses on the relationship between Internet recruitment and posterior job performance in the context of the U.S. Army. The results show that recruits hired via the Internet demonstrate favorable patterns of service. In comparison with other soldiers, they are less likely to drop out within the first 24 months of service, more likely to reenlist after the first term of service, and have a faster pace of one-grade promotion and longer duration of service.

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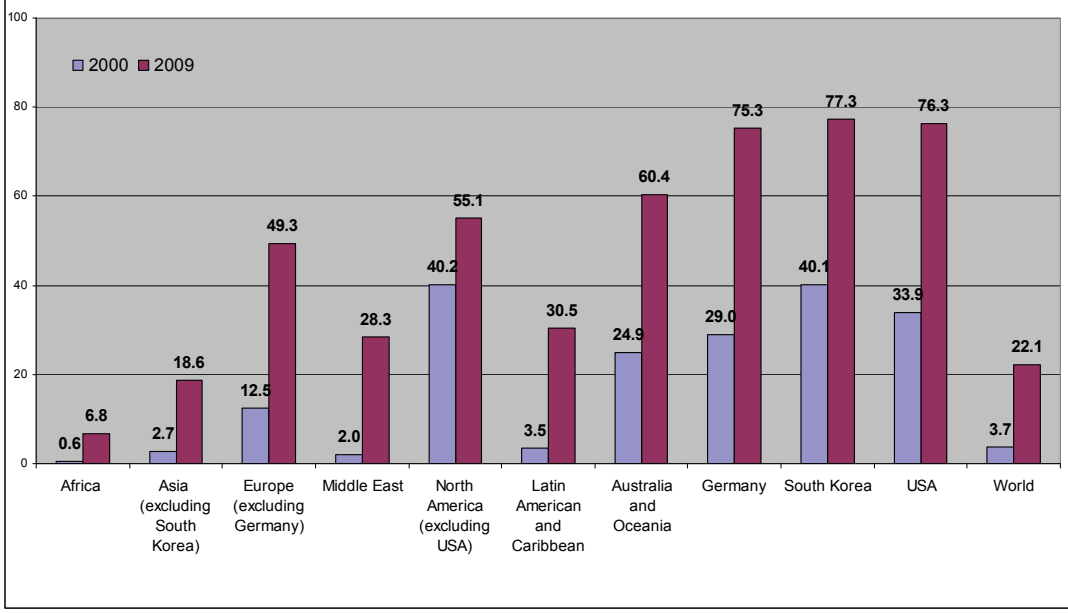
CHAPTER 1 – INTRODUCTION, RESEARCH QUESTIONS, AND POLICY RELEVANCE

1.1 Introduction

The Internet has undoubtedly affected many aspects of our daily lives. It is changing the way we communicate, gather and disseminate information, conduct business, shop for goods and services, and manage our personal affairs. There is no facet of life that is unaffected as Internet penetration rates, defined as the ratio of the regular Internet users to the total population of the geographical area, have skyrocketed over the past decade. Between 2000 and 2009, Internet penetration rates increased, on average, sixfold across all continents (Figure 1.1). In June 2009, over 22 percent of the world population, or 1.4 billion individuals, reported using the Internet on a regular basis, compared with 360 million users in December 2000.[1] North America, Europe, and Australia had the highest penetration rates, although Asia and Latin America have been rapidly gaining on them in recent years.

Figure 1.1 Internet penetration rates in 2000 and 2009, %



Obviously, there are multiple avenues through which the Internet has transformed the labor market. David Autor (2001) writes that the Internet has changed (i) how labor services are delivered, (ii) how local markets shape labor demand, and (iii) how workers and firms search for one another. According to Autor, remote access to email accounts and company documentation enabled many employees to work from home. Indeed, some 48 percent of employers in the United States offered the option of telecommuting at least one day a week, according to a 2008 survey by the

[1] http://www.internetworldstats.com/stats.htm, Internet World Statistics, 2009

Society for Human Resource Management. Autor also writes that the Internet and other telecommunication technologies have diversified the geography of labor demand by subdividing work into components, transmitting the tasks electronically, and coordinating geographically dispersed production processes. Digital check processing and online banking in the financial sector, online customer help centers, and e-commerce are some of the examples of how companies are taking advantage of the Internet and thus significantly changing labor demand in the local markets.

This work focuses on the third aspect of the liaison between the Internet and labor markets mentioned by Autor: the role of the Internet in the job search process.

The use of the Internet in the job search process can take multiple forms. Job boards and corporate career web pages are at the center of the online job search process. They offer several advantages over more traditional search tools such as personal referrals, job fairs, direct employer contacts, public and private employment offices, and newspaper ads. First, the Internet offers access to information on many more openings and in many more locations. Second, the Internet allows employers and job-seekers to update online ads and resumes more frequently and easily. Third, most job boards and career websites offer a more user-friendly experience than their traditional counterparts, for both the job-seeker and employer. For example, on most online job boards, job-seekers are able to filter openings by specifying certain educational and job experience requirements, pay levels, and job locations. Next, Internet job boards have significant advantages with regard to the actual job-application process: On most job boards, the job-seeker can upload or create online his or her CV and cover letter, which can then be easily submitted to an unlimited number of advertised positions. Finally, Internet recruitment is associated with significantly lower costs for both job-seekers and employers. For instance, with regard to the advertising cost, Linda Barber (2006) writes that the average job posting on the Internet costs around £250, as opposed to £5,000 for a quarter-page ad in a British national newspaper.

Internet job boards vary greatly in size and functionality. Monster.com and Careerbuilder.com are two of the largest job boards on the Internet. In fact, Monster.com is among the top 20 most visited websites on the Internet. It is the largest job search engine, with more than 1 million job postings at any time and over 150 million resumes in the database as of November 2008. The company employs approximately 5,000 employees in 36 countries. Careerbulder.com is considered to be the largest online job board in the United States and, according to 2008 estimates, had traffic of more than 23 million unique visitors each month. Yahoo Hot Jobs and Jobcentral.com are also very popular destinations for many job-seekers, and

Craigslist.com has also been on a sharp rise. By tailoring job openings to specific geographic locations, Craigslist was able to emerge as a crucial intermediary in many local job markets across the United States and abroad, despite the fact that it doesn't offer as much functionality as many other online job boards.

Career web pages on corporate websites have also become a norm for most employers. In many ways, employers' career web pages resemble job boards, although the functionality of these web pages varies greatly: Some of them are limited to information about openings, job descriptions, and contact info, while other, more sophisticated pages allow the user to create or upload a resume and apply for the job online.

Job boards and employers' career web pages clearly offer advantages. However, there are also some negative aspects associated with online search and e-recruitment. The primary concern for employers is an adverse selection of job applicants. The Internet has significantly reduced the cost of obtaining job-related information and the cost of the application process. Browsing job advertisements on most of the job boards and career web pages is free. In addition, most websites allow job-seekers to create resumes and cover letters in the standard format and apply for multiple jobs with very low marginal cost. As a result, the job search marketplace could be considered overloaded, with many job-seekers and applications per position. Some employers also believe that resumes posted to job boards represent an unscreened and adversely selected pool of job-seekers (Li, 2000; iLogos 1999), reasoning that Internet job boards are the last resort for job-seekers who lack the leadership and professional characteristics needed to obtain personal referrals and network connections.

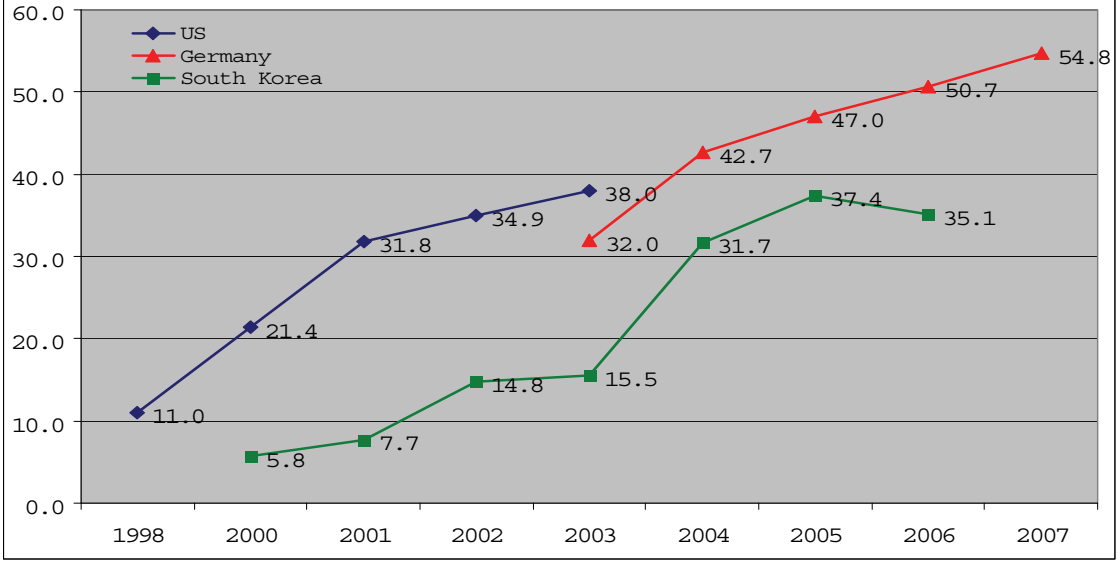
At the outset of Internet explosion in the mid 1990s, some economists and policy makers predicted that the Internet held great potential for improving the channels of communication between employers and job-seekers. But to date, despite enormous interest in the topic, the empirical evidence on the role of the Internet and e-recruitment in the job search process is scarce. The number of past studies on this topic has been rather limited, mostly due to the scarcity of relevant datasets. This dissertation aims to contribute to this discussion by providing an empirical analysis and offering insights for policy implications.

1.2 Research Questions

To discuss issues related to job search on the Internet, this study uses longitudinal and panel data from the United States, Germany, and South Korea. As shown in Figure 1.1, these countries have very high penetration rates. In 2009, South Korea boasted the highest penetration rate, 77.8 percent. The United States and Germany closely followed, with respective

rates of 76.3 and 75.3 percent. As Internet use has grown, its role in the job search and recruitment processes has become increasingly important. By 2003, four out of ten unemployed people in the United States had used the Internet for job search activities (Figure 1.2). Similar growth patterns have been recorded in Germany and South Korea. In 2006, half of unemployed Germans and one-third of unemployed South Koreans used the Internet in some way to look for a job.

Figure 1.2
Use of the Internet by unemployed job-seekers, %



Given an increased role of the Internet for job-seekers in the United States, Germany, and South Korea, this study considers the following research questions:

1. Who has been looking for jobs online?

The study builds a demographic and socio-economic profile of Internet job-seekers and assesses how this profile has evolved since the late 1990s. This part of the dissertation also discusses the so-called "digital divide" based on race, immigration status, and other socio-economic characteristics.

2. Does the use of the Internet affect job search outcomes?

i. How does job search on the Internet affect the likelihood of finding a job and the duration of an unemployment spell?

ii. How effective is use of the Internet compared with traditional job search channels, such as public and private employment offices and print newspapers?

iii. How do these results vary across the United States, Germany, and South Korea?

The third part of the dissertation explores how well the Internet and e-recruitment match employees and employers. This part of the dissertation focuses on the experience of the U.S. Army, which actively uses the Internet as a recruiting tool. The study uses two administrative personnel datasets and attempts to investigate the following research questions.

3. Do recruits hired via the Internet have distinguishable differences in their job performance?

i. What is the relationship between Internet recruitment and the posterior duration of employment?

ii. How does Internet recruitment affect other job performance indicators, such as promotion pace and the decision to reenlist?

Army datasets provide a unique opportunity to link recruitment records with the data on soldiers' performance. The first dataset includes detailed information about which recruiting method generated certain leads, demographic and educational characteristics of enlistees, and results from Army aptitude tests. The second dataset tracks soldiers' performance over the duration of their active duty service. This information about performance is available for every soldier who was on active duty service in the U.S. Army between January 2002 and September 2008.

1.3 Overview

The first chapter of this dissertation provides an introduction to research questions and discusses their policy relevance. Chapter 2 examines recent literature on the use of Internet in human resource management and job search activities. Chapter 3 discusses the demographic and socio-economic profile of Internet job-seekers in the United States, Germany, and South Korea and assesses how this profile has evolved since the mid 1990s. Chapter 4 focuses on the effectiveness of the Internet in ending an unemployment spell. Chapter 5 discusses the link between Internet recruitment and the quality of employee-employer match by examining data on U.S. Army active duty personnel. Chapter 6 reviews key findings from the study and reflects on the potential policy implications.

CHAPTER 2 – FINDINGS FROM THE LITERATURE ON HUMAN RESOURCE MANAGEMENT AND JOB SEARCH

2.1 The Internet in the human resource management literature

First assessments of the Internet as a tool in human resource management (HRM) date back to late 1990s. As early as 1997, Mike Frost wrote that Internet had the potential to bring swift changes in recruiting processes. He cited faster processes, more efficient matches, and lower cost as the main advantages of online recruiting. On the negative side, Frost claimed that most firms considered the Internet as a secondary recruiting source.

A number of earlier studies focused attention on problems of integrating Internet hiring with regular hiring practices. Crispin and Mehler (1997) suggest that the Internet had brought a lot of novelty and ambiguity into the hiring process. They argue that HR managers are yet to figure out how to adjust hiring strategies to online applicant tracking systems, interactive voice recognition services, PC-to-PC interview software, web-based testing tool, search engines, intrusive advertising techniques, and numerous job and resume databases. Greengard (1998) continues that using the Internet for efficient recruiting requires combining technological advances with a well-developed recruitment strategy; the process is reciprocal, since to develop proper strategy, HR managers need to understand the technical capabilities of Internet recruiting services. A study by Schreyer and McCarter (1998) also agrees that online advertising has become HR managers' sharpest recruiting tool, however, the study notes that a proper strategy is of primary importance for overall success. Discussing opportunities provided by the Internet for global recruiting, Laabs (1998) emphasizes the importance of understanding the local labor markets and tailoring approaches to integrate online and traditional practices. Hays (1999) writes that use of the Internet expedites and reduces the cost of the recruiting process. Hays maintains that Internet recruiting significantly reduces paperwork, but that the efficiency impact of the innovation is far from certain. Advocating for a wider use of the Internet, the paper suggests that a well-functioning HR department should use a mix of online and traditional hiring strategies with a significant human touch. Dave Bartram (2000) presents a snapshot of Internet development as a recruitment and selection medium. He examines the role of the Internet within a traditional recruitment cycle. At the so-called "attraction stage," he writes, the Internet helps to draw people into a large pool by providing a virtual stage for a job posting. Actual recruitment is a second stage, in which employers sift applicants' characteristics and credentials to reduce the number of applicants to a practical size for the more formal and more resource-intensive select-in

assessments (interviews, psychometric tests, assessment centre exercises, etc.). This paper suggests that, at the second stage, the Internet is frequently used to filter the number of applicants down by selecting out those who fail to meet key criteria. Most Internet sifting is carried out using educational, demographic, and job experience criteria. Some Internet-based software compares the competencies and capabilities of the applicant to the requirements of the job vacancy and produces a shortlist of applicants. Bartram reports that the role of the Internet is more limited in the third stage: selection of applicants. According to Bartram, most viable options include use of the Internet for video interviews, submission of online references, and objective assessments (psychometric tests of personality and ability).

Dysart (1999) discusses the use of Internet search engines, online application forms, email auto-responders, and mailing lists by HR departments. This study argues that these innovations allow HR departments to link corporate datasets to external websites, enabling applicants to interact with the company more efficiently. In line with above-mentioned articles, Dysart cautions that integration of the Internet should be well planned.

Several other articles discussed the Internet experience in Europe. In 1999, Arkin examined the trend among British executive search firms to use online modes of search for candidates. Interestingly, the paper reports a low usage and awareness of such services due to widespread doubt over whether it is possible to identify leadership and other skills needed in top management positions via the Internet. This remains a frequent critique of online job search even today. Pin et al. (2001) also analyze e-recruitment tools used in Europe. The study describes the historic pattern in the European Internet recruitment market, summarizes the changes in recruiting strategies, and discusses opportunities and risks for firms and job-seekers. The authors suggest that the major plus of the e-recruitment is the ability to reduce the duration of the recruitment process due to expedient job posting, faster applicant response, and faster resume processing. Reduced cost of hiring is described as a second major advantage of Internet penetration; access to remote and passive job-seekers, automatic screening of under-qualified applicants, and increased opportunities for smaller companies are also presented as advantages of Internet hiring. Pin et al. also examine the shortcomings of e-recruitment. According to the paper, the main disadvantage of the Internet recruiting is poor segmentation. Due to a larger number of resumes, some well-qualified candidates may be overlooked. Pin et al. cite the lack of human interaction, overwhelming numbers of resumes, and privacy issues as negative sides of online recruitment. The study also discusses issues

related to discrimination of non-users and higher rates of employee turnover. Pin et al. predict that the future of e-recruiting will rely mostly on so-called "niche sites" that focus on specific industries, services, or geographic areas and that many unspecialized job boards will either go bankrupt or be forced to merge with other ventures.

The lower cost of Internet hiring has been extensively discussed in the literature. Fister (1999) documents two case studies related to Internet recruitment by large corporations: Walgreens and General Electric. In line with the previous literature, the article emphasizes three major advantages: quick turnaround, lower cost, and access to a larger pool of applicants. Cober et al. (2000) also emphasizes the lower cost of recruitment associated with Internet. In addition, the paper suggests that having a presence on the Internet improves the profile of an organization. Along similar lines, Peter Cappelli (2001) writes that the payoffs of Internet recruiting could be huge and that estimates suggest that it costs only about one-twentieth as much to hire someone on the Internet as it does to hire that same person via print newspapers and other traditional media. Cappelli also cites a study by Recruitsoft/iLogos Research of 50 Fortune 500 companies that found that the average company cuts about 6 days off its hiring cycle of 43 days by advertising on the Internet instead of newspapers, another 4 days by accepting online applications instead of paper ones, and more than a week by using online screening and processing technologies. On the negative side, Cappelli writes that one of the biggest complaints about online recruiting is that recruiters spend too much time finding potential candidates and not enough time developing relationships with candidates and persuading them to take jobs. As a result, too many good applicants slip away.

Freeman (2002) provides a comprehensive overview of labor market changes in the new information economy. He writes that companies advertise positions on the web for roughly one-tenth the price of buying a want ad in newspaper classifieds. The development of online recruiting emphasizes the advantages of network or scale economies in job search and recruitment. Job-seekers want sites with many job postings and few competing applicants, whereas firms prefer sites with many job-seekers but few competing vacancy advertisements. Freeman suggests that network and other forms of scale economies will ultimately lead to a few Internet recruitment sites becoming dominant. Freeman writes, "Internet recruitment has the potential for making its biggest contribution to the labor market by producing better job matches. By diffusing information about jobs widely, the Internet should help break down 'old boys networks' and traditional geographic barriers. Someone sitting in an Internet café in a small village in Portugal, for example, can peruse jobs in London or Paris."

Linda Barber (2006) at the Institute for Employment Studies also examines the benefits and challenges of Internet recruiting. Barber writes that the reduced cost of hiring is a leading strength of the Internet, as the average job posting on the Internet costs around £250, compared with £5,000 for a quarter-page ad in a British national newspaper. Barber cites faster process as another key feature of online recruiting, noting the ease of posting jobs online, completing online application forms, and attaching CVs to emails. She also writes that the Internet helps in the processing of applications, enabling employers to filter them according to predetermined criteria and send feedback to applicants in a quick, personalized, and direct manner. The article continues that access to a wider pool of applicants and promotion of a company's reputation and brand are frequently mentioned by HR specialists who analyze the strengths of the e-recruiting. In addition, the paper discusses challenges frequently encountered in the process of e-recruiting. A large number of unqualified applicants tops the list. A vastly increased number of applications force more careful screening of CVs, which is a very resource-intensive process. Barber also discusses a lack of personal touch and unintended discrimination against minorities and low-income job-seekers.

A number of articles discuss the implications of Internet development for labor markets in general. Kinder (2000) examines a new model for decomposing e-commerce. The paper suggests that use of the Internet in recruitment processes is likely to change the interface between internal and external labor markets for many firms. The paper predicts that the conceptions behind current research programs in labor market theory may require rethinking in the Internet era.

Bingham et al. (2002) describe a case of Internet innovation in the Washington State Department of Personnel. The Internet allowed for automated application submittal, screening and testing, evaluation, eligibility list placement, and referral for interview. The authors claim that implementation of the online hiring system will help to hire high-quality, diverse, and readily available job candidates in the shortest possible time. For job-seekers, they write, the Internet application system provides an opportunity to apply in very convenient, easy-to-use, and timely manner from various geographic locations.

Galanaki (2002) of Athens University of Economics and Business conducted a comprehensive review of the literature on the use of the Internet by employers. Lower cost, shorter recruitment cycle, reach to a wider range of applicants, better quality of applicants, opportunity to address specific market niches, and attraction of passive job-seekers are described as the strong sides of the Internet recruitment. However, the review indicates that the Internet is not the first option for many well-

qualified applicants. Coupled with a huge number of unqualified applicants, Internet recruiting might not be the method for certain types and levels of jobs. The paper concludes that online recruiting is just a channel and that the success of its implementation depends on thorough planning and the use of established HR practices.

Lievens et al. (2002) discuss recent developments in personnel selection. The authors discuss the "digital divide," which they defined as the gap between people with effective access to digital and information technology, including the Internet, and those with very limited or no access. The authors suggest that the digital divide in the United States is largely defined along demographic and economic household characteristics.

Several articles have attempted compare print and online media. Zusman and Landis (2002) assess the extent to which applicants preferred web-based job postings to traditional print materials. Contrary to their hypothesis, the authors find that print postings were preferred to those in the Internet-based format. Results of the study also suggest that a firm's website is an important point of contact for job-seekers. Survey results indicate that applicants clearly preferd companies with more attractive web pages to companies with less attractive pages. Zusman and Landis recommend that firms should make a serious commitment of time and capital to the career sections of their website. Study findings also indicate that providing detailed information about posted jobs and the firm is very important. Further, authors find that easily readable, colorful, and interesting web pages tend to do better in attracting job-seekers, since a web page is frequently the first experience that applicants have with a firm. Harris (2005) focuses on perceptions of Internet recruiting among employers. He writes that online recruiting is considered as moderately effective but inferior to networking and personal contacts as well as to professional recruiters. However, according to Harris, online hiring is far more effective than newspaper advertisements. The paper says that the three most frequently mentioned difficulties associated with Internet job searches are slow feedback, limited number of fitting jobs to make the search worthwhile, and lack of relevant information on the company's website.

Jansen and Jansen (2005) examine how job-seekers use the Internet and assess the effectiveness of such activity. They use query data from a major online search engine at three points in time over a five-year period. The study indicates that job-seekers tend to submit a single query using several keywords. Forty-five percent of the job-seekers specify location. The analysis of search results shows that only 52 percent of the referenced websites are relevant and that only 40 percent retrieve actual job postings.

Veger (2006) reviews Internet recruitment methods and describes how they can enhance recruitment performance. According to Veger, job boards and corporate career websites are used frequently by recruiters to post jobs and to search for resumes. Efficiency gains include time savings, cost reduction, and minimizations of other resources. Internet recruitment is also associated with a broader audience and more accurate and detailed information about applicants. Veger emphasizes that the benefits of Internet recruiting may differ between organizations due to a variation in corporate strategy and overall recruitment objectives. Kroustalis (2006) assesses whether applicants can gain a sense of person-organization fit through a recruitment website. The study finds that culture-specific pictures on a recruitment website allow job-seekers to accurately assess organizational culture, while employee testimonials have no such effect. Starr (2006) reviews the online recruiting industry since the mid 1990s and suggests that in recent years job boards have become very multifunctional: They help to manage the entire job-hunting process, including actual job search, interview tips, and resume- and cover-letter-writing tips. Brencic and Norris (2008) also examine more recent developments and historic trends among online job boards industry in the United States, Canada, and Europe. The authors collected descriptions and outcome of job openings posted on Monster.com between 2004 and 2006. Their results suggest that the gains to online search tools offered by Internet boards are not uniform across all employers and vacancies. In particular, the biggest beneficiaries of the online job boards appear to be employers who have access to a better online search technology.

Piotrowski and Armstrong (2006) examine survey data on recruitment methods used in 151 major American firms. Their analysis indicates that the majority of firms rely heavily on traditional recruitment techniques over the use of online assessment instruments. Nevertheless, one-fifth of the firms intend to introduce personality online testing in the future. Katz (2007) suggests that individuals with specific, advanced skills or in certain professions need to focus their efforts on specialty job boards. She reviews such boards for emergency physicians, including www.PhysicianWork.com, www.EDphysician.com, www.EMCareerCentral.org, and www.AAEM.org/membership/jobbank.

Verhoeven and Williams (2008) document the advantages and disadvantages of Internet recruitment based on a literature review, and they compare their findings with views expressed by employers in the United Kingdom. They find evidence that the most of the advantages and disadvantages reported in literature are also experienced in the UK. In another paper, Williams and Verhoeven (2008) discuss the different tools available to recruiters and establishe user patterns for these tools. The study results

suggest that the distinction between traditional and alternative sources still seems appropriate, as some tools within Internet recruitment are more established than others. The study compares "you-find-us" and "we-find-you" approaches (Table 2.1) for Internet hiring. They find that firms tend to underutilize the "we-find-you" approaches to Internet recruitment.

Table 2.1 Internet recruitment methods

WE-FIND-YOU APPROACH	**YOU-FIND-US APPROACH**
Searching through resumes on a job board	Posting jobs on a job board
Searching through resumes on organizational career websites	Posting jobs on the organizational career website
Generating names using search engines or chat rooms	Advertising jobs online
Using the service of name generation firms	Putting jobs on computers in physical kiosks
Web-event recruiting	Participating in online job fairs
Using the service of aggregator sites	
Relationship recruiting	

Overall, findings from the abundant literature indicate a wide variety of issues related to the use of Internet in human resource management. However, among the key points to be kept in mind is the fact that the Internet has evolved considerably since most of these studies were conducted. Tables 2.2 and 2.3 summarize pros and cons of Internet-based techniques in human resource management obtained for employer and job-seekers, respectively. Many of the reviewed papers date back to the late 1990s, so to reflect the latest development of the Internet industry Tables 2.2 and 2.3 also provides, in the "Applicability" columns, an assessment (by the author of this dissertation) of the relevancy of each pro and con as of April 2010.

Table 2.2 Pros and cons of Internet hiring for employers and their applicability (scale from 1 - not applicable to 5 - very applicable) as of April 2010

Advantages		Disadvantages	
Source	**Applicability**	**Source**	**Applicability**
Geographical spread Verhoeven and Williams (2008), Fister (1999), Cappelli (2001), Pin et al. (2001) Bingham et al. (2002), Freeman (2002), Veger (2006), and Barber (2006)	5	**Difficulty of reconciling e-recruiting with overall HR strategy** Crispin and Mehler (1997), Greengard (1998), Schreyer and McCarter (1998), and Sprague (2007)	5
Larger audience Bartram (2006), Burke (1998), Laabs (1998), Pin et al. (2001), Zusman and Landis (2002) Fister (1999), Bingham et al. (2002), Galanaki (2002), Freeman (2002), Veger (2006), and Barber (2006)	5	**Development fees for small companies** Barber (2006)	2
Greater chance to find right candidate; quicker/greater effectiveness Crispin and Mehler (1997), Galanaki (2002), Bingham et al. (2002), Veger (2006), and Barber (2006)	Uncertain	**Corporate name recognition required** Galanaki (2002), and Barber (2006)	4
24/7, no waiting for issue dates Pin et al. (2001), Cappelli (2001), Galanaki (2002), Veger (2006), and Barber (2006)	5	**Outdated résumés** Hays (1998)	Uncertain
Relatively cheap Crispin and Mehler (1997), Fister (1999), Galanaki (2002), Kuhn (2003), Schreyer and McCarter (1998), Joe Dysart (1999), Cappelli (2001), Galanaki (2002), Veger (2006), Pin et al. (2001), Frost (1997), Cober et al. (2000), Hays (1999), and Freeman (2002)	4	**Discrimination/privacy** Bartram (2000), Dash (1999), Feldman and Klaas (2002), Pin et al. (2001), and Barber (2006)	4
Higher quality of applicants Bartram (2000) and Bingham et al. (2002)	Uncertain	**Internet not the first option for applicants** Frost (2002), Feldman and Klaas (2002), Galanaki (2002), Harris (2005), Piotrowski and Armstrong	5

		(2006), and Brencic and Norris (2008)	
Better match workers/vacancies Freeman (2002)	Uncertain	**Overwhelming number of candidates** Brooke (1998), Galanaki (2002), Bartram (2000), Cappelli (2001), Pin et al. (2001), and Barber (2006)	5
Shift from manual screening to using "HRM expertise" Bingham et al. (2002), Pin et al. (2001), and Joe Dysart (1999)	4	**Number of unqualified candidates** Brooke (1998), Galanaki (2002), Bartram (2000), Cappelli (2001), Pin et al. (2001), Galanaki (2002), and Brencic and Norris (2008)	5
Positive effect on corporate image/up-to-date image Galanaki (2002), Pin et al. (2001), and Barber (2006)	3	**Time consuming siftng of application forms** Cappelli (2001)	5
Access passive job-seekers Galanaki (2002), Pin et al. (2001), Bingham et al. (2002), and Feldman and Klaas (2002)	5	**Poor segmentation of the market** Pin et al. (2001), Crispin and Mehler (1997), and Galanaki (2002)	5
Target candidates/address niche markets Galanaki (2002), Pin et al. (2001), and Katz (2007)	4	**Transparency of data** Pin et al. (2001)	5
Reduction of unqualified candidates Pin et al. (2001)	Uncertain	**Higher expectations regarding relocation costs** Brooke (1998)	4
More opportunities for smaller companies Pin et al. (2001)	4	**Lack of personal touch** Feldman and Klaas (2002), Milman (1998), Pin et al. (2001), Cappelli (2001), Galanaki (2002), and Brencic and Norris (2008)	5
Quicker turn-around time/cost saving Galanaki (2002), Pin et al. (2001), Zusman and Landis (2002), Fister (1999), Joe Dysart (1999), and Cappelli (2001)	5		

Table 2.3 Pros and cons of Internet hiring for job-seekers and their applicability (scale from 1 - not applicable to 5 - very applicable) as of April 2010

Advantages		Disadvantages	
Source	**Applicability**	**Source**	**Applicability**
Easier to apply Crispin and Mehler (1997), Fister (1999), Cappelli (2001), Pin et al. (2001), Bingham et al. (2002), Galanaki (2002), Veger (2006), and Barber (2006)	5	**Privacy problems** Pin et al. (2001) and Brencic and Norris (2008)	5
Larger geographic area within easy reach Fister (1999), Cappelli (2001), Pin et al. (2001), Bingham et al. (2002), Galanaki (2002), Freeman (2002), Veger (2006), and Barber (2006)	5	**Level and type of job available online** Galanaki (2002), Pin et al. (2001), Feldman and Klaas (2002), Brencic and Norris (2008)	3
More passive process Pin et al. (2001), Galanaki (2002), Pin et al. (2001), Bingham et al. (2002), and Feldman and Klaas (2002)	5	**User-unfriendly tools** Feldman and Klaas (2002)	5
More specific searches Cappelli (2001), Bingham et al. (2002), Galanaki (2002), Barber (2006), and Katz (2007)	3	**Discrimination of those who do not have access** Pin et al. (2001), Cappelli (2001), and Barber (2006)	4
24/7, time saving and relatively cheap Fister (1999), Crispin and Mehler (1997), Cappelli (2001), Pin et al. (2001), Bingham et al. (2002), Galanaki (2002), Freeman (2002), Veger (2006), and Barber (2006)	5	**Lack of personal touch** Feldman and Klaas (2002), Milman (1998), Pin et al. (2001), Cappelli (2001), Galanaki (2002), and Brencic and Norris (2008)	5
Quick turn-around time Fister (1999), Pin et al. (2001), Bingham et al. (2002), Galanaki (2002), Veger (2006), and Barber (2006)	5		
Easy access to information about employer Kroustalis (2006) and Barber (2006)	5		
Feel for labor market Feldman and Klaas (2002)	3		

2.2 Job search on the Internet and search outcomes

As discussed earlier, the Internet has become an integral part of the job search process. In 2002, Feldman and Klaas conducted a survey of 256 business school alumni of a large university in the Southeast. Questions were related to job search strategies and the use of the Internet in the process. Study findings suggest that use of the Internet is highly correlated with non-intensive job searching, especially for those who want to examine job opportunities in a covert manner, without fear of retribution from current coworkers. The study also finds that online search is correlated with a larger geographical scope of the search. Survey results further indicate that use of the Internet is perceived as a somewhat less effective job search strategy than personal networking, although it is by far superior to searching for jobs through newspaper ads and cold calls. Major disadvantages of Internet recruiting are the response rate, lack of specific and relevant job descriptions on a company's website, concerns about the security of personal information, and difficulty in customizing, formatting, and uploading resumes to companies' specifications.

Three of the few empirical papers about the effect of online job search were written by Kuhn and Skuterud (2000, 2002, and 2004). They assess the incidence of job search on the Internet and estimate the outcomes for individuals who use the Internet as one of the channels for job search. The study uses December 1998 and August 2000 Current Population Survey (CPS) Computer and Internet Supplements matched with subsequent CPS files. Kuhn and Skuterud find that people who search for jobs on the Internet are better educated, more likely to own a home, more likely to be age 26-55, and more likely to have occupations with lower unemployment rates. The data indicate that, overall, Internet job-seekers have a lower average unemployment duration than individuals who don't use Internet for their job search. In the CPS data, the average unemployed Internet searcher had already been unemployed for 3.44 months, significantly less than 3.75 month duration of the unemployed job searchers who did not use the Internet. However, once the authors control for observable characteristics, they find no difference in unemployment duration. Kuhn and Skuterud conclude that either (1) using the Internet for job search is ineffective in reducing unemployment duration or (2) Internet searchers are negatively selected on unobservable characteristics.

Interestingly, Fountain (2005) uses the same longitudinal dataset but comes up with somewhat different results. Fountain finds that in 1998 the odds of finding a job for a person who conducted a search using the Internet were 164 percent greater than for a person who did not

search online, holding other variables constant. In contrast, in 2000, the odds of finding a job for an Internet searcher were 28 percent lower. Fountain argues that the effect of Internet searching changed in both magnitude and direction during this time. The study confirms previous studies in finding that Internet users are selected on observable characteristics. On average, they have higher levels of education, are more likely to have a college degree, and have higher incomes. They also come from occupations with lower unemployment rates. Further, Fountain finds that, even holding education and income constant, whites are more likely to use the Internet than minorities. Age had an inverted U-shaped relationship with Internet job searching in 1998; the relationship becomes insignificant in 2000.

Job search methods in general have received relatively little attention in the job search literature. Classical job search models were more focused on the assessment of the determinants of the reservation wage and considered the arrival rate of job offers to be exogenous. In particular, the classical model of job search puts into an economic framework individuals' decisions of whether to participate in the labor market and whether to change or leave jobs. It is assumed that the employee lacks perfect information and could encounter unsuitable offers before finding a job. In most theoretical and empirical studies, the job search process has been treated as a uniform activity. However, according to Bradshaw (1973), this is fallacious because of the long-recognized differences in job search methods. He argues that job search methods clearly vary in their time and money costs as well as in their success rates. For instance, it widely reported that informal channels, such as personal contacts, are among most effective search routes, whereas public employment services rank very low.

Graves (2006) attempts to obtain unbiased estimates of the impact of Internet use on the probability of reemployment using an instrumental variable approach. She uses 1998, 2000, 2001, and 2003 CPS Computer and Internet Supplements and matches them with subsequent CPS monthly files. Graves attempts to utilize data on access to the Internet in public libraries as an instrument for Internet job search. Based on the Public Library Data File, Graves calculates the average number of computers with Internet connections per branch by county and the average number of general public Internet terminals per person by county. However, she finds that the instrumental variable performs poorly in explaining the endogenous variable.

Stevenson (2006) finds that over 80 percent of online job-seekers in the United States are employed and that Internet users, conditional on the socio-economic and demographic observables, are more likely to

change jobs and less likely to transition into unemployment. She estimates that a 10 percentage point rise in the state-level Internet penetration rate leads to a 5 percent increase in employer-to-employer flows. Furthermore, she finds that those who use the Internet have greater wage growth when changing jobs. Stevenson compares Internet dispersion at the state level with average state ownership rates of household appliances in the 1960s and finds that the two patterns are similar.

Stevenson (2008) explores how the frequency and characteristics of job search activity have changed since the emergence of the Internet. The study finds that the Internet has induced significant expansion of job search methods used by the unemployed. In addition, the Internet has caused reallocation of search efforts among various job search activities. She finds that the unemployed are now more likely to have looked at ads and to have contacted an employer directly. She also finds evidence that the unemployed are becoming more discriminating about the jobs to which they submit an application, as the Internet enables them to better target specific positions. The paper suggests that the overwhelming majority of job-seekers who use the Internet to collect information about specific positions and employers of interest are those who are already employed; compared with the unemployed, currently employed workers are better able to assess opportunities in the marketplace, and the Internet has a role in this process.

Bagues and Labini (2007) evaluated the impact of the access to AlmaLaurea, an inter-university Internet job dataset in Italy, on university-to-work transition. They use difference-in-difference techniques and estimate that a student's access to AlmaLaurea reduces the student's likelihood of unemployment and improves matching characteristics. The study also finds that access to AlmaLaurea is associated with increased geographic labor mobility in Italy. In particular, according to study's most conservative estimate, AlmaLaurea decreased graduates' unemployment probability by about 1.6 percentage points. Furthermore, Bagues and Labini find that online labor market intermediaries have a positive effect on matching quality, as the wage of graduates from member universities increased by about 3 percent. Use of the AlmaLaurea online dataset increases the mobility of job-seekers by about 2.4 percentage points. Bagues and Labini explain that the findings of the paper are specific to a given segment of the labor market and to a specific Internet intermediary. They warn that external validity has to be cautiously applied, since the job postings on AlmaLaurea are screened by the staff of member universities.

Beard, Ford, and Saba (2010) analyze the 2007 CPS Computer and Internet Use Supplement to estimate the effect of Internet use on job search efforts. Study results are in line with Stevenson's (2008) findings of a positive impact. The empirical model of the study is based on multinomial logit and propensity score matching techniques. The central focus of the study is impact of Internet use on the labor status of workers with no current employment. The authors distinguish between the unemployed and the discouraged, where both desire employment but the latter has ceased active job search due to negative beliefs about the labor market. Study findings indicate that broadband use at home or at public locations (library, employment center, etc.) deters defection from the labor market due to discouragement by over 50 percent. Using a dial-up connection also makes a difference, reducing labor market dropout by about one-third. Beard and colleagues emphasize the policy implications of the study. The Internet is a strong factor in keeping jobless individuals in the labor market and may equate to more employment. On the supply side, study findings suggest that promotion of shared connections in libraries in underserved areas may produce substantial societal benefits.

As mentioned earlier, Craigslist is one of the largest job boards and rapidly gained a significant share of the online job search market. Kroft and Pope (2008) analyze Craigslist, which allows users to post job ads as well as apartment and housing rental ads. Kroft and Pope estimate that the emergence of Craigslist in large cities led to a decline in the Help-Wanted Index, an official measure of job classifieds in print newspapers. On average, between January 2005 and April 2007, Craigslist diminished the number of classified job notes by approximately 10 percent. Kroft and Pope also assess the link between Craigslist and housing rental vacancy rates. They find that, on average, Craigslist reduced the rental vacancy rate by 11 percent (1.2 percentage points). Craigslist led to about a three-week reduction in time to rent out. Finally, the study finds that Craigslist has had no measurable impact on labor market outcomes, as measured by local area unemployment rates. Kroft and Pope offer several hypotheses to explain these findings. Unlike the apartment and housing rental market, the labor market has many other online job boards, and therefore the marginal impact of Craigslist may have been minimal. Kroft and Pope also explain that the large proportion of Craigslist job posting are for temporary and contract-based positions. In contrast, rental ads for long-term lodgings have heavier presence on Craigslist. Authors note that the two markets may be different in ways that make the apartment and housing rental market more responsive to improvements in information flows.

The literature also offers very limited evidence on the quality of online employer-employee match characteristics. The central issue of interest in this regard is whether use of the Internet for job search and e-recruitment is associated with improved posterior job performance of the employee. Only a single study compared Internet recruits with employees hired via more conventional recruitment channels. Haddas (2004) develops a framework in which Internet recruitment is modeled as reducing application cost to workers and improving a firm's screening technology. He argues that Internet recruitment reduces the proportion of well-qualified applicants. Haddas uses 1995–2003 human resource data from a single multinational company with 15,000 employees. He finds that employees hired via the Internet are more likely to have shorter job duration than employees hired via employee referrals but similar to those hired via print advertising. Due to data constraints, the author was able to look at only one characteristic of the employee's performance, namely, the duration of employment.

In contrast to findings from human resource management field, the literature on the Internet and search outcomes is rather limited and findings are somewhat mixed. As reported earlier, Kuhn and Skuterud (2000, 2002, and 2004) and Kroft and Pope (2008) indicate that the Internet is not associated with improved probability of reemployment. However, Fountain (2005), Stevenson (2006, 2008), and Bagues and Labini (2007) find a positive relationship between Internet use and labor market outcomes. These results need to be treated with a caution, as it looks as though results are very sensitive to outcome variable, model selection, and specification. Furthermore, almost all studies are focused on the U.S. labor market and use the CPS Internet Supplement, which is a cross-sectional dataset. This leaves a large area for further empirical investigation. This dissertation intends to partially fill that area by developing and estimating models on the relationship between use of the Internet in job search and labor market outcomes.

CHAPTER 3 - PROFILE AND EVOLUTION OF ONLINE JOB-SEEKERS

3.1 The United States

This section discusses the demographic and socio-economic profile of Internet job-seekers in the United States and assesses how this profile has evolved since the mid 1990s. As reported earlier, data used in this paper come from the CPS Computer and Internet Supplements. The CPS is a monthly survey sponsored by the Census Bureau and the Bureau of Labor Statistics (BLS). Each month, the CPS surveys some 50,000 household units. The survey is designed to represent the non-institutionalized U.S. population. The questions in the CPS focus on demographic and labor characteristics, although for some months CPS administration extends the questionnaire by including supplemental questions on various topics of interest. One such CPS supplement is related to computer and Internet use. This study uses data from the CPS Computer and Internet Supplements for December 1998, August 2000, September 2001, October 2003, and October 2007.[2]

As shown in Table 3.1, approximately 4 out of 5 individuals using the Internet for job search activities are already employed. In fact, in 2003 13.8 percent of employed individuals used the Internet to search for jobs. Unfortunately, the CPS does not provide information on whether these and other employed individuals were searching for jobs using traditional (offline) search channels. Thus, it is not possible to analyze the efficiency of the online job search for this subsample of respondents. The share of unemployed individuals among the online job-seekers varies significantly from year to year and ranges between 6.6 and 9.8 percent. As one would expect, unemployed individuals account for a disproportionally high share of online job search due to greater intensity and necessity of job search. In 2003, unemployed individuals comprised 2.4 percent of the adult population, but they represented 9.7 percent of individuals who searched for jobs online. In fact, over the reviewed period, of the proportion of unemployed individuals who used the Internet in the job search activities grew from 11.0 percent in 1998 to 37.7 percent in 2003.

Another key observation is related to the growing proportion of individuals categorized by the CPS as "not in labor force: other." By October of 2003, 9.2 percent of this subsample of individuals were in this category, which includes students, stay-at-home parents, and others. It seems that for those job-seekers, the Internet is playing an increased role as an inactive search outlet.

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[2] Questions in the October 2007 survey are restricted to the use of the Internet and access to the Internet at home. Therefore, the analysis of job search activities on the Internet is limited to the period of 1998-2003.

In contrast to the labor force structure, the demographics of unemployed Internet job-seekers changed noticeably over the period of 1998–2003. Historically, whites and Asian Americans have had much higher rates of Internet job search. As shown in Table 3.2, 12.8 percent of white and 16.8 percent of Asian American job-seekers used the Internet in 1998. In contrast, only 5.3 percent of black and 3.6 percent of Hispanic job-seekers used online methods. The racial gaps further widened by 2000, when 26.3 percent of unemployed white job-seekers used the Internet, compared with 8.5 percent of African-American and Hispanic job-seekers. Since 2000, these group of minorities have had somewhat higher growth rates. By 2003, for African-Americans, the absolute size of the gap was reduced to 13.4 percentage points. In 2003, the usage rate of Hispanic Americans was still only a half of the rate of white Americans. In fact, in absolute terms, the white-Hispanic gap widened from 17.8 percentage points in 2000 to 21.1 percentage points in 2003.

From Table 3.2, it seems that the relationship between age and use of Internet for job search may be somewhat more complex. In earlier waves, individuals aged 46–55 had the highest rates of Internet use. However, over the years Internet job-seekers became much younger. By 2001, those aged 26–35 were the most active job-seekers online. The 25-and-under cohort of job-seekers had also experienced a tremendous growth. The table also shows that married respondents consistently reported higher rates of the Internet use relative to single individuals.

Table 3.1 Labor force status of Internet job-seekers, United States

	Dec 1998 sample		Aug 2000 sample		Sep 2001 sample		Oct 2003 sample	
	% of individuals in this group who searched for job online	Labor force status of Internet job-seekers aged 16 and older, %	% of individuals in this group who searched for job online	Labor force status of Internet job-seekers aged 16 and older, %	% of individuals in this group who searched for job online	Labor force status of Internet job-seekers aged 16 and older, %	% of individuals in this group who searched for job online	Labor force status of Internet job-seekers aged 16 and older, %
Employed	5.2	82.1	9.1	79.1	11.3	85.7	13.8	78.5
Unemployed		6.6		9.7		6.7		9.7
- on layoff	2.9	0.3	7.8	0.5	14.2	0.4	18.1	0.5
- job-seekers	11.0	6.3	21.4	9.2	31.7	6.3	37.7	9.2
Not in labor force		11.3		11.0		7.7		11.9
- retired	0.3	1.1	0.5	0.9	0.5	0.6	1.1	1.2
- disabled	1.1	1.1	1.9	0.8	1.8	0.6	2.6	1
- other	2.7	9.1	5.4	9.3	6.8	6.5	9.2	9.7

As expected, higher educational attainment was associated with the increased use of the Internet for job search. Data from 1998 and 2000 surveys indicate that college attendance made a significant difference in terms of the use of Internet for job search. In 2001 and 2003, the educational effect somewhat weakened, as more high school graduates went online. Nevertheless, the digital divide was still there: In 2003, high school dropouts and individuals with only a high school diploma comprised more than half of the population in the comparison sample but only one-quarter of the Internet-user sample.

The immigrant population has had consistently lower usage rates. In contrast, veterans tend to use the Internet for job search more frequently. Income level is positively correlated with the use of the Internet in job search. However, over the years the data indicate a relative convergence of the numbers as the Internet became more accessible. For instance, in 1998 the gap in Internet usage rates between households with incomes of $20,000–$24,999 and those with incomes of $50,000–$59,999 was equal to 12.9 percentage points. By 2003, this gap had shrunk to 5.1 percentage points. Clearly, many of the socio-economic and demographic observables in the analysis may be correlated with each other. Multivariate analysis, which is considered next, helps to disentangle such individual effects.

Table 3.2 Use of the Internet for job search by the unemployed, United States

	Dec-98	Aug-00	Sep-01	Oct-03
Sample Average	**11.0**	**21.4**	**31.8**	**38.0**
Female	9.6	19.4	30.9	36.3
Age 16-25	4.9	15.7	24.9	30.1
Age 26-35	9.0	23.9	35.0	43.0
Age 36-45	13.1	20.4	32.3	38.9
Age 46-55	16.1	26.8	34.3	38.0
Age 56 and older	8.2	13.1	21.7	28.7
Married	15.8	24.9	35.7	38.8
Single	6.4	15.1	26.0	33.3
Incomplete high school	1.0	6.3	8.3	14.1
Complete high school	6.7	11.8	19.9	27.0
Some college	14.8	28.4	39.4	44.9
Associate degree	20.1	34.2	44.9	55.6
Bachelors degree	28.3	48.3	67.9	69.0
Graduate and professional degree	45.5	48.8	65.8	72.6
White	12.8	26.3	36.9	42.6
Black	5.3	8.5	19.8	29.2
Asian or Pacific Islanders	16.1	29.4	40.8	39.9
Hispanic	3.6	8.5	12.9	21.5
Immigrant	6.7	16.1	24.1	27.0
Veteran	17.9	30.0	32.3	47.5
Metropolitan Area	10.7	21.0	31.6	37.6
Household Income:				
Less than $5,000	2.5	7.8	18.0	29.1
5,000 to 7,499	2.0	5.6	13.9	33.2
7,500 to 9,999	0.8	3.9	21.5	25.3
10,000 to 12,499	4.9	3.3	13.3	34.4
12,500 to 14,999	3.3	8.1	11.1	22.6
15,000 to 19,999	3.4	18.1	26.2	28.0
20,000 to 24,999	7.2	10.3	25.0	35.5
25,000 to 29,999	6.7	26.3	30.1	37.5
30,000 to 34,999	16.0	20.4	31.9	38.8
35,000 to 39,999	11.0	19.4	37.6	42.7
40,000 to 49,999	12.3	27.3	30.3	32.2
50,000 to 59,999	20.1	25.7	34.7	40.6
60,000 to 74,999	20.5	33.5	38.2	54.3
75,000 to 99,999	26.8	36.5	55.1	55.5
100,000 to 149,999				53.6
150,000 or more				44.8

Empirical estimation uses the multivariate probit model, where the dependent dummy variable takes the value of one if the unemployed use the Internet in the job search process. Table 3.3 displays the marginal effects estimated at mean value for continuous variables. For dummy variables, which in fact represent most of the right-hand side, variable marginal effects are associated with a unit change in the value of the variable. Specification I controls for most of the variables listed in Table 3.2. In specification II, race categories are replaced with a single indicative variable for Spanish speakers. In specification III, in the right-most column of Table 3.3, also includes variables for major groups of occupations as defined by BLS.

Results indicate that, compared with white job-seekers, African American job-seekers had a 9.0–9.2 percentage point lower probability to use the Internet in their job search efforts. Usage likelihood among Hispanic job-seekers was slightly lower than among African Americans. To analyze how this trend evolved over time, Table A.3.1 in the appendix presents findings from similar probit regressions estimated separately for the 1998, 2000, 2001, and 2003 waves of the survey. As reported earlier, the white-black gap peaked in 2000, when, compared with white job-seekers, African-American job-seekers had 12.3 percentage points lower probability of using the Internet. Although the gap declined to 10.3 percentage points in 2001, it went back to 12.1 percentage points by 2003. The trend for Hispanic American looks very sluggish. Despite the higher growth rate among this minority group, the size of the white-Hispanic gap has significantly widened. By 2003, Hispanic job-seekers were 12.8 percentage points less likely to use the Internet than their white peers.

Interestingly, compared with white job-seekers, Asian American job-seekers were also less likely to use the Internet, despite the fact that raw Internet usage rates among Asian Americans tend to be higher (Table 3.2). It is likely that raw Internet usage rates among Asian Americans were driven by other observables, such as education and income levels.

Jobs-seekers aged 26–35 were most likely to use the Internet to search for jobs. The regressions displayed in Table 3.3 also confirm the inverse relationship of Internet usage with the age of the job-seekers. Annual breakdown in Table A.3.1 of the appendix shows somewhat mixed trends. For instance, by 2003 the difference between age groups 36–45 and 26–36 becomes insignificant. However, for older age categories the respective absolute gap notably widens.

Furthermore, in line with earlier findings, all three models show that married job-seekers were more likely to search online (Table 3.3).

Breakdown in Table A.3.1 of the appendix shows that this gap is mostly driven by data from the 2000 survey.

Findings in the Table 3.3 robustly indicate that educational level is positively correlated with use of the Internet for job search. Job-seekers with no high school diploma were least likely to use the Internet, whereas job-seekers with a graduate or professional degree were most likely to do so. Annual breakdown (Table A.3.1 of the appendix) illustrates that, despite higher growth rates among job-seekers with lower educational attainment, the gap in marginal effects has broadened significantly. For instance, college graduates in 2000 had a 15.1 percentage point higher probability of using the Internet than job-seekers with just a high school diploma. By 2003, this gap widened to 26.0 percentage points.

Income level has a significant impact on the usage rates as well. Higher-income households are more likely to have Internet job-seekers (Table 3.3). For instance, compared to a job-seeker from the lowest group of household income (under $15,000), a job-seeker with household income of $25,000–$35,000 is 8.8–10.3 percentage points more likely to use the Internet to search for jobs. Results from annual regression (shown in Table A.3.1 of the appendix) indicate that income disparities in usage rates had peaked in 2000. Specifically, the gap between the base group and the $35,000–$50,000 group was 19.5 percentage points. However, by 2003 the gap declined to 5.8 percentage points. A similar trend is observed across other income categories. In fact, by 2003 for most of the income categories parameter estimates lose statistical significance.

Metropolitan area residents also seem to use the Internet more frequently. The effect seems to be driven by data from the 2001 and 2003 waves. In contrast, union membership reduces the likelihood of using the Internet by around 7 percentage points (Table 3.3).

Table 3.3 Use of the Internet for job search by the unemployed, marginal effects from probit models, United States

	Job search on the Internet in the United States, 1998–2003		
	Spec. I	Spec. II	Spec. III
Year 2000	0.148***	0.149***	0.150***
Year 2001	0.249***	0.252***	0.260***
Year 2003	0.325***	0.323***	0.333***
Female	-0.005	-0.009	-0.031***
Single	-0.047***	-0.055***	-0.044***
Incomplete high school	-0.154***	-0.156***	-0.139***
Associate degree	0.136***	0.142***	0.122***
Bachelors' degree	0.259***	0.272***	0.205***
Graduate or professional degree	0.297***	0.307***	0.216***
Aged 16_25	-0.001	0.003	0.008
Aged 36_45	-0.049***	-0.045***	-0.050***
Aged 46_55	-0.057***	-0.050***	-0.064***
Aged 56 and older	-0.145***	-0.137***	-0.158***
Black	-0.090***		-0.092***
Hispanic	-0.104***		-0.095***
Asian or Pacific Islanders	-0.053***		-0.053**
Other Race	-0.057**		-0.061**
Language: Spanish only		-0.137***	
Household income: more than 14,999 and less than 25,000	0.039**	0.043***	0.040**
Household income: more than 24,999 and less than 35,000	0.093***	0.103***	0.088***
Household income: more than 34,999 and less than 50,000	0.107***	0.120***	0.096***
Household income: more than 49,999 and less than 75,000	0.124***	0.142***	0.113***
Household income: more than 74,999	0.163***	0.189***	0.138***
Metropolitan Area	0.069***	0.055***	0.061***
Number of traditional job search channels	0.068***	0.068***	0.066***
Union Member	-0.070***	-0.068***	-0.069***
Management, business, and financial occupations			0.062***
Professional occupations			0.003
Service occupations			-0.112***
Sales and related occupations			-0.026
Farming, fishing, and forestry occupations			-0.143***
Construction and extraction occupations			-0.115***
Installation, maintenance, and repair occupations			-0.093***
Production occupations			-0.095***
Transportation and material moving			-0.104***

occupations			
Armed forces occupations			0.145
Observations	9799	9799	9150
Pseudo R2	0.24	0.24	0.26
* significant at 10%; ** significant at 5%; *** significant at 1%			

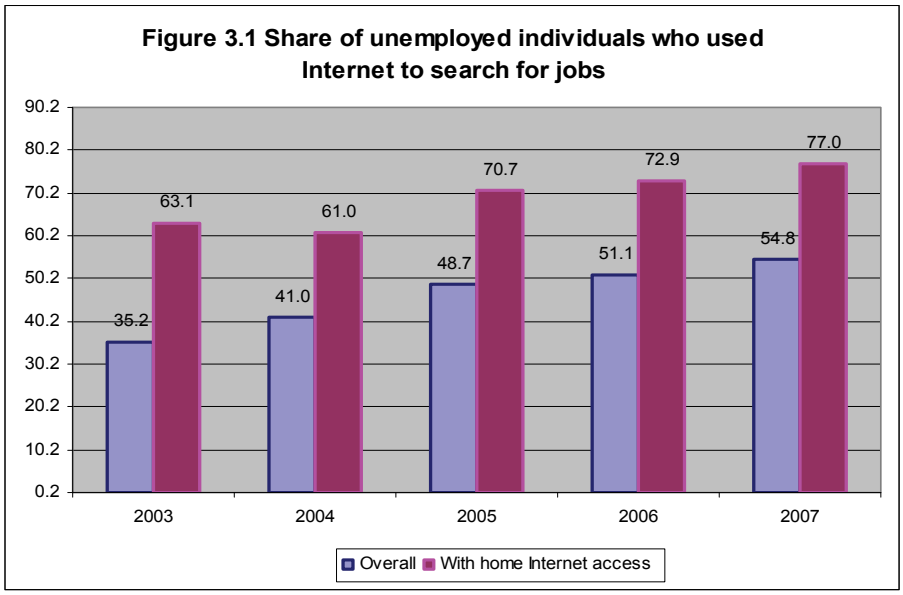
Internet usage is positively associated with the search intensity, as measured by the number of traditional search methods used by a job-seeker (Table 3.3). The list of traditional search methods reported in CPS includes (i) contacted employer directly, (ii) contacted public employment agency, (iii) contacted private employment agency, (iv) contacted friends and relatives, (v) contacted school employment center, (vi) sent resumes/filled applications, (vii) checked union/professional registers, (viii) placed or answered ads, (ix) other active search methods, and (x) looked at ads. Results from annual regressions (Table A.3.1 of the appendix) indicate that marginal effects of the number of traditional search methods on the likelihood of using the Internet have grown from 1.6 percentage points in 1998 to 8.2 percentage points in 2003.

Clerks are used as the reference occupational group, so it is expected that most other occupations will have a negative marginal effect. In fact, only one group of occupations—management, business, and financial occupations—was more likely to use the Internet in job search process (Table 3.3). Job-seekers with farming, forestry, and fishing occupations were least likely to search online (marginal effect of -14.3 percentage points).

Overall, findings from the 1998–2003 CPS indicate that Internet job-seekers in the United States were positively selected on observables, as they had higher education levels, tended to be younger, and were more likely to be married and white and come from richer households. The results from the regressions estimated separately for each wave of the survey show that the digital divide along most of the observable socio-economic and demographic characteristics peaked in 2000. Since then, compared with whites, both African-American and Hispanic job-seekers had higher growth in usage rates; however, the gap measured in absolute terms (percentage points) was not reduced. In fact, for Hispanic job-seekers the gap has widened. A similar trend is observed across educational spectrum. Despite higher rates among job-seekers with lower educational achievement, the disparities in the usage rate remain strikingly large in 2003. Household income level is the single characteristic for which the data show a consistent and robust indication of a decline in the digital divide.

3.2 Germany

In this section, discussion is focused on the demographic and socio-economic profile of Internet job-seekers in Germany in the 2003-2007 period. The data used in this paper come from the SOEP. The SOEP is an annual social and economic panel survey in Germany that is funded by the German Federal Government and administered by the German Institute for Economic Research. The first wave of the survey was conducted in 1984; questions related to the use of the Internet for job search activities were included starting in 2003. Unfortunately, SOEP restricts questions about job searching on the Internet to the unemployed only. Therefore, our discussion in this section leaves aside job searching on the Internet by employed respondents and individuals not included in the German labor force.



As it is shown in Figure 3.1, between 2003 and 2007 the use of Internet for job searching among the unemployed in Germany was on a consistent rise. In 2007, 54.8 percent of the unemployed and 77 percent of the unemployed with home access to Internet searched for jobs online. Table 3.4 lists sample means for the use of the Internet across major demographic and socio-economic dimensions.

The age profile of German Internet users seems to be somewhat different from that of Americans. The youngest cohort of job-seekers, aged 16-25, have consistently higher-than-average usage rates. In 2003, 36.9 percent of those aged 16-25 used the Internet to search for job. The average rate in the sample was 35.2 percent. In contrast, in the United States only 30.1 percent of the youngest cohort searched online,

and the average rate for the entire sample was 38.0 percent. For older cohorts, numbers for Germany are noticeably lower than corresponding usage rates in the United States. On the whole, it seems that Internet users in Germany have a somewhat younger age profile. Partly due to age characteristics and unlike to American job-seekers, married Germans are less likely to use the Internet to search for job than unmarried job-seekers.

Table 3.4 Use of the Internet for job search by the unemployed, Germany

	2003	2004	2005	2006	2007
Sample Average	**35.2**	**41.0**	**48.7**	**51.1**	**54.8**
Age 16-25	36.9	50	51	56.4	66.5
Age 26-35	39.8	48.9	57.7	58.9	64.9
Age 36-45	36.4	44.8	51.3	47.9	48.0
Age 46-55	28.7	32.7	40.1	45.9	44.0
Age 56 and older	22.1	10.1	35.6	41.0	48.4
Female	35.7	41.4	48.1	51.8	53.7
Married	31.5	32.6	42.5	49.3	47.6
Single	42.2	51	51.3	59.2	65.0
Incomplete secondary school	28.3	17.6	17.1	36.2	46.3
Complete secondary school	31.3	37.9	49.5	49.8	53.3
University degree	42.9	52.3	51.6	73.3	67.8
Vocational degree	36.3	43	53.0	53.0	55.1
Immigrant	22.9	21.7	40.2	36.0	32.4
Member of trade union	45.1	51.3	50.6	65.2	51.0
Managers	81.2	58.3	49	65.2	57.7
Professionals	70.6	71.7	68.9	63.7	66.7
Technicians and Associate Technicians	63.4	47.7	67.8	63.2	67.0
Clerks	55.6	63	65.7	66.6	71.7
Service workers and sales	19.2	35.2	60.7	59.5	54.6
Agricultural and fishery workers	19	25.3	25.3	25.2	29.4
Crafts and related trades workers	14.2	35.2	41	41.6	47.7
Plant machine operators and assemblers	20.6	22.9	30.2	62.0	56.8
Elementary occupations	17.5	23.8	28.3	36.0	32.0

As Table 3.4 shows educational attainment is positively correlated with the use of the Internet in job search process. Similar to the U.S. experience, immigrants have noticeably lower usage rates. The findings

from occupational characteristics are as anticipated and similar to those for the United States. Clerks, managers, and professionals have higher Internet usage rates, while job-seekers with agricultural and fishery occupations are les likely to browse online to search for jobs.

The results from multivariate analysis are listed in Table 3.5. Similar to the analysis of U.S. data, empirical estimation uses multivariate probit model, where the dependent dummy variable takes the value of one if the unemployed use the Internet in the job search process. Table 3.5 lists the marginal effects from two probit models. Specification I is a base model. Specification II, shown in the right-most column of the table, also includes occupation dummy variables. Marginal effects are calculated at a mean value of continuous variables. For dummy variables, which are the majority, marginal effects are associated with a unit change in value of the variable. To identify the trend in the usage of the Internet, similar models have been also estimated for each wave of the survey; Table A.3.2 in the appendix illustrates estimates from such probit regressions

The reference group for year dummies is 2003. Positive and growing marginal effects for year dummies validate the evidence of growing penetration of the Internet.

Table 3.5 also confirms a positive relationship between education levels and use of the Internet for job search. Specifically, job-seekers with a university degree have a 12.0 percentage point higher probability of using the Internet than job-seekers with only a secondary school diploma. Vocation/technical degree holders are also more likely to search online (7.9 percentage points). From the analysis of annual data (Table A.3.2), it is hard to identify a certain trend, as the marginal effects of educational attainment vary from year to year.

Table 3.5 Use of the Internet for job search by the unemployed, marginal effects from probit models, Germany

	Job search on the Internet in Germany, 2003-2007	
	Spec. I	Spec. II
Year 2004	0.065*	0.074**
Year 2005	0.138***	0.148***
Year 2006	0.202***	0.212***
Year 2007	0.238***	0.245***
Female	0.028	-0.020
Single	0.050	0.043
No secondary school	-0.135*	-0.113
University degree	0.137***	0.120***
Vocational/technical degree	0.070**	0.079***
Aged 16 25	-0.004	0.003
Aged 36 45	-0.063*	-0.067*

Aged 46 55	-0.166***	-0.161***
Aged 56 and older	-0.212***	-0.221***
Immigrant	-0.122***	-0.113***
Union member	0.119***	0.111***
Number of traditional job search channels	0.098***	0.100***
Unemployment benefits	-0.082***	-0.070**
Management, business, and financial occupations		0.210**
Professional occupations		0.144***
Technicians		0.131***
Service and retail trade occupations		0.004
Farming, fishing, and forestry occupations		-0.230***
Craftsmen and other trades		-0.093**
Plant, machine operators and assemblers		-0.173***
Elementary occupations		-0.063
Military member		-0.215*
Observations	4,766	4,766
Pseudo R2	0.14	0.16
* significant at 10%; ** significant at 5%; *** significant at 1%		

Job-seekers in the two youngest cohorts have no distinguishable differences in their likelihood of using the Internet. For older job-seekers, the Internet is a less popular tool. For instance, compared with a reference group of individuals aged 26–45, job-seekers aged 36–45 are 6.3–6.7 percentage points less likely to search online when looking for a job. Assessment of separate annual models (Table A.3.2) indicates some convergence of Internet usage rates for job-seekers under age 45. In contrast, job-seekers in the 46–55 and 55-and-older age groups remain significantly behind of younger cohorts.

Immigrants' probability of using the Internet for job search is also significantly lower. Once again, the trend is not obvious, as the marginal effects remain consistently negative but vary in size from year to year (Table A.3.2). Similar to findings from the U.S. regressions, German results indicate that use of the Internet is positively correlated with the search intensity, as measured by the number of traditional search methods used by job-seekers. In fact, the relationship remains very robust in split annual regressions as well (Table A.3.2).

Receiving unemployment benefits is negatively correlated with use of the Internet. The associated marginal effects are around –8.0 percentage points. The effect is largely driven by the 2006 and 2007 surveys (Table A.3.2). Managers, job-seekers with professional and technical occupations, and clerks are more likely to search online. Not

surprisingly, job-seekers with agricultural, fishery, and forestry occupations are lest likely to use the Internet to find a next job.

Overall, findings from Germany also indicate that Internet users have better observable socio-economic characteristics. They tend to be better educated, younger, less likely to be immigrants, and to have occupations with better pay. Furthermore, it appears that the Internet usage is negatively associated with participation in public assistance programs for the unemployed and positively associated with union membership. Gender of the unemployed seems to play little role when it comes to the use of the Internet. The age profile of German Internet job-seekers seems to be somewhat younger than in the U.S. Results from regressions estimated separately for each wave of the survey show growing differences in the Internet usage rates between job-seekers under age of 46 and those over that age. For the rest of the social-economic and demographic characteristics of German job-seekers in 2003–2007, the study finds no clear evolving trend.

3.3 South Korea

To discuss the role of the Internet for unemployed job-seekers in South Korea, this dissertation uses KLIPS, an annual social and economic panel survey of the South Korean population. It was launched in 1998 by the government of South Korea and is currently administered by the Korea Labor Institute (KLI). KLIPS designed to represent the entire population of South Korea. It is a publicly available dataset and may be accessed at the KLI website. This study uses nine waves (1998–2006) of the survey.

Compared with the United States and Germany, Internet usage rates among job-seekers in South Korea are significantly lower. In 2003, only 15.5 percent of unemployed South Korean searched online, as opposed to 35.2 percent in Germany and 38.0 percent in the United States. Table 3.6 lists sample means for three time periods: 1999–2001, 2002–2004, and 2005–2006.[3] Means reveal both similarities and distinct differences from German and American cases.

The first eye-catching phenomenon is related to gender differences. Women in South Korea have had considerably higher Internet usage rates. The gender gap is especially striking in the period of 2002–2004, placing South Korea in sharp contrast with Germany and the United States. The age profile of online job-seekers in South Korea is young and resembles in many ways that of Germany. Job-seekers aged 16–25 have

[3] The annual breakdown depicts similar trends.

the highest rates of using the Internet in job search across all time periods.

Table 3.6 Use of the Internet for job search by the unemployed, South Korea

	1999–2001	2002–2004	2005–2006
Sample Average	**9.7**	**20.7**	**36.3**
Female	11.7	28.2	36.6
Single	13.1	35.0	37.4
Aged 16 25	12.5	39.4	43.9
Aged 26 35	12.4	31.0	37.1
Aged 36 45	3.4	6.9	20.2
Aged 46 55	2.1	5.6	7.2
Aged 56 and older	0.7	10.2	6.4
No secondary school	3.2	17.4	19.6
Secondary education	4.1	24.3	33.1
Some college / two-year college	24.0	34.2	49.1
Bachelor degree or higher	18.7	29.7	25.3
Seoul resident	12.0	32.6	34.9
Management, business, and financial occupations	20.0	16.7	14.3
Professional occupations	16.7	31.0	40.0
Technicians	13.3	20.0	31.2
Clerks	21.1	40.4	28.1
Service occupations	6.1	10.2	38.6
Sales and related occupations	3.2	9.5	30.0
Farming, fishing, and forestry occupations	0.0	0.0	20.0
Craftsmen and other trades	5.5	21.6	24.2
Plant, machine operators, and assemblers	0.0	14.1	26.7
Elementary occupations	4.6	20.9	14

Mostly due to the younger age profile of Internet job-seekers, the data for South Korea also show that single job-seekers have much higher than average rates of Internet usage.

The relationship between educational attainment and use of the Internet for job search activities resembles an inverse U-shape. Job-seekers with some college education and those who attended two-year colleges had the highest rates. In contrast to findings from the United States and Germany, job-seekers with bachelor's and higher degrees had lower usage rates than job-seekers with some college education. In earlier survey waves, Seoul residents had significantly higher than average Internet usage rates. However, by 2005 the rest of the country

caught up with Seoul. Finally, review of occupational characteristics shows some interesting trends. Management and financial occupations had significantly higher rates at the earliest period, 1999–2001, but since then the rates have been on a decline. In contrast, professional and service occupations have been consistently on a sharp surge. As expected, job-seekers with farming, fishing, and forestry occupations had the lowest propensity to search for jobs online.

Findings from the multivariate probit model are listed in Table 3.7. Similar to the analysis of U.S. data, empirical estimation uses multivariate probit model where dependent dummy variable takes the value of one if an unemployed uses the Internet in the job search process. Table 3.7 lists marginal effects from two probit models. Specification I is a base model. In specification II right hand side also includes occupation dummy variables. Marginal effects are calculated at a mean value of continuous variables. For dummy variables which are the majority marginal effects are associated with a unit change in value of the variable. To identify the trend in the usage of the Internet, similar models have been also estimated for each wave of the survey. Table A.3.3 in the appendix illustrates estimates from such probit regressions.

The reference group for time dummies is 2002–2004, so estimates provide evidence of growing penetration of the Internet in South Korea. Regression results mostly confirm findings from the descriptive statistics. Female job-seekers were more likely to use the Internet by 0.8–1.3 percentage points. This effect is largely due to the strong positive relationship in the period of 2002–2004 (Table A.3.3).

Job-seekers with some college and two-year college education were most likely to use the Internet. In particular, compared with secondary school diploma holders, they have 7.7–8.4 percentage points higher probability of using the Internet to search for jobs. Job-seekers with a college degree also have somewhat higher likelihood (3.0–4.3 percentage points), whereas a lack of secondary school diploma significantly reduces the likelihood of search for jobs online. From more detailed models shown in the appendix, it becomes clear that most of these educational disparities were driven by data from earlier years (1999–2004). In contrast, in 2005 and 2006 the parameter estimate for college degree changes the sign. Attendance of two-year college turns out to have little effect in 2005–2006. Finally, secondary school dropouts continue to have the lowest odds of using the Internet for job search activities throughout the entire period of analysis.

Age of the job-seeker has a negative impact. This relationship remains consistent and steady in detailed regressions as well (Table A.3.3).

Table 3.7 Use of the Internet for job search by the unemployed, marginal effects from probit models, South Korea

	Job search on the Internet in South Korea, 1999–2006	
	Spec. I	Spec. II
Year 1999–2001	-0.105***	-0.11***
Year 2005–2006	0.052***	0.063***
Female	0.013*	0.008*
Single	0.042*	0.032
No secondary school	-0.039*	-0.038*
Some college / two-year college	0.084***	0.077***
Bachelor degree or higher	0.043*	0.030
Aged 16 25	0.022	0.010
Aged 36 45	-0.138***	-0.133***
Aged 46 55	-0.156***	-0.154***
Aged 56 and older	-0.147***	-0.144***
Number of traditional job search channels	0.087***	0.090***
Household income (log)	0.015	0.015
Unemployment benefits	0.197***	0.184***
Seoul resident	0.113***	0.114***
Management, business, and financial occupations		-0.043
Professional occupations		0.005
Technicians		-0.056**
Service occupations		-0.062**
Sales and related occupations		-0.088***
Farming, fishing, and forestry occupations		-0.132***
Craftsmen and other trades		-0.008
Plant, machine operators, and assemblers		-0.079***
Elementary occupations		-0.073**
Observations	2553	2553
Pseudo R2	0.22	0.23
* significant at 10%; ** significant at 5%; *** significant at 1%		

Findings also confirm that younger and single job-seekers were more likely to search online for job-related information. Search intensity is positively correlated with Internet usage, which is consistent with earlier findings from Germany and the United States.

Next, job-seekers who reside in Seoul were more likely to use the Internet. The Seoul effect remains strong in the latest waves as well.

Contrary to findings from Germany, recipients of unemployment assistance were more likely to use the Internet to search for jobs.

Job-seekers with clerical and professional occupations were most likely to use the Internet in their job search efforts. Unsurprisingly, job-seekers with farming, fishing, and forestry occupations had the lowest likelihood, just as in Germany and the United States. Findings from detailed regressions shown in Table A.3.3 illustrate no clear pattern of changes.

3.4. Discussion of findings

Findings from the United States, Germany, and South Korea indicate that use of the Internet for job search purposes is clearly correlated with a set of demographic and socio-economic observables. In the United States, the analysis indicates that Internet job-seekers were positively selected on observables. They had higher education levels, tended to be younger, and were more likely to be married and white and to come from richer households. Relative to whites, African-Americans and Hispanics have significantly lower probabilities of using the Internet for job search activities. These findings point to the presence of the digital divide that has been widely discussed in the literature and mass media. The disparities along educational and racial characteristics remain largely unchanged throughout considered period of 1998–2003. Household income level is the single characteristic for which the study finds consistent and robust indication of the decline in the digital divide in the United States.

Data from Germany also show that Internet users have more favorable characteristics. They are better educated, younger, less likely to be immigrants, less likely to receive unemployment assistance, and more likely to have occupations with better pay. German Internet job-seekers seem to be somewhat younger than the ones in the United States. This feature is also true in South Korea, where the usage rate for job-seekers under age 25 is more than double that of those aged 35–46. Findings for South Korea are distinguished by two more aspects. In sharp contrast with Germany and the United States, women in South Korea are more likely to use the Internet to search for jobs and job-related information. This result is not surprising given the fact that many other social and economical indicators in South Korea favor women as well. For instance, college graduation rates for South Korean women are higher than those for South Korean men. Further, the conventional positive relationship between Internet use and educational levels does not hold in South Korea, as analysis illustrates that job-seekers with

bachelor's and advanced degree are less likely to rely on the Internet than graduate of two-year colleges.

In all three countries, lack of the high/secondary school diploma significantly reduces the likelihood of looking for a job on the Internet. The gap remains significant throughout the entire period of analysis.

Overall, although data show that for some characteristics the disparities have been on a slow decline, the presence of the digital divide along most of the socio-economic and demographic characteristics is unequivocal. This aspects needs to be clearly addressed if Internet usage is utilized to explain variation in labor market outcomes.

The presence of digital divide also establishes evidence for further policy interventions aimed to provide broader access to the Internet and training opportunities. Implications of such disparities have been described by Gowen (2009). She writes that hardships and obstacles associated with a lack of stable Internet access in low-income households force these job-seekers and students to public libraries, where they try to use library computers to access the Internet for an allowed period of 30 minutes. Gowen continues that individuals with home access have a large advantage, because they have ample time to develop social networking, research, and other skills necessary to succeed later on. For instance, an increased number of homework assignments and student discussion is moving online, so it is likely that the remaining digital divide may have deeper negative impact on student academic achievement and labor market outcomes.

More detailed discussion of policy implications of these disparities is presented in Chapter 6 of the dissertation.

CHAPTER 4 - THE INTERNET AND JOB SEARCH OUTCOMES

4.1 The theoretical model

In this section, a formal model of the optimal job search strategy by unemployed job-seekers is presented. Model settings are similar to the framework developed by Burdett (1980) and extended by Holzer (1988) and Weber and Mahringer (2007). The innovation in the version of the model presented here is the introduction of the Internet as one of the endogenously selected search channels.

Similar to Holzer, in this model unemployed individuals face exogenously determined job offer probabilities and wage distribution, which reflects prevailing labor market conditions. For simplicity, it is also assumed that an unemployed job-seeker splits his job search efforts between two channels: *IJS* and *TR,* Internet and off-line (or traditional) channels, respectively; where IJS and TR $\in$ [0;1]. For instance, if a job-seeker uses the Internet twice as frequently as traditional channels, *IJS* may take value of 0.8 whereas *TR – 0.4.*

Next, λ_{ijs} and λ_{tr} are channel-specific offer arrival rates; thus, the probability of getting a job via either channel is equal to $A(\lambda_{ijs} IJS + \lambda_{tr} TR)$, where *A* is a fixed job acceptance rate. It is further assumed that offered wages come from wage distribution *F(w)* and that both channels generate wage offers from the same wage distribution across the same positions. *C* denotes the cost of the job search, which is function of *IJS* and *TR*. Finally, it is assumed that unemployed workers receive a benefit and/or a non-wage income of *b*.

Using these notations, an unemployed job-seeker's utility function could be expressed by the following equation:

$$pU = u(b) - C(IJS, TR) + A(\lambda_{ijs} IJS + \lambda_{tr} TR) \int \max\{W(w) - U, 0\} dF(w)$$

where *p* is a discount factor and *W(w)* and *U* are the utilities of being employed and unemployed, respectively.

A job-seeker solves the following maximization problem:

$$\max_{IJS,TR} U = u(b) - C(IJS, TR) + A(\lambda_{ijs} IJS + \lambda_{tr} TR) \int \max\{W(w) - U, 0\} dF(w)$$

In other words, the utility of an unemployed individual is equal to the value of the utility from non-work-related income *b* less the disutility of search efforts plus the expected utility increase from getting a job.

To determine an optimal job search strategy, the following first-order conditions could be solved with regard to the choice variables *IJS* and *TR*.

$$\frac{\partial U}{\partial IJS} = 0 \Rightarrow \qquad \frac{\partial C}{\partial IJS} = A\lambda_{ijs} \int \max\{W(w) - U, 0\} dF(w)$$

$$C_{IJS} = A\lambda_{ijs} \int \max\{W(w) - U, 0\} dF(w) \qquad (1)$$

$$\frac{\partial U}{\partial TR} = 0 \Rightarrow \qquad \frac{\partial C}{\partial TR} = A\lambda_{tr} \int \max\{W(w) - U, 0\} dF(w)$$

$$C_{TR} = A\lambda_{tr} \int \max\{W(w) - U, 0\} dF(w) \qquad (2)$$

From (1) and (2), it is possible to derive a conventional economic interpretation of the FOCs. The left-hand side of the equations (1) and (2) represent the marginal cost of the search via the Internet and off-line, respectively. Right-hand sides represent the marginal benefits from such search efforts. In other words, a job-seeker optimizes the use of the Internet and off-line channels by equalizing marginal cost and marginal benefit.

Since it is known that C_{IJS}, the cost of the job search on Internet, has significantly declined over the past decade, from equation (1) it is likely we will observe a decline in productivity of the Internet (reduction in λ_{ijs}) if $\frac{\lambda_{tr}}{C_{TR}}$ is fixed and the acceptance rate and wage distribution remain fixed as well.

By combining (1) and (2), the following equation can be derived:

$$\frac{\lambda_{ijs}}{C_{IJS}} = \frac{\lambda_{tr}}{C_{TR}} \qquad (3)$$

Equation (3) states that, given that the search channels generate wage offers from the same wage distribution and a fixed acceptance rate, a job-seeker equalizes productivity of the each job-searching channel adjusted for the marginal cost of conducting such search.

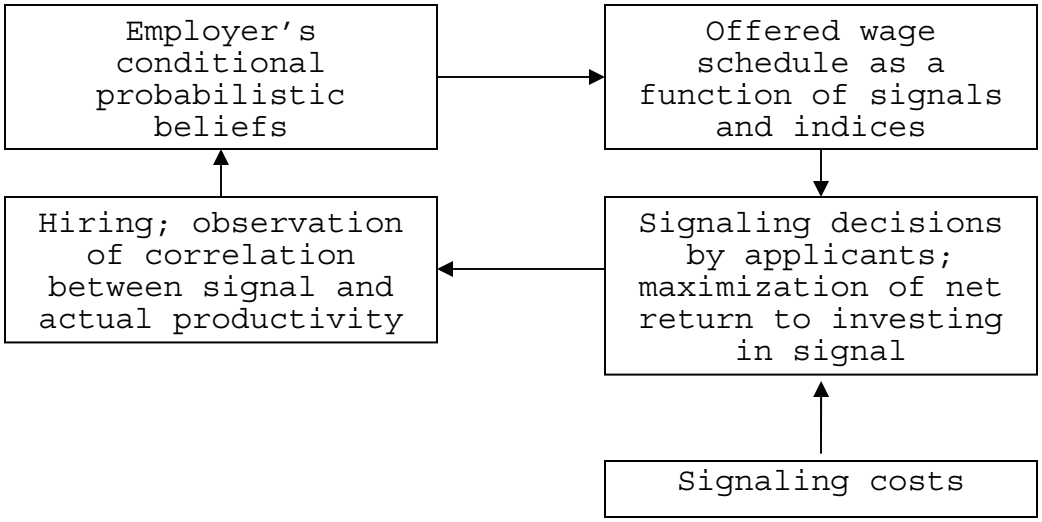
Needless to say, the Internet has vastly improved job-seekers' access to job-related information. A simple economic model of job search

developed by McCall (1970) implies that more affordable and extensive information about vacant positions has several important implications for the job-seeker. First, it increases the number of potential applications for the job-seeker. This is especially true in the case of the Internet, as it has allowed job-seekers to extend the geographical borders of their search. Second, by increasing number of applications, the job-seeker improve his or her chances of getting a better job, as measured by wage, benefits, schedule, etc. Third, job-seekers that actually find a job are expected to perform better and longer, since the chosen job was selected by the applicant from a longer list of potential positions. As productivity rises and search costs are reduced, society also benefits from this process.

The job search process is frequently described as a signaling game (Spence 1973, 1974). In an optimal world, employers would prefer to pay their workforces according to their marginal productivity, but this is only possible if productivity is observable in advance. Each job-seeker possesses observable characteristics. Some of these characteristics, indices, are fixed, and some, signals, are adjustable. Both sets of characteristics can convey messages about unobservable attributes to third parties. Spence suggests that, essentially, if the employers cannot observe any characteristics correlated with productivity, they purchase a lottery when they decide to submit an offer. The remuneration is a certain monetary equivalent of the lottery. Regardless of the posterior performance of the hired worker, the employer incurs considerable cost of screening, training, and evaluating. Therefore, from employer's perspective, the more information they can collect about potential workers before the hiring decision, the better off they will be in the long term. This also implies that, to reduce risks, employers would prefer to hire job-seekers about whom they have more information prior to the offer. Under these circumstances, high-productivity job-seekers try to send signals to the potential employers. In certain conditions, though, it maybe also beneficial for low-productivity employees to invest efforts into signaling. According to Spence, education and special training are among the most important signals that separate high- and low-quality job-seekers. Spence's model also assumes that high-quality job-seekers are better off because either (1) education or another signal enhances their actual productivity, so the marginal benefit of the signal is greater for them, or (2) the marginal cost of obtaining education is less for these individuals. These are key assumptions, since without them the value of the signal disappears. In other words, since the cost of obtaining the signal is negatively related to productivity, high-productivity job-seekers will be the ones with the signal. As costs fall, the value of the signal declines as

well. Figure 4.1 summarizes the flow of information in the job market (Spence 1973).

Figure 4.1 Information feedback on the job market



Job search on the Internet can certainly serve as a signal. It indicates to the employers that that the job-seeker is proficient in using computers and browsing online. Even for jobs that don't require computer skills, use of the Internet may indicate adaptability to new technology, education, and income level. Bertrand and Mullainathan (2003) find that, *ceteris paribus*, resumes that included an email address were more likely to receive a call back from potential employers.

Lower application costs and increased number of applicants caused by use of the Internet also significantly changed the strategy and cost of recruiting campaigns. Clearly, employers benefit from the reduced cost of job advertising and more detailed information about suitable job-seekers. However, obvious problems arise when they are bombarded by a huge number of unqualified applicants as the cost of the Internet declines. In other words, the signal becomes less valuable or totally irrelevant. On the cost side of the recruiting process, the emergence of the Internet has increased initial screening costs. In fact, many organizations outsource the initial screening of applicants to third parties or use special software products to select the pool of applicants for further consideration.

In addition to a decline in the value of a signaling mechanism, there are two other possible explanations for the reduced efficiency of job search on the Internet. In the early years of the Internet, only a small proportion of job-seekers had Internet access, and very few

companies actually hired online; the information available online was restricted in nature. In other words, the online applicants had access to premium information. Obviously, as number of Internet users grew, this premium was gradually diminished.

Finally, changes in the unobserved characteristics of Internet users may also explain the downward trends in the efficiency of the Internet for job search. Clearly, job-seekers have observed and unobserved heterogeneity in their characteristics. While the dynamics of the observed heterogeneity may be clearly identified, changes in unobserved characteristics are difficult to track. It is likely that in the early years of the Internet unobserved characteristics of Internet job-seekers were correlated with a likelihood of being hired faster. Such qualities may include technological savvy, cleverness, and other unobserved productivity and skills. As the number of Internet users has substantially increased, the distribution of unobserved characteristics may have also changed.

4.2 Twelve-month reemployment probability

Estimation of the Internet's effectiveness for job search is hampered by the fact that Internet use by job-seekers is correlated with a wide range of observable characteristics, as shown in Chapter 3. Even worse, it may be correlated with unobserved characteristics of job-seekers. In other words, a problem arises when those unobservable characteristics influence treatment choice, use of the Internet in job search, resulting in a biased parameter estimate of treatment effects. More formally,

$$Y_i = \alpha + \theta IJS_i + \varepsilon_i$$

where Y_i is an outcome variable, such as a labor status in 12 months of search; IJS is the use of the Internet; θ is treatment effect (effect of enlisting via the Internet); and ε_i is a random disturbance term. The difference in outcomes between those who are in the treatment and control groups can be summarized as follows:

$$E[Y_i \mid IJS_i = 1] - E[Y_i \mid IJS_i = 0] = \theta + (E[\varepsilon_i \mid IJS_i = 1] - E[\varepsilon_i \mid IJS_i = 0])$$

where T_i is dummy variable indicating treatment, θ - treatment effect $(E[\varepsilon_i \mid IJS_i = 1] - E[\varepsilon_i \mid IJS_i = 0])$ is a measure of selection bias. In random experiments, this expression is equal to 0. However, in studies that use observational data, this expression can easily deviate from zero. To estimate an unbiased estimate of θ, which is the effect of

using the Internet, this study uses two approaches: conditional independence and instrumental variable (IV) technique. The conditional independence approach decomposes the disturbance term ε_i into a linear function of observable characteristics X and the residual ϕ_i that is uncorrelated with X:

$$\varepsilon_i = X_i'\lambda + \phi_i$$

Further, estimation of

$$Y_i = \alpha + \theta IJS_i + \lambda X_i' + \phi_i$$

will produce consistent estimate of θ if ϕ_i is uncorrelated with X_i.

The assumption that ϕ_i is uncorrelated with X_i is relatively strong. To verify parameter estimates, an instrumental variable approach is applied. For U.S. data, this study uses the percentage of residential end-user premises with access to high-speed Internet services at the zip code level as an instrument for the use of the Internet in the job search process. Specifically, this study attempts to estimate the following regressions to recover an unbiased estimate of θ:

$$Y_i = \alpha + \theta IJS_i + \lambda X_i' + \phi_i \quad (4.1)$$

$$IJS_i = \alpha + \pi HSI_i + \chi X_i' + \omega_i \quad (4.2)$$

where equation 4.1 is a structural equation, equation 4.2 is a first-stage equation, HSI is high-speed Internet penetration at the zip code level, and X is a vector of observable variables. To obtain an unbiased estimate of θ, IV structure should satisfy two conditions:

(1) $\pi \neq 0$, so the instrument HSI is correlated with the treated variable IJS

(2) $Cov(HSI_i \phi_i) = 0$ so the instrument is correlated with the outcome only through its effect on IJS.

For German and South Korean data, panel model estimation utilizes information about the use of the Internet in previous and future periods to calculate the instrument for the value of the variable in the current period. Specifically, this study uses the Hausman-Taylor IV model. Under

Hausman-Taylor IV settings, IJS is considered as endogenous time-variant regressor and is subject to within transformation, which eliminates correlation with ϕ_i. The instrumental variable for the use of the Internet is obtained in the following manner:

$$\ddot{IJS}_{it} = IJS_{it} - \overline{IJS_i}$$

where $\ddot{IJS}_{it}$ is an instrumental variable for IJS_{it} and $\overline{IJS_i}$ is a mean value for each unit of observation. One of the primary advantages of the Hausman-Taylor IV model is that it enables calculation of the coefficients for time-invariant as well as dummy variables.

4.2.1 USA

The longitudinal feature of the CPS provides an opportunity to match CPS Computer and Internet Supplements with regular monthly CPS files and estimate reemployment rates for individuals. In merging CPS waves, the study followed guidelines by Madrian and Lefrgen (1999). The IV estimates are obtained via two-stage regressions. First, the study estimates OLS regression 4.2 and assesses whether condition (1) is met.[4] Next, fitted values $\hat{IJS}_i$ are calculated. In other words, $\hat{IJS}_i$ is a variation of IJS_i that is only due to variation in HSI_i since control for X is present in both the structural and first-stage regressions. Intuitively, there are no reasons to believe that condition (2) is not met. High-speed Internet penetration rate at the zip code in which the job-seeker resides is not linked directly with unobserved characteristics of the job-seeker. The first-stage regression presented in Table A.4.1 in the appendix indicates that use of the Internet for job search is positively correlated with the high-speed Internet penetration rate in the residing zip code. Test of the relevance of the instrument has been conducted by comparing the value of F-statistics from the first-stage regression with the conventional benchmark value of 10. If the instrument is weak, 2SLS is no longer dependable because the estimator will not only be significantly biased but also have an abnormal sampling distribution, even in large samples. This would make findings inconsistent and statistical inference meaningless. First-stage OLS regression produces the value of 24.0. The coefficient for the instrumental variable is positive and statistically significant.

Next, it is necessary to test the exogeneity of the instrumental variable. Exogeneity cannot be tested directly, but the literature

[4] I use F-test to check the correlation between the IV and instrumented variable.

offers indirect ways of testing it. The overidentifying test has become the standard approach in the recent economic literature. This study uses the Sargan test and fails to reject the null hypothesis with a p-value of 0.62 that all instruments are uncorrelated with ϕ_i. The Sargan test indicates that the IV is not correlated with the error term in the structural equation, and the proposed framework passes the test on exogeneity of the instrumental variable.

Table 4.1 lists the marginal effects from three models. Model I is the base model, in which in addition to the Internet search variable specifications include controls for socio-economic and demographic observable characteristics. In Model II, year dummies are interacted with the Internet use variable to identify changes in Internet effects. Finally, Model III is a structural (second-stage) model in the 2SLS framework. Marginal effects were estimated at the mean value of explanatory variables. For dummy variables, marginal effects are calculated based on unit change in a value of the dummy variable.

The results from Model I indicate that for Internet job-seekers the probability of being employed in 12 month is 7.1 percentage points higher than for job-seekers who don't use the Internet to search for jobs. These findings are noticeably different from earlier findings by Kuhn and Skuterud (2002, 2004). Divergence is caused by three key differences. First, this study uses additional waves of CPS Internet Use Supplemental (2001 and 2003). Second, model specifications differ from those of Kuhn and Skuterud. Specifically, the right-hand sides of the equations include controls for occupational categories using standard BLS breakdown of major occupations. Further, the number of traditional job search methods is also omitted from the right-hand side of the equation, since this variable is highly correlated with several dummy variables that indicate use of these methods. Thirdly, to simplify the comparison with German and South Korean findings, traditional search methods are aggregated into six channels, namely, search via public employment agencies, private employment agencies, friends and family, other media (newspapers, etc), contacted employers directly, and other search methods.

The findings on the marginal effect of using the Internet are comparable to those of Fountain (2005), who finds that in 1998 the odds of finding a job for a person who conducted a search using the Internet were 164 percent greater than for a person who did not search online, holding the other variables constant.

Table 4.1 The likelihood of being employed the year following the search time in USA (marginal effects)

	MODEL I	MODEL II	MODEL III
	Probit Marginal Effects	Probit Marginal Effects	2-Stage IV, Marginal Effects
Search on the Internet	**0.071****	0.127**	0.033
Search on the Internet 2000		0.039	
Search on the Internet 2001		0.047	
Search on the Internet 2003		0.009	
Female	**-0.027**	-0.026	-0.041**
Single	**-0.031**	-0.031	-0.049
Black	**-0.081****	-0.081**	-0.077*
Hispanic	**-0.014**	-0.014	0.005
Asian or Pacific Islanders	**-0.009**	-0.008	0.015
Incomplete high school	**-0.044**	-0.044	-0.084
Associate degree/some college	**0.135****	0.134**	0.041
Bachelors' degree	**-0.011**	-0.012	-0.004
Graduate or professional degree	**-0.028**	-0.030	0.009
Aged 16 25	**0.039**	0.040	-0.011
Aged 36 45	**-0.041**	-0.042	-0.017
Aged 46 55	**-0.070**	-0.073	-0.074**
Aged 56 and older	**-0.197*****	-0.200***	-0.202***
Self-employed	**0.022**	0.021	0.022
Union membership	**0.115**	0.114	0.049
Metropolitan area	**0.055**	0.055	0.056
On layoff	**0.227*****	0.230***	0.148***
Duration of unemployment	**-0.013*****	-0.013***	-0.004***
Search method: public employment agencies	**0.087****	0.088**	0.069***
Search method: private employment agencies	**0.040**	0.042	0.064*
Search method: friends and family	**0.064***	0.066*	0.043*
Search method: other media (newspapers, etc)	**-0.018**	-0.017	-0.018
Search method: contacted employers directly	**0.036**	0.038	0.095
Search methods: other methods	**- 0.023**	-0.023	-0.022
Observations	3606	3606	3510
Pseudo R2	0.08	0.08	0.05

* significant at 10%; ** significant at 5%; *** significant at 1%
Coefficients not shown in table but controlled for are year dummies, U.S. geographic regions, other race and occupational categories.

Findings from Model II indicate that Internet effects have been on a gradual decline. In fact, by 2003 the value of the marginal effect declined to 0.9 percentage points. In addition, estimates lose statistical significance. Results confirm the hypothesis from the

theoretical model, which says that since the cost of using the Internet to search for jobs has significantly declined over the past decade, we are likely to observe a decline in productivity of the Internet (reduction of λ_{ijs} in equation (3) in section 4.1). As discussed in section 4.1, reduced effects of the Internet may be explained by three developments. First, the signaling power of the Internet is expected to decline over the years, as more and more job-seekers have gone online. Second, in the earlier years of Internet development, online applicants had access to premium information. In other words, the Internet was not available to all those who could have benefited. As the number of Internet users grew, this premium was gradually depleted. Third, changes in the unobserved characteristics of Internet users may also explain downward trends in the efficiency of the Internet for job search. Clearly, job-seekers have observed and unobserved heterogeneity in their characteristics. It is likely that in earlier years unobserved characteristics of Internet job-seekers were correlated with a likelihood of being hired faster. Such qualities may include technological savvy, cleverness, and other unobserved productivity and skills. As the number of Internet users has substantially increased, unobserved characteristics may have also changed over time. For instance, some of the papers discussed in Chapter 2 argue that job-seekers who heavily rely on the Internet do so due because of a lack of good network connections and poor interpersonal skills.

The IV method in Model III also indicates a positive relationship between use of the Internet in the job search process and employment in 12 months following the survey. However, the estimated marginal effects lose statistical power and the value of the marginal effects reduces to 3.3 percentage points.

Female and African-American job-seekers are less likely to be employed in 12 months following the survey. Across all levels of educational attainment, job-seekers with an associate degree and some college education are most likely to be employed in 1 year. Next, the regression results indicate that there are no distinguishable differences in the reemployment probabilities of the self-employed, union members, and those living in a metropolitan area. Older job-seekers are more likely to remain unemployed, although many parameter estimates are not statistically significant at conventional levels.

Job-seekers on layoff had significantly higher probabilities of reemployment. The negative relationship between duration of unemployment and reemployment probabilities suggests that there are possible stigma effects, which are frequently discussed in the literature.

Finally, estimated marginal effects show that search via public and private employment offices as well as family and friends yields higher likelihood of reemployment. In contrast, search via traditional media outlets, such as newspapers, had no effect significant impact on reemployment probability.

4.2.2 Germany

SOEP is a panel dataset and requires a more complex approach in estimation. The standard errors of panel estimators need to be adjusted since an observation in the next time period is not independent of the observations in current or previous time periods for a given unit of observation. In spite of some technical complexities, models generated using panel datasets offer two major advantages. First, panel models increase the precision of estimates by combining several waves of observation for an individual. Second, they can provide a treatment for unobserved heterogeneity, which, as discussed earlier, may cause omitted variable bias. To estimate parameter estimates of interest in panel settings, researchers frequently use fixed and random effects models. A fixed effects model allows for unobserved heterogeneity that may be correlated with observable characteristics. A random effects model assumes that heterogeneity is not correlated with observable characteristics. Compared with a fixed effects model, a random effects model relies on a stronger assumption but allows for consistent estimates of all repressors, including dummy variables.

Questions in the SOEP related to use of the Internet for job search activities since 2003. This study utilizes 2003–2007 annual waves and estimates the probability of being employed year following the search time. Table 4.2 lists marginal effects estimated at mean values for continues variables and at value of 0 for dummy variables. Model I is a pooled probit estimator with a cluster-robust estimates for the variance-covariance estimator to correct for error correlation over time for a given individual. In Model II, Internet use is interacted with the year dummies to sift dynamic changes in the effectiveness of job search via the Internet.

The column for Model III displays estimates from the random effects model. A robust Hausman test is conducted by first running a fixed effects linear model. Under the null hypothesis, the individual effects are random, and estimators from fixed and random effects linear models are similar and consistent. Under the alternative, these estimators are significantly different. The test fails to reject the null hypothesis and apply random effects to obtain parameter estimates for all observables, including dummy variables. Model IV is Hausman-Taylor IV

model. As reviewed earlier in the discussion of Hausman-Taylor IV settings for this study, IJS is considered an endogenous time-variant regressor and is subject to within transformation.

Table 4.2 The likelihood of being employed the year following the search time in Germany (marginal effects)

	MODEL I	MODEL II	**MODEL III**	MODEL IV
	Pooled probit		**RE Probit**	Hausman-Taylor IV estimator
Job Search on the Internet	0.040**	0.029	**0.050****	0.07***
Job Search on the Internet 2004		0.067		
Job Search on the Internet 2005		0.057		
Job Search on the Internet 2006		0.040		
Female	-0.032	-0.031	**-0.035**	-0.12***
Single	-0.025	-0.024	**-0.024**	-0.07**
No secondary school	0.000	-0.000	**0.003**	-0.07
University degree	0.046*	0.045*	**0.039**	0.01
Vocational/technical degree	0.066***	0.065***	**0.070*****	0.02
Aged 16 25	-0.033	-0.033	**-0.042**	-0.15***
Aged 36 45	-0.038	-0.038	**-0.042**	-0.13***
Aged 46 55	-0.125***	-0.125***	**-0.134*****	-0.20***
Aged 56 and older	-0.201***	-0.199***	**-0.216*****	-0.28***
Immigrant	-0.050**	-0.050**	**-0.058****	-0.12***
Union Member	-0.012	-0.013	**-0.018**	-0.03
Unemployment benefits	0.053**	0.054***	**0.053****	0.07**
Duration of unemployment	-0.007***	-0.007***	**-0.007*****	-0.001***
Search: federal employment office	-0.042*	-0.043*	**-0.055****	-0.10***
Search: private employment agency	-0.033	-0.034	**-0.040**	-0.02
Search: friends and family	-0.008	-0.009	**-0.004**	0.01
Search: contacted employers	0.076***	0.076***	**0.077*****	0.03
Search: ads at other media (newspapers, etc)	-0.032	-0.032	**-0.035**	-0.02
Search: other methods	-0.022	-0.022	**-0.024**	0
Observations	3594	3594	2273	2273
Pseudo R2	0.09	0.10	0.10	0.09
* significant at 10%; ** significant at 5%; *** significant at 1%				
+ Coefficients of dummies for occupational categories are not shown in the table.				

The pooled probit estimator (Model I) indicates that job-seekers who use the Internet have 4 percentage points higher probability of being employed in a 12-month period. The largest marginal effect was registered in 2005 and has been gradually declining ever since, although it needs to be mentioned that marginal effects are not statistically significant in Model II.

The random effects model (Model III) produces a statistically significant marginal effect of 5 percentage points for use of the Internet. The Model IV estimator of marginal effects is equal to 7 percentage points.

From the cross-sectional models, university degree holders were more likely to be employed in a 12-month period. However, in panel settings, the estimated coefficient and marginal effect lose their statistical significance. Similarly, obtaining a vocational degree improves the probability of being employed by 6.5–7.0 percentage points in comparison with secondary school diploma holders. Unemployed Germans aged 26–35 were most likely to be employed within 12 months of the survey. For older unemployed, the likelihood of finding a job declines rapidly.

Similar to the findings from the United States, estimates also indicate that immigrants and job-seekers with longer unemployment duration are less likely to be employed in a 12-month period. The negative relationship between duration of unemployment and reemployment probabilities suggests that there are possible stigma effects.

The analysis of the traditional job search channels reveals two channels with statistically significant impact on reemployment likelihood. Search via federal employment institutions had a negative effect on the search outcome. In contrast, job-seekers who contacted employers directly had much higher odds of being employed in a 12-month period. Given the high penetration rate of the Internet in Germany, it is likely that direct contract with employer and use of the Internet had complementary effects.

4.2.3 South Korea

Similar to the German SOEP, KLIPS is a well-established panel survey and thus allows for more rigorous level of analysis. As in the German case, Model I is a pooled probit model with a cluster-robust estimates for the variance-covariance estimator to correct for error correlation over time for a given individual. In Model II, Internet use is interacted with the year dummies to analyze trends in the effectiveness of job search via the Internet. Model III is a random effects model. Once again, a robust Hausman test is conducted by first running a fixed effects linear model. Model IV is a Hausman-Taylor IV model. As reviewed earlier in the discussion of Hausman-Taylor IV settings for this study, IJS is considered an endogenous time-variant regressor and is subject to within transformation, which eliminates correlation with ϕ_i. The IV is calculated in the following manner:

$$\ddot{IJS}_{it} = IJS_{it} - \overline{IJS_i}$$

where $\ddot{IJS}_{it}$ is an instrumental variable for IJS_{it} and $\overline{IJS_i}$ is a mean value for each unit of observation. One of the primary advantages of the Hausman-Taylor IV model is that enables calculation of the coefficients for time-invariant as well as dummy variables. Marginal effects in Table 4.3 were estimated at the mean value of explanatory variables. For dummy variables, marginal effects are calculated based on unit change in a value of the dummy variable.

Table 4.3 The likelihood of being employed the year following the search time in South Korea (marginal effects)

	MODEL I	MODEL II	**MODEL III**	MODEL IV
	Pooled probit		**RE Probit**	Hausman-Taylor IV estimator
Internet	0.092**	0.140*	**0.067***	0.127**
Internet 2001-2002		0.096		
Internet 2003 – 2005		0.082		
Female	-0.054*	-0.054*	**-0.066****	-0.09**
Single	-0.071*	-0.071*	**-0.074****	-0.14***
No secondary school	-0.087***	-0.087***	**-0.097*****	-0.16***
Some College / 2-year college	0.035	0.033	**0.049**	-0.04
Bachelor degree	-0.034	-0.036	**0.001**	-0.07
Graduate/ professional degree	-0.105	-0.106	**-0.121**	-0.08
Aged 16 25	0.029	0.029	**0.038**	-0.10**
Aged 36 45	0.103**	0.103**	**0.042**	0.02
Aged 46 55	0.065	0.064	**0.009**	-0.04
Aged 56 and older	-0.075	-0.075	**-0.156*****	-0.23***
Duration of Unemployment	-0.002***	-0.002***	**-0.002****	0.00***
Unemployment benefits	0.116*	0.115	**0.051**	-0.12
Seoul resident	0.003	0.003	**0.002**	-0.08**
Search: public employment office	0.049**	0.048**	**0.012****	0.03
Search: private employment office	0.050	0.049	**0.113**	0.01
Search: friends and family	-0.007	-0.006	**0.016**	-0.04
Search: other media ads	0.018	0.018	**0.007**	-0.03
Search: contacted employers	-0.037	-0.038	**-0.036**	-0.04
Search: other methods	0.029	0.027	**0.009**	0.05
Observations	1954	1954	1531	1531
Pseudo R2	0.05	0.05	0.05	0.04
* significant at 10%; ** significant at 5%; *** significant at 1%				
+ Marginal effects of dummies for occupational categories are not shown in the table.				

Once again, all four models produced positive effects for the Internet search variable. Overall, estimated effects in South Korea are somewhat larger than those for the United States and Germany, which is not surprising given that lower percentages of South Korean unemployed use the Internet to search for jobs. Model II also indicates that the Internet effect was much stronger in the earliest time period studied (1999–2000), which also serves as a reference time period in Model II.

Women and single job-seekers are less likely to be reemployed in a 12-month period. The effects for both variables are more pronounced that in Germany and the United States. Further, compared with secondary school graduates, dropouts have significantly lower probability of being employed in a 12-month period. In fact, secondary school dropouts are the only educational category in which the likelihood is significantly different form the reference category. Interestingly, aside from the oldest age category of 56 and older, and in contrast with findings from Germany and the United States, this study fails to find a relationship between age and probability of employment in a 12-month period.

The relationship between unemployment duration and reemployment probability is negative, in line with German and American findings. Once again, it may indicate the presence of a stigma effect for prolonged unemployment spells. With the exception of public employment agencies, none of the traditional search channels are associated with a likelihood of being employed.

4.2.4 Reemployment probit for minority and immigrant subsamples

The findings from reemployment models indicate that job-seekers who use the Internet were more likely to be employed in a 12-month period. Estimated marginal effects are equal to 5.0 in Germany, 6.7 in South Korea, and 7.1 in the United States. As was discussed earlier, Internet job-seekers are selected on a set of observable characteristics. Race and immigration status remain among the key determinants of Internet usage in the United States and Germany. In particular, African-Americans in the United States and immigrants in Germany had significantly lower probabilities of using the Internet for job search. From empirical and policy perspectives, it is interesting to assess whether the Internet effect on reemployment differs for minorities and immigrant populations. Table 4.4 lists estimates for marginal effects from reemployment probit regressions for the entire sample in the United States and Germany and for African-American and Hispanic subsamples in the United States and the immigrant subsample in Germany. Table 4.4 lists overlapping set of variables in the German and U.S. models. In fact, to generate these estimates for minorities and immigrant populations, the analysis uses

model specifications that are identical to those in Table 4.1 for the United States and Table 4.2 for Germany.

Table 4.4 Reemployment probit for minority and immigrant subsamples (marginal effects) in the USA and Germany

	USA			Germany	
	Probit Entire Sample	Probit African-American	Probit Hispanics	RE Probit Entire Sample	RE Probit Immigrants
Search on the Internet	0.071**	0.102*	0.123*	0.050**	0.186***
Female	-0.027	0.026	-0.064***	-0.035	0.056
Single	-0.031	-0.049	0.015	-0.024	-0.177**
Incomplete high school in the U.S./ incomplete secondary school in Germany	-0.044	-0.099*	-0.091*	0.003	0.05
Associate degree/some college	0.135**	0.029	-0.116		
Bachelors' degree	-0.011	0.087	-0.205		
Graduate or professional degree	-0.028	0.307*	0.099		
University degree				0.039	-0.119
Vocational/technical degree				0.070***	0.15**
Aged 16 25	0.039	-0.018	-0.095	-0.042	0.142
Aged 36 45	-0.041	0.072	-0.060	-0.042	-0.033
Aged 46 55	-0.070	-0.044	-0.174**	-0.134***	-0.121*
Aged 56 and older	-0.197***	-0.145	-0.415***	-0.216***	-0.235***
Duration of Unemployment	-0.013***	-0.029***	-0.007	-0.007***	-0.004***
Search method: public employment agencies	0.087**	0.135**	0.150**	-0.055**	-0.016
Search method: private employment agencies	0.040	0.089	0.134	-0.040	-0.048
Search method: friends and family	0.064*	0.055	0.118*	-0.004	0.104
Search method: other media (newspapers, etc)	-0.018	0.028	-0.063	-0.035	0.037
Search method: contacted employers directly	0.036	-0.004	0.167**	0.077***	0.236***
Search method: Other	-0.023	-0.02	-0.04	-0.024	-0.022
Observations	3606	611	475	2273	517
Pseudo R2	0.08	0.109	0.133	0.10	0.09
* significant at 10%; ** significant at 5%; *** significant at 1%					
For the United States, the regression includes controls for self-employed status, union membership, metropolitan area, on layoff, year dummies, geographic regions, and occupational categories. For Germany, the regression includes control for union membership, unemployment benefits, and occupational categories. Marginal effects for these variables are not shown in the table.					

The results show sizable Internet effects both for African-American and Hispanic population in the United States and the immigrant population in Germany. All three marginal effects are greater than the marginal effects for entire sample shown in Table 4.1 and 4.2.

In the subsample of African-American job-seekers, individuals who used the Internet to search for job had 10.2 percentage points higher probability of being employed in 12 months. In the Hispanic subset, the marginal effect is yet larger (12.3 percentage points). For the immigrant subsample in Germany, the marginal effect for using the Internet to search for a job is more than triple the marginal effect for the entire SOEP sample. Such findings may primarily be caused by an extensive amount of job-related information available online. It is likely that the Internet provides minorities and the immigrant population with an access to a larger and more diverse pool of job postings. For instance, the Internet may induce applicants to change occupations or industry affiliation or to move to another geographic location.

The cost of search for a job may explain the story as well. Significantly lower cost of job search may induce more minorities and immigrants, who are likely to be more cost-sensitive than other populations, to search for a job with an increased intensity. In other words, the Internet may be helping to overcome the cost barrier of job search.

Finally, it is also likely that Internet job-seekers from minority and immigrant populations have better unobserved characteristics than white (in the United States) and non-immigrant (in Germany) job-seekers who search online. Particularly, compared with white and non-immigrant population in the United States and Germany, respectively, minorities and immigrant job-seekers have weaker network connections that ease the way towards employment. Therefore, the pool of Internet job-seekers from minority and immigrant populations is less negatively selected on unobserved characteristics, such as attitude to work, diligence, discipline, and persistence—qualities that help to locate and keep a job. Obviously, this train of thought should be treated as a hypothesis only.

4.3 Job search on the Internet and transition to a new industry and occupation

The CPS, SOEP, and KLIPS also contain occupational and industry characteristics of job-seekers. This information is available both for the last position occupied by the job-seeker and for a new position if the job-seeker is reemployed. To analyze whether use of the Internet is

associated with a transition to a new industry and occupation, the analysis in this section limits the data in all three datasets to the job-seekers who had a job within 12 months of the initial survey. Two new indicative variables identify whether individuals remained in the same industry and occupation. Empirical estimation uses probit models in which job search on the Internet is one of the right-hand side variables along with a standard set of variables featured earlier in sections 4.1 and 4.2. Tables 4.5 and 4.6 present marginal effect estimates from such probit models. In IV models (not shown in the table below) with the same specifications, use of the Internet loses statistical significance for all three countries. The tables below list only those variables that overlap in all three country datasets.

Table 4.5 Job search on the Internet and transition to a new industry[5]

	UNITED STATES	SOUTH KOREA	GERMANY
Search on the Internet	-0.051*	-0.089*	-0.018
Female	0.033	0.05	-0.199
Single	0.013	-0.007	0.079
Incomplete high school in the U.S./incomplete secondary school in Germany and South Korea	0.075**	0.051	0.076
Associate degree/some college	0.067	0.04	
Bachelors' degree	0.069**	0.07	
University degree			0.13
Graduate or professional degree	0.027	-0.111	
Vocational/technical degree			-0.032
Aged 16 25	0.011	0.092**	0.058
Aged 36 45	0.018	-0.07	0.164**
Aged 46 55	0.009	-0.077	0.4***
Aged 56 and older	0.073	-0.073	0.442***
Search method: public employment agencies	0.05	0.027	0.011
Search method: private employment agencies	-0.1	0.022	-0.096*
Search method: friends and family	-0.03	0.005	-0.025
Search method: other media (newspapers, etc)	-0.03	0.033	-0.097*
Search method: contacted employers directly	0.01	0.009	-0.072
Search method: other	0.00	-0.060	-0.099**
Duration of unemployment in months	0.001	0.002**	0
Number of observations	2178	887	1047
Pseudo R2	0.04	0.12	0.11
* significant at 10%; ** significant at 5%; *** significant at 1%			
For the United States, the regression includes controls for self-employed status,			

[5] The job-seeker is identified to be employed in a new industry if industry affiliation of the latest pre-unemployment job differs from industry affiliation of the first post-unemployment job.

union membership, metropolitan area, on layoff, race, immigrant status, year dummies, and geographic regions. For South Korea, the regression includes controls for union membership, unemployment benefits, and Seoul residency. For Germany, the regression includes controls for union membership, immigrant status. and unemployment benefits. The marginal effects for these variables are not shown in the table.

Table 4.6 Job search on the Internet and transition to a new occupation[6]

	UNITED STATES	SOUTH KOREA	GERMANY
Search on the Internet	-0.063**	-0.14***	-0.03
Female	0.089***	0.017	-0.148
Single	-0.003	-0.022	0.026
Incomplete high school in the U.S./incomplete secondary school in Germany and South Korea	0.074**	0.102**	0.037
Associate degree/some college	0.027	0.078	
Bachelors' degree	0.076**	0.123	
University degree			0.066
Graduate or professional degree			
Vocational/technical degree			0.004
Aged 16 25	0.035	0.173***	0.03
Aged 36 45	0.055*	-0.025	0.142*
Aged 46 55	0.02	-0.108	0.173*
Aged 56 and older	0.013	0.107	0.277
Search method: public employment agencies	-0.056*		0.037
Search method: private employment agencies	0.013		-0.043
Search method: friends and family	0.043		-0.009
Search method: other media (newspapers, etc)	0.005		0.00
Search method: contacted employers directly	-0.029		-0.009
Search method: other	0.00		-0.071
Duration of unemployment in months	-0.003	0.002**	-0.004*
Number of observations	**2178**	**887**	**1047**
Pseudo R2	0.03	0.13	0.17
* significant at 10%; ** significant at 5%; *** significant at 1%			
For the United States, the regression includes controls for self-employed status, union membership, metropolitan area, on layoff, race, immigrant status, year dummies, and geographic regions. For South Korea, the regression includes controls for union membership, unemployment benefits, and Seoul residency. For Germany, the regression includes controls for union membership, immigrant status, and unemployment benefits. The marginal effects for these variables are not shown in the table.			

[6] The job-seeker is identified to be employed in a new occupation if occupational affiliation of the latest pre-unemployment job differs from occupational affiliation of the first post-unemployment job.

The results from the United States and South Korean datasets indicate that Internet users were more likely to have a new industry and occupational affiliation at the new job. The analysis in this study does not include an assessment of job features, nor does it consider whether the identified relationship differs by age, educational level, or other socio-economic characteristics. Certainly, this is an attractive area for further empirical research.

The marginal effects are very striking in South Korea. In the case of occupational affiliation, Internet job-seekers were 14.0 percentage points less likely to remain in the same occupation compared with the job-seekers who didn't use the Internet. No such relationship is found for Germany, where it looks like use of the Internet is not associated with the change of occupational or industry affiliation. It may be that the lack of correlation in Germany is explained by a rigidity of labor markets, which is thoroughly covered and discussed in European academic and policy circles. Not surprisingly, this study finds some evidence that older job-seekers and job-seekers with advanced education tend to stick to their previous occupation and remain in the same industry.

Strong association between use of the Internet and occupation and industrial mobility in the United States and South Korea show that the Internet may contribute to awareness about new job opportunities in other occupations and industries. When an economy goes through structural changes, occupational and inter-industry mobility of job-seekers helps smoothen the negative effects of structural changes. Obviously, more research is needed in this area. In particular, study of the link between the use of the Internet and geographic mobility may provide additional insights.

4.4 Job search on the Internet and duration of unemployment

Findings from the probit model in section 4.2 indicate that integrating the Internet into the job search process is helpful. However, estimation of 12-month reemployment probits disregards a lot of information available in the German SOEP and South Korean KLIPS. Specifically, probit and logit models center on a job-seeker's labor force status at a specific date. This has obvious shortcomings, as job-seekers may be able to find a job slightly after specified date, and probit models would ignore this information. In contrast, duration models take into account the entire length of the unemployment spell and therefore utilize available data more efficiently. This section presents findings from duration models estimated using data from SOEP and KLIPS.

The analysis uses a single-spell duration framework and includes an estimation of discrete-time hazard function, which is defined as the

instantaneous probability of leaving an unemployment status conditional to a survival to time t. Duration is expressed in months. Two duration models are estimated. The first is a Cox proportional hazards model, where $\lambda(t/x)$, the hazard function at time t for individual with a vector of observable characteristics x, could be written as:

$$\lambda(t/x) = \lambda_0(t)\phi(x,\beta)$$

where $\lambda_0(t)$ is the baseline hazard, which is not a function of observable characteristics. In contrast, $\phi(x,\beta)$ is a function of observable characteristics, x.

Unobserved heterogeneity is key issue in duration models as well. In the presence of unobserved heterogeneity, hazard rates for individuals with similar observables vary. If unobserved heterogeneity is present and ignored, estimated hazard rates may be biased. To account for the potential presence of unobserved heterogeneity in the duration models, this study utilizes the Weibull distribution-inverse Gaussian mixture model. In mixture models, individual hazards are obtained by controlling for observable characteristics x and averaging out unobserved heterogeneity terms for each individual. Table 4.7 lists estimated hazard ratios for unemployed job-seekers in South Korea and Germany.

From the Cox PH model, job search on the Internet has a hazard ratio of 1.17 for South Korea and 1.28 for Germany. This means that using the Internet in the job search process increases the hazard of leaving an unemployment status by 17 and 28 percent over the baseline hazards in South Korea and Germany, respectively. Controlling for unobserved heterogeneity increases the hazard ratios to 1.24 in South Korea and 1.29 in Germany.

Table 4.7 Unemployment duration: estimated hazard ratios

	South Korea		Germany	
	Cox PH model	Weibull model with unobserved heterogeneity	Cox PH Model	Weibull model with unobserved Heterogeneity
Internet search	1.17*	1.24**	1.28***	1.29***
Female	0.93	0.95	1.04	1.03
Single	0.85*	0.82*	0.85**	0.85**
No secondary school	0.78***	0.73***	0.89	0.9
Some college / 2-year college	1.12	1.16	1.01	1
Bachelor degree	1.02	1.04	0.60***	0.59***
Graduate/ professional degree	0.73	0.69		
Aged 16 25	0.99	0.95	0.79***	0.77***
Aged 36 45	0.99	0.99	0.77***	0.76***
Aged 46 55	0.97	1.02	0.53***	0.52***
Aged 56 and older	0.70**	0.67**	0.34***	0.33***
Unemployment benefits	1.09	1.12	0.86**	0.82***
Seoul resident	0.97	0.95		
Immigrant			0.85*	0.84*
Union member	1.08	1.22	1.05	1.04
Search: public employment office	0.99	0.99	0.65***	0.63***
Search: private employment office	1.40**	1.50*	0.93	0.93
Search: friends and family	1.09	1.13	1.07	1.08
Search: other media ads	0.93	0.92	0.88	0.88
Search: contacted employers	1.01	1.02	1.19**	1.20**
Search: other methods	1.12	1.11	0.92	0.93
Observations	**1661**	**1661**	**2685**	**2685**

* significant at 10%; ** significant at 5%; *** significant at 1%

Similar to findings from probit reemployment models, duration models show that that single job-seekers have less successful outcomes. Hazard estimates also indicate that those aged 26-35 are more likely to leave unemployment status in Germany. For older job-seekers, there seems to be an inverse relationship between age and hazard ratio in Germany. In South Korea, individuals aged 56 and older have significantly lower hazard ratios compared with a reference category of those aged 26-35.

The results in the Table 4.7 indicate that the receipt of unemployment benefits in Germany increases duration of unemployment by reducing hazard ratios by 14-18 percent. It is also confirmed that immigrants in Germany have longer unemployment duration. In South Korea, job search via private employment agencies seems to be negatively associated with unemployment duration. In contrast, in Germany contacting employers directly results in increased hazard ratios and shortened unemployment duration. Figures 4.2 and 4.3 depict a parametric survival function constructed based on Cox PH models. One can clearly see that through the entire duration of the unemployment job-seekers who used the Internet had lower survival rates.

Figure 4.2 Survival function estimates by Internet usage in the job search in South Korea (analysis time is in months).

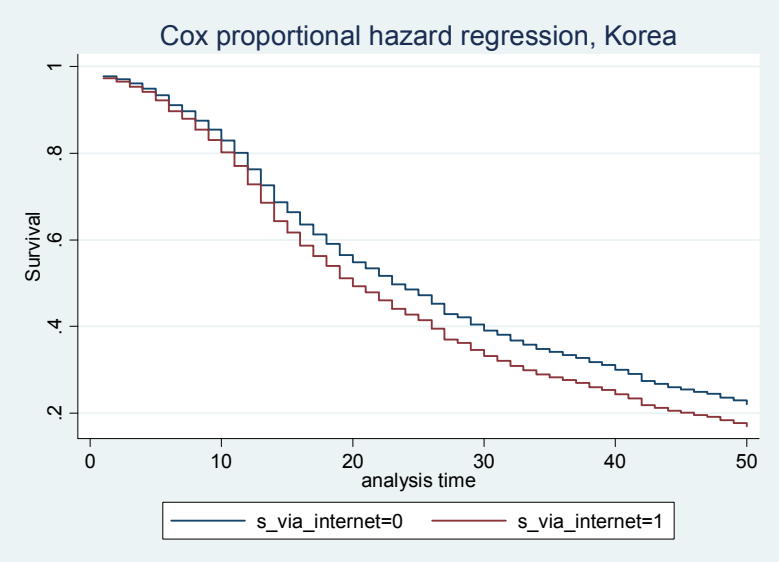
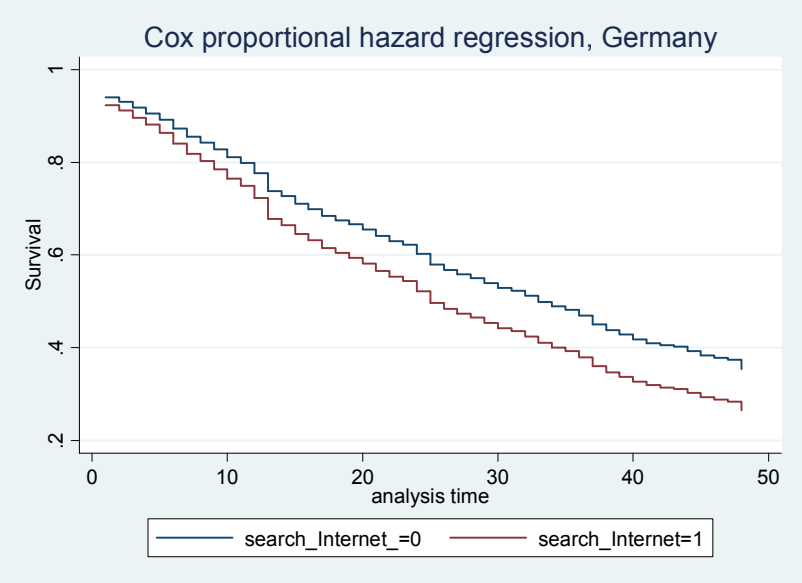


Figure 4.3 Survival function estimates by Internet usage in the job search in Germany (analysis time is in months).



Figures 4.2 and 4.3 indicate that in both Germany and South Korea incorporating the Internet into the job search process yields increased hazard of leaving unemployment status and shortened unemployment duration. Overall, these findings indicate that the Internet has a noticeable positive impact on job search outcomes over the entire duration of the unemployment spell.

4.5 Endogeneity and discussion of findings

As discussed earlier, a major empirical issue with use of the Internet is endogeneity. In an economic model, endogeneity refers to the fact that an independent variable included in the model is potentially a choice variable, correlated with unobservables relegated to the error term. In the case of the use of the Internet for job search activities, endogeneity is most likely to arise as a result of omitted variables. For instance, even for jobs that don't require computer skills, use of Internet in the job search may correlated with adaptability to new technologies—an attribute that is hard to quantify and control for in the regression. Unaccounted endogeneity may lead to biased estimates and affect statistical inference.

To account for endogeneity of use of the Internet for job search, this study used an instrumental variable (IV) approach. In the U.S. case, a percentage of residential end-user premises with access to high-speed Internet services at the zip code level has been utilized as an instrument for use of the Internet in the job search process. The first-stage regression produced a positive and statistically significant relationship between IV and the instrumented variable. In line with probit model outcomes, the second-stage regression yielded a positive

relationship between use of the Internet instrumented by fitted values from the first-stage regression and 12-month reemployment probability, although the marginal effect is reduced in the IV settings (3.3 as opposed to 7.1 in probit model). Furthermore, the fact that in IV settings the estimated effect loses its statistical significance compels a more cautious interpretation of results from the United States.

Table 4.8 Summary of 12-month reemployment models (marginal effects)

	Probit models	IV models
U.S.	0.71**	0.033
Germany	0.050**	0.07***
South Korea	0.067*	0.127**
* significant at 10%; ** significant at 5%; *** significant at 1%		

In contrast, the results from IV models based on German and South Korean panel data indicate that the Internet effects are robust. As reviewed earlier in the discussion of Hausman-Taylor IV settings for this study, IJS is considered as endogenous time-variant regressor and the IV is formed as $\ddot{IJS}_{it} = IJS_{it} - \overline{IJS_i}$. Both in the German and South Korean analyses, parameter estimates from IV models are larger than those from random effects probit models (Table 4.8). Findings from duration models for German and South Korean data reinforce our findings from reemployment models. Both the Cox PH model and the Weibull model with unobserved heterogeneity show that use of the Internet increased the hazard of ending an unemployment spell. It is worth noting that control for unobserved heterogeneity increased the hazard rate in Germany to 1.29 from 1.28 and in South Korea to 1.24 from 1.17. If uncontrolled, unobserved heterogeneity seems to lessen the marginal effects of the Internet. Overall, findings from Germany and South Korea consistently indicate the positive impact of the Internet.

In the subsample of African-American job-seekers, individuals who used the Internet to search for a job had 10.2 percentage points higher probability of being employed in 12 months. In the Hispanic subset, the marginal effect is yet larger (12.3 percentage points). For the immigrant subsample in Germany, the marginal effect for using the Internet to search for job is more than triple (18.6 percentage points) the marginal effect for entire SOEP sample. In IV models, the marginal effects lose statistical significance; however, this may be explained by the size of the subsample. The African-American sample size was equal to 611 observations, the Hispanic sample used only 475 observations, and there were only 517 immigrants in German dataset. Therefore, while

probit findings represent early indication of the enlarged positive impact among minorities in the United States and immigrants in Germany, more research and data are required to disentangle possible issue of endogeneity persuasively.

A similar framework can be applied to the findings on the relationship between job search on the Internet and transition to a new occupation and industry. While probit models based on American and South Korean data decisively indicate that the use of the Internet is positively associated with the change in industry and occupational affiliation, IV models are unable to produce parameter estimates that are statistical significant. Once again, it could be hypothesized that significantly reduced sample size is part of the story, and further research is required on the role of online job search on industry and occupational transitions.

CHAPTER 5 – INTERNET RECRUITMENT AND EMPLOYMENT OUTCOMES

5.1 Use of the Internet in Army recruiting

The U.S. Army is one of the largest employers in the country, and every year it faces the challenging task of recruiting around 50–60 thousand[7] enlistees for an active-duty service.

To fulfill this mission, the U.S. Army Accession Command utilizes various recruitment resources and programs, such as advertising, military pay, enlistment bonuses, college benefits, and recruiters. In recent years, the Internet has become an important part of advertising and recruiting programs as the Army has established an extensive presence online. Despite the fact that the Army is unique in terms of its mission and operating environment, its human resource management systems have many similarities to other large employers. To begin with, the Army competes for its employees in a civilian labor market. Similar to civilian jobs, service in the Army is based on a contract with very specific terms and conditions. Furthermore, the Army offers extensive opportunities for training and pays a salary. To improve its attractiveness, the Army also offers an attractive benefits package that includes money for education, retirement, comprehensive health care for current and former employees, vacation, bonuses for special duties and occupations, food, clothing, housing arrangements, and family support services. In many regards, the Army resembles large civilian employers, and therefore assessing use of the Internet in its recruiting campaign, coupled with the analysis of posterior performance of recruited soldiers, may provide valuable information about the nature of Internet hiring in general.

Prior to detailed discussion of the Army's use of the Internet, this section goes though some conceptual issues regarding recruitment and briefly reviews the Army's recruitment cycle.

The conceptual framework of the recruitment process has been extensively discussed in the literature. According to Orvis and Asch,[8] in 2001 (Figure 5.1) the central element of the conceptual framework is a propensity to serve in the military. It measures overall interest in the Army and is affected by (i) individual tastes for the military service, (ii) societal views for the military service, and (iii) a set of labor conditions, educational opportunities, and recruiting resource levels.

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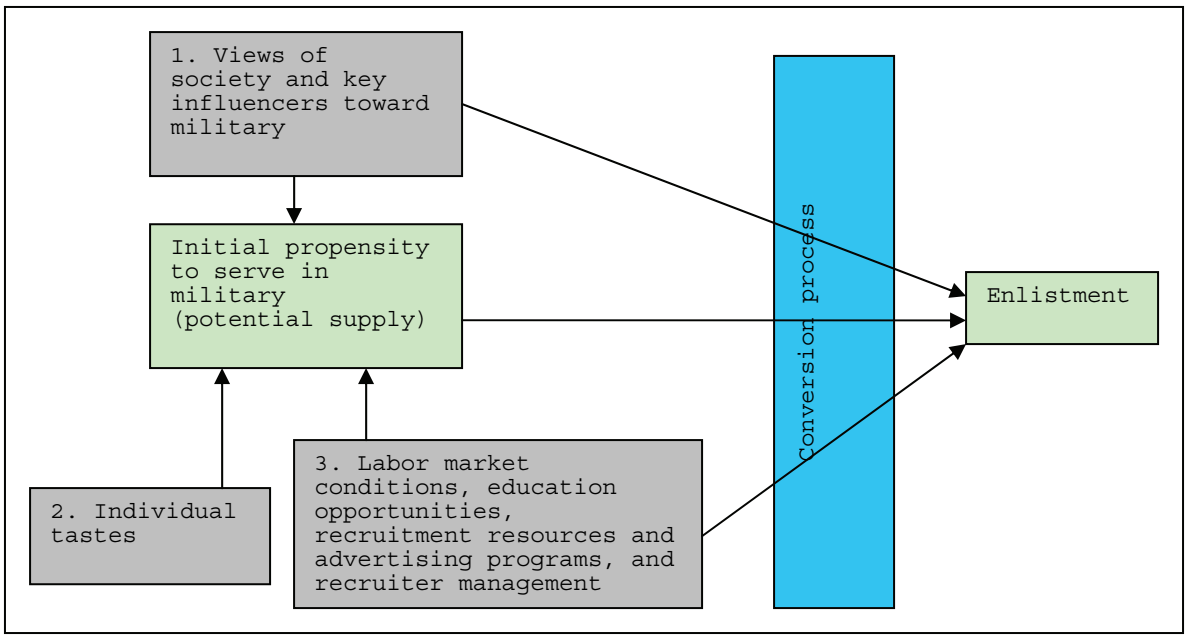
[7] Enlistment missions vary from year to year, as they are determined based on a required manpower accession level and overall tasks of the military and the U.S. Army.
[8] Bruce Orvis and Beth Asch, *Military Recruiting: Trends, Outlook, and Implications*, RAND Corporation 2001.

Figure 5.1 Conceptual framework of the enlistment process.



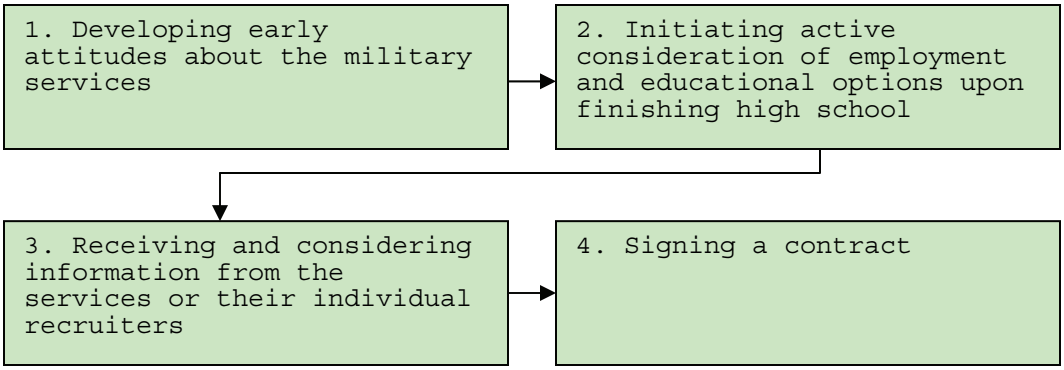
According to Orvis and Asch, factors 1–3 in Figure 5.1 have a direct effect on the conversion process, determining how much of the potential supply is actually tapped in the form of the signed contracts. For instance, more favorable views towards the armed services improve recruiters' access to youth at schools and families. Positive individual taste and attitude for the armed services also improve the efficiency of the conversion process by strengthening the commitment for recruiting events such as counseling. Orvis and Ash also indicate that past research also provides strong evidence that recruiters' performance and resource management factors are associated with improved conversion rates; for example, the mission levels and incentives provided for the recruiters, advertising strategy, and recruiting resource distribution have significant bearing on the success of recruitment campaigns.

Dertouzos and Garber[9] (2003) suggest that potential enlistees go through a sequential process culminating with the contract signing (Figure 5.2). Societal perception, image, and prestige of military service contribute to the development of individual attitudes about military service. The next key moment of the enlistment process is when a teenager actively considers his employment and educational alternatives. It is likely that at this stage a potential enlistee also prioritizes and ranks the branches of armed forces: the U.S Army, U.S. Marine Corps, U.S. Navy, U.S. Air Force, and U.S. Coast Guard. Also at this stage of the process, incentives such as enlistment bonuses and

9 James Dertouzos and Steven Garber, *Is Military Advertising Effective? An Estimation Methodology and Applications to Recruiting in the 1980s and 90s*, RAND Corporation, 2003.

college bonuses are taken into account. Subsequently, the potential enlistee receives and analyzes more detailed information about the terms of service, military career outlook, and potential jobs. At a final stage, an individual signs a contract, accesses (ships) the service, and starts a basic military training program

Figure 5.2 Sequential enlistment process

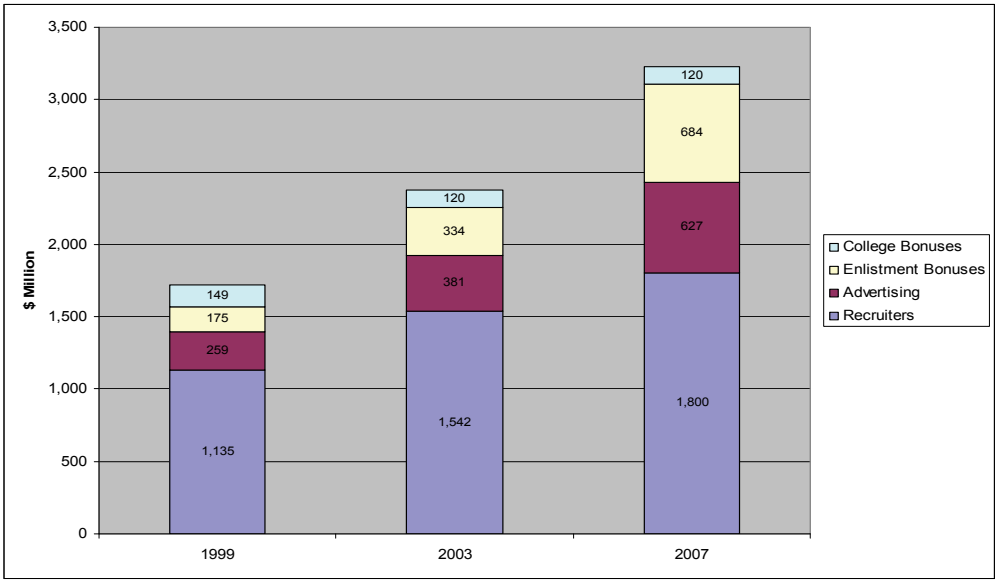


Military advertising has a key role in the recruitment process. It influences attitudes and actions at various stages of a teenager's decisionmaking process. At early years, an individual who is exposed to military advertising may be introduced to the option of military service as a career or service to one's country. Over the years, the propensity of service in the military of such individual may increase, leading to active consideration of enlistment opportunities. Advertisements may also play an important role at a later stage. For example advertising can have reassuring effect at both stages 2 and 3 in Figure 5.2. Overall, a teenager's decisionmaking process and the potential roles of advertising are multifaceted and dynamic, as lags in advertising effects may range from instant to long-term.

The cost of recruitment programs constitutes a significant part of the Department of Defense's (DOD) annual budget. It is estimated that an average cost per enlistee is above $20,000 in the Army and Navy and somewhat smaller in the Air Force and Marine Corps. In 2007, the total recruiting budget for the Air Force, Army, Marine Corps, and Navy topped $3.2 billion. Figure 5.3 presents a more detailed picture of DOD's recruiting expenditures in 1999–2007.[10] Over the reviewed period, DOD's recruiting budget in nominal terms increased by more than 40 percent.

[10] James N. Dertouzos, *The Cost-Effectiveness of Military Advertising: Evidence from 2002-2004*, RAND Corporation, 2009.

Figure 5.3 The annual DOD budget for recruiting active service armed forces



The growth of expenditures on advertising and enlistment bonuses significantly outpaced the trend, with increases of 290.9 and 142.1 percent, respectively. Recruiters' costs increased more modestly—by 58.6 percent. Interestingly, the cost of college-related bonuses declined in nominal terms from $149 billion in 1999 to $120 billion in 2007.

DOD's choice of advertising outlets has changed over time. Historically, DOD strongly relied on advertising via broadcast television and cable TV. In 1984, 72.8 percent of the advertising budget was allocated to broadcast television. However, by the early 90s, TV's share significantly declined. The rise of cable TV penetration in the mid-1990s once again strengthened television's competitive position as a major advertisement outlet.

By 2003, the Internet had become an important factor in the advertising industry, and DOD successfully tapped this opportunity by spending 10.0 percent of its advertising on the Internet; by 2005, it more than doubled it to 23.6 percent. DOD's Internet banners are usually strategically placed on websites with increased youth traffic. Sports, popular culture, and music websites are frequent destinations of the advertising campaign. In addition to advertising opportunities, the Internet has enabled the Army to provide extensive amounts of information. The army maintains its official web portal for recruitment purposes at www.goarmy.com. The web portal is a central authority and has the following structure:

- **About the Army:** Overview, Personnel, Service Options, Training, Careers & Jobs, Vehicles & Equipment, Post Locations, Ranks & Insignia

- **Careers and Jobs**: Overview, Help Choosing a Career / Job, Search Careers & Jobs, Browse Career & Job Categories, Army Friendly Companies

- **Benefits:** Overview, Total Compensation, Money, Education, Health Care and Vacation, Additional Incentives, Soldier & Family Services, After the Army

- **Soldier life**: Overview, Becoming a Soldier, Being a Soldier, Fitness Nutrition, Army Families, A Soldiers Future

- **Information for Parents and Advisors:** Overview, Service Options, Training, Job Opportunities, Money for College & More Benefits, Personal Growth, Deployment, Daily Life, Keeping in Touch, Using GoArmy.com

- **Description of Fields:** Airborne, Army Bands, Army Chaplain, Health Care/Army Medical Department, Law/Judge Advocate General (Jag), Ranger, Reserve Officers' Training Corps, Special Forces

- **Army Events:** Overview, U.S. Army Athletes, Virtual Army Experience, Meet A Drill Sergeant, U.S. Army All-American Bowl, Army Marksmanship Unit, Golden Knights

- **Army Racing:** Overview, Army Team Crossover, NASCAR Sprint Cup, NHRA Top Fuel

- **Games and Downloads:** Overview, Games, Wallpapers and Screen Savers, Ringtones, Podcasts RSS Feeds, Physical Training Guide, Web Players

- **Contact the Army:** Request Info Pack, Ask a Question, Chat with a Recruiter, Locate a Recruiter, Learn How to Join, Ask Sergeant Star, Army Career Explorer, Apply Online, Discussion Board.

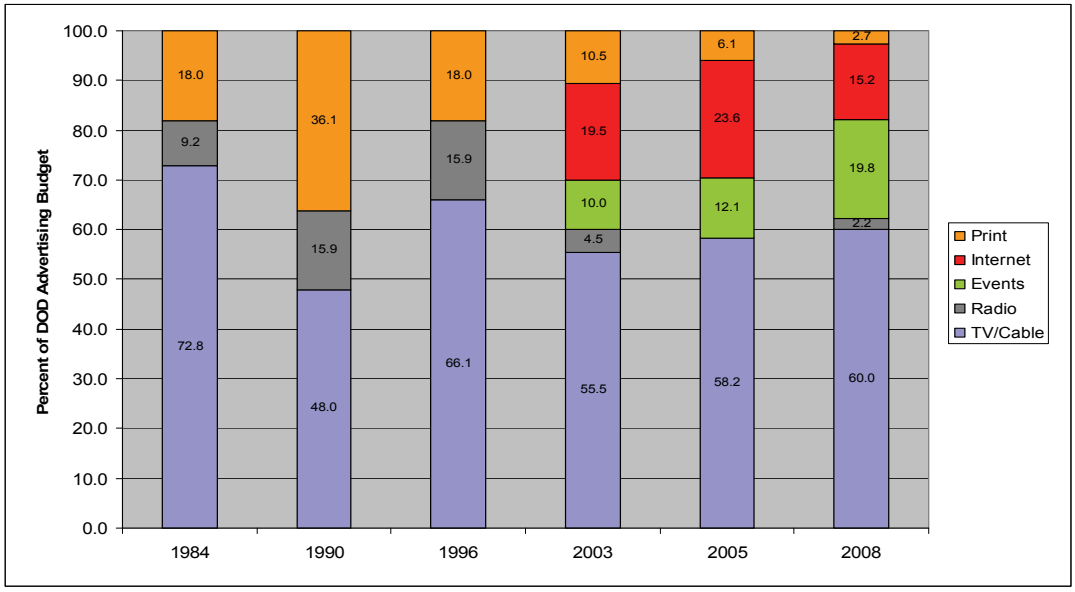
The web portal is well designed, and information is provided using the latest multimedia technologies. It also has fully functional job boards, including personal account maintenance and features for online applications.

More recently, the U.S. Army has penetrated into the social networking realm. It maintains an official presence on Facebook (http://www.facebook.com/USarmy), Twitter (http://twitter.com/USARMY), and Youtube (http://www.youtube.com/USArmy). Among the frequent

destinations for Army banners are also websites of professional sport leagues, popular music events, and TV realty shows.

As Figure 5.4 indicates, the armed forces have significantly expanded their budgets for recruiting events as well. In 2008, events accounted for one-fifth of recruiting budgets. The Army participates in two types of events—local and special events. By far, the most important local events organized by the recruiting station are school visits.

Figure 5.4 The annual DOD Budget for advertising



Source: Dertouzos (2009)

During regular visits to neighborhood high schools, recruiters disseminate information about the opportunities and benefits of military service and collect contact information from interested individuals. Intensity and characteristics of school visits vary from place to place, as each recruiter station functions in a unique external environment and faces recruiting missions. Every special recruiting event is associated with and conducted at a particular national sporting, music, or other type of entertainment event in which the Army is involved as a sponsor and an advertiser. The Internet plays an active role here as well. The Army maintains very informative web pages about special events, their schedule, and organization.

The Army's websites and banner ads are rich in both traditional content and multimedia materials. In fact, in 2007 the Army maintained more than 15,000 pages of discrete Army-related information, which is among the highest numbers of web pages for public organizations in the United States and abroad.

5.2 Who is recruited online: analysis of recruits' characteristics

As the U.S. Army faces multiple options for expanding its recruiting and campaign, it becomes important to assess what types of individuals are drawn to various recruiting channels. Findings from civilian labor markets indicate that use of Internet is significantly associated with the socio-economic status (SES) of the job-seeker. Internet users tend to have higher education levels, have occupations with a lower unemployment rate, are more likely to be white than any other minority, and tend to have a higher household income level.

Identifying a set of attributes that are associated with a specific recruiting channel is important from a planning standpoint. These empirical relationships could be used to target enlistees with a desired educational and occupational profile. For instance, each year the Army faces a challenge to recruit for critical military occupation specialties (MOSs). If a certain recruiting channel is more likely to yield such enlistees, the Army will be in position to increase resources for this recruiting channel via advertising and other programs.

To analyze whether Internet and other recruits have different attributes, this study uses data on the Army's marketing leads for FY2002–2008. According to the Army's definition, a lead is a person who has registered to attend the recruitment event or the acted in response to advertising, direct mail, or recruitment event by requesting additional information via email, mail-in postcard, the Army website, or the Army's 1-800 number. Leads do not include individuals directly contacted by a recruiter and individuals who visit a recruiting station to request additional information about the service without a prior contact. Leads have a low enlistment rate. Dertouzos and Garber (2003) report that in 2002–2004 only 3–6 percent of leads eventually join the U.S. Army by signing an enlistment contract.

In FY2002–2008, the Army enlisted a total of 427,189 soldiers, 45,640 of whom were leads who signed the enlistment contract. The remaining 381,549 enlistees were directly contracted by a recruiter or visited the recruitment center without a prior contact and therefore had no leads information. In addition to Internet recruiting, available data distinguish among four other recruitment channels: a direct mail, TV ads/inbound phone calls, local events, and special events.

Leads data indicate that in the reviewed period of 2002–2008, 58 percent of leads enlisted via the Internet. Direct mail ranks second with 20.6 percent. TV advertising generated 13.2 percent of the enlistees with leads information. Special recruiting events produced 3.3 percent leads and are closely followed by inbound toll-free phone calls.

The smallest number of leads, 1.8 percent, was generated at local recruiting events. Table 5.1 displays mean values for educational and demographic characteristics of the enlistees by major recruiting channels. Overall, mean values show a significant variation in attributes across recruiting channels.

Gender: Internet recruits have the highest percentage of the women (18.8 percent). This is followed by local events, with 17.8 percent of women. Women are less likely to react to TV ads, as only 10.9 percent of the leads in this recruiting category were female.

Age: Internet recruits have the highest average age, 21.5 years. In contrast, local events tend to attract the youngest crowd. This could be explained by the fact that school visits constitute the major part of recruiting campaigns at the local level. The average age of enlistees in this category is 19.4 years. Direct mail and special events follow, with average ages of 19.7 and 20.1 years, respectively.

Race: White enlistees are better represented in TV ads, direct mail, and Internet categories, whereas the shares of African Americans and Hispanics are significantly higher among the individuals who responded to local and special events.

Education: Higher educational attainment seems to correlate positively with use of the Internet. Table 5.1 shows that 12.8 percent of the leads reached via the Internet have taken some college classes or completed college. This is significantly higher than figures in any other recruiting channel. High school graduates were more drawn to local and special events. This finding is likely to be linked to an age and school visits effect discusses earlier. The share of GED diploma holders is around 19 percent. However, among TV/phone leads, the share of GED graduates is extremely high (30.0 percent).

Armed Forces Qualification Test (AFQT): Internet leads and enlistees from a base category appear to have somewhat higher scores on the AFQT. Once again, numbers indicate that enlistees who responded to TV ads and/or placed a phone call to toll-free number had less favorable numbers. The average AFQT score among these enlistees was 55.5, the lowest score across all the recruiting channels.

Table 5.1 Leads by recruiting channels

Explanatory Variables	ARMY WEBSITE/ INTERNET BANNERS	DIRECT MAIL	TV/ ADS INBOUND PHONE	LOCAL EVENTS	SPECIAL EVENTS	OTHER
Female	0.188	0.155	0.109	0.178	0.149	0.161
Age at enlistment	21.5	19.7	21.3	19.4	20.1	21.0
White	0.707	0.739	0.724	0.677	0.633	0.667
Black	0.149	0.125	0.139	0.170	0.190	0.154
Hispanic	0.096	0.097	0.099	0.116	0.148	0.123
Other Race	0.048	0.040	0.189	0.037	0.028	0.056
HS Diploma	0.644	0.753	0.611	0.849	0.780	0.698
GED	0.223	0.185	0.300	0.096	0.133	0.188
Some College	0.077	0.039	0.061	0.041	0.057	0.065
Bachelors/Graduate/Professional Degree	0.051	0.016	0.022	0.007	0.025	0.036
AFQT Percentile	59.2	57.7	55.5	57.0	57.1	59.5
Combat Primary MOS	0.404	0.452	0.510	0.380	0.393	0.403
Initial Pay Grade Level	2.07	1.97	1.97	2.18	2.14	2.03
Northeast: New England	0.036	0.027	0.027	0.007	0.009	0.032
Northeast: Middle Atlantic	0.096	0.074	0.089	0.073	0.057	0.092
Midwest: East North Central	0.156	0.184	0.160	0.192	0.166	0.140
Midwest: West North Central	0.063	0.075	0.074	0.065	0.049	0.063
South: South Atlantic	0.235	0.226	0.216	0.243	0.259	0.205
South: East South Central	0.061	0.071	0.082	0.078	0.061	0.061
South: West South Central	0.142	0.155	0.156	0.176	0.233	0.151
West: Mountain	0.070	0.069	0.069	0.066	0.060	0.075
West: Pacific	0.131	0.105	0.114	0.093	0.099	0.140
U.S. unincorporated territories	0.003	0.002	0.002	0.000	0.001	0.014
Foreign country or N/A	0.008	0.010	0.011	0.006	0.007	0.028
Observations	**26464 (6.2%)**	**9395(2.2%)**	**7429(1.7%)**	**830(0.2%)**	**1522(0.4%)**	**381549 (89.3%)**

Initial pay grade level and combat MOS: Initial pay level is a critical indicator that reflects educational level, AFQT score, and MOS of the enlistee. The mean of the initial pay grade level is around 2. Local and special event enlistees tend to start, on average, with slightly higher pay level, whereas TV/phone and direct mail leads tend to start a lower pay level. While it is hard to hypothesize what causes these differences, it expected that pay level is most likely linked with other attributes. The multivariate analysis in the next section may be of help in sorting out these factors.

Advertising on broadcast and cable TV is more likely to generate leads with combat MOSs. Specifically, 51 percent of the enlistees originating from TV/phone leads sign up for a combat profession. For comparison, the share of combat soldiers in the entire sample is 40.6 percent.

Regression analysis allows controlling for a set of covariates. Since there is no natural ordering in the recruitment channel alternatives study, a multinomial logit model is utilized. A multinomial logistic model assumes that the utility of each alternative is a function of observed characteristics and an error term. Individuals select an alternative with the highest utility. Formally, estimation assumes that there is a choice of *M* alternatives, indexed j=1,2,... *M.* The ,odel predicts the probability (*P*) for each individual to select a particular alternative *j* where:

$$P\{y_i = j\} = \frac{\exp\{x_i'\beta_j\}}{1 + \exp\{x_i'\beta_2\} + \ldots + \exp\{x_i'\beta_M\})}, \quad j=1,2,\ldots,M.$$

where x_i is a *K*-dimensional vector containing the observable characteristics of individual I (including intercept term) and β_j denotes a vector of alternative-specific coefficients. The model assumes that ε_{ij} are mutually independent, with log the Weibull distribution.

Table 5.2 presents finding from the regression. It lists an estimated coefficient, odds ratio as well *p*-value associated with these parameter estimates. The omitted (base) category is other recruiting channel (individuals with no leads information). Therefore, the interpretations of coefficients and odds ratio are relative to the enlistee who was directly contacted by recruiters or visited the recruiter station without a prior contact. The base category for race is white; for sex, the base category is male; and for educational attainment, the base category is high school graduate.

Gender: Logistic regression confirms earlier cross-tabulation indicating that women are significantly more likely to enlist through the Internet. The odds ratio for women is 1.30. Further, women are less likely to react to TV ads and/or place a phone call to the 1-800 number. The odds ratio for this leads channel is 0.75. For women, estimates also indicate a sizable and statistically significant negative effect for special events (odds ratio of 0.81).

Age: Findings from the regression confirm that local special events tend to generate the youngest group of potential enlistees. Leads generated at special events and via a direct mail are also associated with a significantly younger cohort of enlistees. In contrast, older enlistees are more likely to be enrolled after placing a phone call to the 1-800 number or clicking on Internet banners and websites.

Race: White enlistees were better represented in the TV/phone, direct mail, and Internet categories, whereas shares of African Americans and Hispanics enlistees are significantly higher among special event leads. There results are in line with tabulated means discussed earlier. The effect of local events on minorities seems to disappear once controls for the observable characteristics are introduced in the model.

Education: As expected, higher educational attainment is positively correlated with use of Internet. The correlation is sizable and consistent. In line with findings from descriptive statistics, GED graduates are significantly more likely to react to TV ads and/or placing phone calls than enlistees with any other level of education.

AFQT: Regression estimates indicate nonlinearity in the relationship of AFQT scores and use of Internet in the enlistment process. The share of Internet leads is higher among categories I and IV and lower among categories II and IIA. Once again, results indicate that leads originating from TV ads and/or inbound phone calls have consistently lower AFQT scores.

Table 5.2 Multinomial logit model of recruitment channel selection*

Explanatory Variables	INTERNET		DIRECT MAIL		TV ADS/ PHONE CALLS		LOCAL EVENTS		SPECIAL EVENTS	
	Coef	Odds ratio	Coef	Odds ratio	Coef	Odds ratio	Coef	Odds ratio	Coef	Odds ratio
Female	0.26***	1.30	0	1.00	-0.28***	0.75	-0.01	0.99	-0.21***	0.81
Age at enlistment	0.03***	1.03	-0.23***	0.80	0.04***	1.04	-0.32***	0.73	-0.15***	0.86
Black	-0.13***	0.87	-0.32***	0.73	-0.14***	0.87	-0.07	0.93	0.14*	1.15
Hispanic	-0.20***	0.82	-0.21***	0.81	-0.19***	0.83	0.02	1.02	0.29***	1.33
Other Race	-0.06*	0.94	-0.17***	0.84	-0.30***	0.74	-0.13	0.88	-0.35**	0.71
GED	0.01	1.01	-0.25***	0.78	0.39***	1.48	-1.03***	0.36	-0.68***	0.51
Some College	0.14***	1.15	-0.07	0.93	0.07	1.08	0.03	1.03	0.16	1.17
Bachelors/Graduate/ Professional Degree	0.26***	1.30	0.28***	1.32	-0.16*	0.85	-0.36	0.70	0.38*	1.46
AFQT Category II	-0.07**	0.94	-0.03	0.97	0.53***	1.54	-0.48***	0.61	-0.02	0.97
AFQT Category IIIA	-0.08***	0.93	0.05	1.03	0.75***	1.79	-0.33**	0.73	0.09	2.11
AFQT Category IIIB	0.01	1.01	0.11**	1.13	0.89***	1.92	-0.28*	0.78	0.17	1.18
AFQT Category IV	0.33***	1.35	0.29***	1.33	1.16***	1.24	0.09	1.12	0.19	1.20
Combat Primary MOS	0.06***	1.08	0.10***	1.11	0.29***	1.29	-0.1	0.89	-0.03	0.97
Observations	418925									

Robust SE in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%
Regression also controls for enlistees' geographic home division and enlistment year. Those coefficients are not presented in the table.

Combat MOS: Leads generated via advertising on broadcast and cable TV and/or through a phone call to the 1-800 number are more likely to enroll with a combat MOS. Compared with a base category, Internet and direct mail leads are also more likely to select a combat occupation, although the correlation is less strong than in case of TV/phone leads.

Multinomial logit models frequently have the undesirable property of independence of irrelevant alternatives (IIA). This model has been examined using the Hausman technique, which tests whether model parameters can be estimated consistently by applying the multinomial model to any subset of alternatives. Result from the Hausman test indicate that IIA is not a problem in the estimated model.

5.3 Description of empirical approach

The central policy issue in the analysis of recruiting leads is whether the soldiers recruited via certain channels, conditional on their characteristics, perform better. In this section, the discussion is focused on the Internet as a recruitment channel. The analysis considers four metrics of an enlistee's performance: (i) early attrition rate. (ii) time until one-grade promotion, (iii) reenlistment decision, and (iv) total length of service. The primary challenge of such an analysis is the empirical framework, because Internet use (IJS) by potential enlistees is correlated with a wide range of observable characteristics, as shown in Section 5.2. More problematically, Internet use may be correlated with unobserved characteristics of future soldiers. In other words, a problem arises when those unobservable characteristics influence use of the Internet for job search, which could be considered as a treatment choice that results in a biased parameter estimate of treatment effect. More formally, let us consider a causal effect estimation using regression form,

$$Y_i = \alpha + \theta IJS_i + \varepsilon_i$$

where Y_i is an outcome variable such as early attrition, time to promotion, reenlistment decision, or length of service; θ is treatment effect (effect of enlisting via the Internet); and ε_i is a random disturbance term. The difference in outcomes between those who are in treatment and control groups[11] can be summarized as follows:

$$E[Y_i \mid IJS_i = 1] - E[Y_i \mid IJS_i = 0] = \theta + (E[\varepsilon_i \mid IJS_i = 1] - E[\varepsilon_i \mid IJS_i = 0])$$

[11] Control group refers to the enlistees selected via non-Internet channels.

where T_i is a dummy variable indicating treatment, θ - treatment effect $(E[\varepsilon_i \mid IJS_i = 1] - E[\varepsilon_i \mid IJS_i = 0])$ is a measure of selection bias. In random experiments, this expression is equal to 0. However, in studies that use observational data, this expression can easily deviate from zero. To obtain an unbiased estimate of θ, the study applied two concepts – conditional independence and covariate overlap – that are frequently used in the literature and summarized by Imbens and Wooldridge in 2009.

The conditional independence approach decomposes the disturbance term ε_i into a linear function of observable characteristics X and the residual ϕ_i that is uncorrelated with X:

$$\varepsilon_i = X_i'\lambda + \phi_i$$

Further, estimation of

$$Y_i = \alpha + \theta IJS_i + \lambda X_i' + \phi_i$$

will produce unbiased estimate of θ since ϕ_i is uncorrelated with X_i.

The assumption that ϕ_i is uncorrelated with X_i is fairly strong. If this assumption fails, the regressions will produce inconsistent parameter estimates. The instrumental variable approach used in Chapter 4 yields consistent estimates, enabling measure of both direction and magnitude of causation. For the U.S. data in Chapter 4, the study uses the percentage of residential end-user premises with access to high-speed Internet services at the zip code level as an instrument for use of the Internet in the job search process. Unfortunately, in the U.S. Army case, the zip code of the recruit is not available in the Army datasets. Search for other instrumental variables failed to produce suitable candidates. In the absence of valid instrumental variables and with the aim to reduce the selection bias associated with use of the Internet, the study utilizes the propensity score method.

The propensity score method that is usually applied in the context of the overlap condition. Following Imbens and Wooldridge (2009), the overlap condition is defined as:

$$0 < p(IJS_i = 1 \mid X_i = x) < 1, \text{ for all } x$$

where p is conditional probability of using the Internet in job search. This condition implies that covariate X distribution in treated group (IJS=1) is sufficiently alike to covariate distribution of these variables in the control group (IJS=0). There are several ways to compare covariate distribution in the treated and control group. Descriptive statistics and distribution histograms are frequently used in the literature. Imbens and Wooldridge (2009) suggest examining the normalized differences for each covariate. If such comparisons reveal that covariate distributions vary significantly for treatment and control groups, the latter can be trimmed. The propensity score is the most popular trimming technique. Propensity score is defined as the conditional probability of being treated (enlisting via the Internet), given the observable socio-economic and demographic characteristics, and can be applied to balance such covariates in the treatment and control groups and therefore reduce selection bias (if any). As a result, propensity score matching involves dropping observations that exhibit a high propensity of being in the treatment group or in the control group. These observations are unlikely to be observed if assignment has been randomized.

Compared with estimates from the untrimmed (raw) sample, the propensity score method produces parameter estimates that are less likely to be biased and more likely to be consistent. However, compared with the instrumental variable approach, the propensity score method relies on the stronger although feasible assumption. It assumes that individuals with a similar probability of being in the treatment group (i.e., enlisting via the Internet) have a similar set of unobserved characteristics. In other words, the propensity score method attempts to mimic the random assignment in which the individual has an equal probability to be placed in the treatment and control groups.

In sections 5.4–5.7, the propensity score is used to match each Internet recruit to five other recruits on propensity score using nearest neighbor matching without replacement technique. Consequently, the sample is reduced to 60,144 observations. The distributions of major covariates in the treatment and control group before and after propensity score matching are displayed in Figure A.5.1. Notably, propensity score matching has significantly improved the overlap of covariates. Therefore, for each performance indicator (early attrition rate, time until one-grade promotion, reenlistment, and total length of service), the study uses both conditional independence and covariate overlap methods to explore the relationship between Internet enlistment and posterior performance of the soldier.

5.4 Recruitment channels and first-term attrition rate

The first-term attrition rate is an important indicator that has major policy implications for the U.S. Army because it costs the Army (and other services) millions of dollars annually to replace lost labor and train newly hired enlistees. Several previous studies assessed the relationship between recruits' demographic and educational characteristics and first-term attrition rate. Direction of the relationship between age at enlistment and attrition rate is not certain. Buddin (1984) found a positive relationship between male attrition during the first six months of service in the U.S. Army, Navy, and Marine Corps. Grissmer and Kirby (1984) came up with similar results for the Army Reserve and Army National Guard. However, in a subsequent RAND study, Buddin (1988) finds no straightforward relationship.

African Americans tend to have lower first-term attrition rates in the Army and other services. Buddin (1981, 1984, and 1988) consistently finds that black enlistees have lower attrition rates both for men and women. These results are confirmed by a study of the Army Reserve and Army National Guard by Grissmer and Kirby (1984). A very limited number of studies assessed the relationship between marital status and first-term attrition. Buddin (1981) finds that Army enlistees married at the time of recruitment were less likely to be separated after training than their single colleagues. Further, Buddin also finds that soldiers with dependents show a somewhat reduce marriage effect.

A large number of studies have attempted to link empirically enlistees' educational attainment and aptitude with first-term attrition. In fact, education level and AFQT are among the formal enlistment standards. Studies have found that having a high-school diploma accounts for more variation that any other variable. Studies such as Buddin (1981, 1984), Kohen (1984), Means and Heisey (1986), and Grissmer and Kirby (1984) find that enlistees with a high school diploma are considerably less likely to separate due to attrition. Blaker and Fraker (1986) and Antel, Hosek and Peterson (1987) find that interest in college education is correlated with lower attrition rate.

An enlistee's aptitude level, as measured by AFQT score, has been frequently used to explain early separation decisions. Buddin (1984, 1988) and Grissmer and Kirby (1984) find a negative relationship between AFQT and the probably of attrition. Black and Fraker (1986) confirm this relationship. Furthermore, the effect of lower AFQT percentile on attrition is stronger for black enlistees than for whites.

This study considers analysis of attrition rates within the first 24 months of active duty service. As a norm, Army enlistees incur an

eight-year military service obligation. For most soldiers, three or four years of the commitment is served on active duty. The remainder of the eight-year service obligation can be fulfilled as (i) an active member of the Army Reserve or National Guard, (ii) an inactive member of Individual Ready Reserve (IRR), or (iii) as a member of a National Service Program such as AmeriCorps or the Peace Corps. For a few occupations that don't require extensive training time, the Army allows individuals to enlist for teo years of active duty. Partly for this reason, this study uses a 24-month period as a cutoff for first-term attrition.

Attrition of Army enlistees is frequently considered in the analytical framework of job separation in the civilian sector. Buddin (1984) led the way on this approach by placing early attrition into two types of job separation models widely used in labor economics: a firm-specific human capital model and a job matching model.

The firm-specific human capital model recognizes that, during employment, in addition to many transferable skills, an employee acquires a set of skills and knowledge uniquely suited to a given employer. Employers value such skills and pay a premium for them. A firm-specific human capital model implies that

$$MRP > w > w_a$$

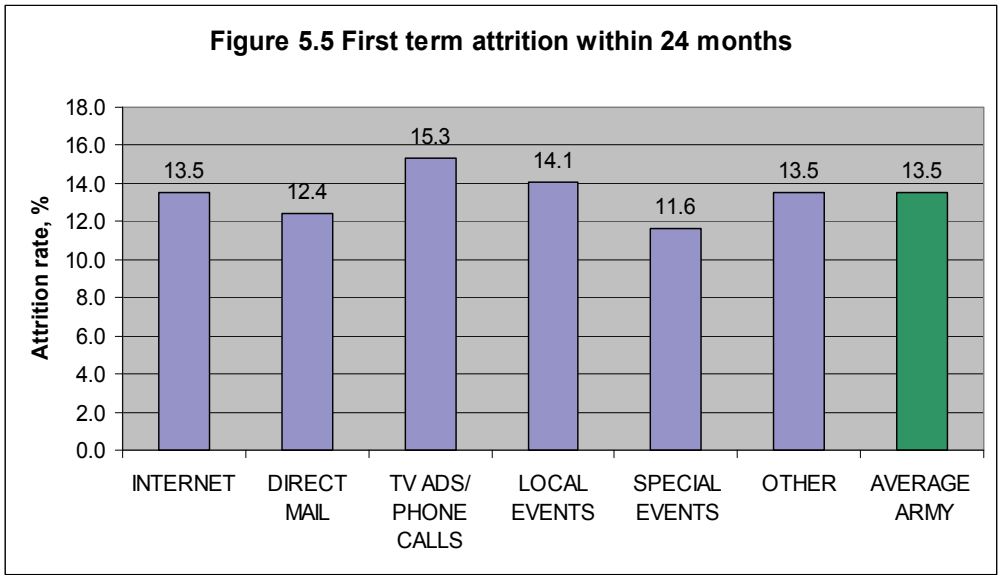
where MRP is marginal revenue product, w is a paid wage at a firm, and w_a is the alternative wage at another firm where firm-specific skills are not compensated. $(MRP - w)$ is a firm's return for recruiting and training efforts; $(w - w_a)$ is the employee's premium for acquiring firm-specific skills. Firm-specific investments have a cumulative effect. With an increased tenure at a firm, $(MRP - w_a)$ is expected to grow, making it even harder for a firm to let the employee separate. So the model predicts that the number years of employment is negatively correlated with a separation rate.

In addition to tenure, the model emphasizes the role of education and aptitude in accumulating firm-specific human capital. In a certain time period, more educated and more able employees accumulate a greater amount of human capital, including firm-specific skills. In other words, a firm-specific human capital model predicts that, controlling for tenure, more educated and more able employees are less likely to separate. The tenure effect is not very relevant for the Army analysis, since the study is limited the study to first-time enlistees.

Consequently, the key hypotheses that can be drawn from the firm-specific human capital model are related to the relationship between (i) education level and attrition and (ii) aptitude and attrition. The study uses the educational attainment and AFQT to test both of these hypotheses.

The bob matching models explain job separation using constructs of imperfect information and uncertainty. When the contract is signed, neither the employer nor the employee have full information about the goodness of the odel (Jovanovich, 1979; Wilde, 1979). As the employee gains experience in the new position and the employer observes the employee's performance, they each update their expectations. If the value of the match is significantly reduced after such an update, the employer or the employee can terminate the contract. For that reason, the job matching model predicts that availability of more complete information about the employees and the position reduces the likelihood of a bad match and early separation. In theory, the Internet has had a crucial role in accomplishing this mission, as it has substantially improved access to information both for employers and job-seekers. In fact, these days potential enlistees have 24/7 access to enormous amount of information about terms of service. Accordingly, the maintained hypothesis is that recruitment via the Internet is negatively related to attrition rate.

To avoid the effect of censored observations, the analysis is restricted to the enlistees with an accession date between January 2002 and September 2006. As shown in Figure 5.5, attrition levels vary significantly across the advertising channels. Recruits generated via TV/phone have the highest attrition rate, 15.3 percent, within the first 24 months of service. Enlistees who responded to the special events have the attrition rate of 11.6 percent, the lowest rate across all recruitment channels. Soldiers enlisted via the Internet seem to have same attrition rate as Army average (13.5 percent).



The logistic model helps to determine the relationship between leads channels and attrition probability. The study uses a standard logit framework to estimate three different models. In the first model, the controls include recruitment channels and set of socio-economic status (SES) variables used earlier. The second model compares Internet recruits against all other enlistees. By controlling for covariates in the first and second specifications, the study attempts to use the conditional independence approach discussed earlier in the section.

The third specification uses a trimmed sample for the purpose of creating treatment and control groups that satisfy the overlap condition. As discussed earlier, each observation in the treatment group (enlistees who enlisted through the Internet) is matched with five observations in the control group (enlistees who didn't use the Internet during the recruitment process) with closest propensity score. The distributions of major covariates in the treatment and control group before and after propensity score matching are displayed on Figure A.5.1. Overall, propensity score matching has significantly improved the overlap of covariates.

Table 5.3 reports both coefficients and marginal effects at mean values. Compared with the referenced recruitment channel, the probability of attrition for Internet recruits is about 1.0 percentage points lower. The recruits hired through direct mail communication are also less likely to attrite (0.9 percentage points). TV/phone leads are the only group of soldiers with a higher probability of attrition. Their marginal effect on attrition is 1.2 percentage points higher than for the soldiers in the reference category.

Table 5.3 Logit model of the attrition within first 24 months of service

	Spec. 1 All recruitment channels		Spec. 2 The Internet vs. other channels		Spec. 3 The Internet vs. other channels, Propensity score method	
	Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
ARMY WEBSITE/INTERNET BANNERS	-0.10***	-0.010***	-0.10***	-0.010***	-0.11***	-0.011***
	[0.03]		[0.03]		[0.03]	
DIRECT MAIL	-0.08**	-0.009**				
	[0.04]					
TV ADS/ PHONE	0.12***	0.013***				
	[0.04]					
LOCAL EVENTS	0.12	0.014				
	[0.14]					
SPECIAL EVENTS	-0.16	-0.016				
	[0.11]					
Female	0.97***	0.133***	0.97***	0.132***	1.03***	0.142***
	[0.01]		[0.01]		[0.03]	
Age at enlistment	0.02***	0.002***	0.02***	0.002***	0.02***	0.002***
	[0.00]		[0.00]		[0.00]	
Black	-0.23***	-0.024***	-0.23***	-0.024***	-0.31***	-0.032***
	[0.02]		[0.02]		[0.04]	
Hispanic	-0.36***	-0.034***	-0.36***	-0.034***	-0.40***	-0.039***
	[0.02]		[0.02]		[0.05]	
Other Race	-0.36***	-0.034***	-0.36***	-0.034***	-0.28***	-0.028***
	[0.03]		[0.03]		[0.06]	
GED/No HSD	0.44***	0.053***	0.44***	0.053***	0.44***	0.054***
	[0.01]		[0.01]		[0.03]	
Some College	-0.02	-0.002	-0.02	-0.002	-0.08	-0.008
	[0.02]		[0.02]		[0.05]	
Bachelors/Graduate/ Professional Degree	-0.42***	-0.039***	-0.42***	-0.039***	-0.44***	-0.041***
	[0.04]		[0.04]		[0.08]	
State unemployment rate at enlistment	-0.02***	-0.002***	-0.02***	-0.002***	-0.03*	-0.003*
	[0.01]		[0.01]		[0.02]	
AFQT Category II	0.22***	0.024***	0.22***	0.024***	0.35***	0.040***
	[0.03]		[0.03]		[0.06]	
AFQT Category	0.31***	0.035***	0.31***	0.036***	0.46***	0.055***

IIIA						
	[0.03]		[0.03]		[0.06]	
AFQT Category IIIB	0.34***	0.038***	0.34***	0.038***	0.44***	0.052***
	[0.03]		[0.03]		[0.06]	
AFQT Category IV	0.26***	0.031***	0.27***	0.031***	0.39***	0.050***
	[0.05]		[0.05]		[0.10]	
Combat Primary MOS	0.06***	0.007***	0.06***	0.007***	0.10***	0.011***
	[0.01]		[0.01]		[0.03]	
Observations	299364		299364		60144	

Robust SE in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Constant coefficients and coefficient for year dummies and U.S. geographic divisions are not shown in the table.

These findings also demonstrate that the attrition rate among women is significantly higher. Compared with men, women have 13.3 percentage points higher probability of attrition within the first 24 months. Older enlistees were slightly more likely to attrit as well, which confirms findings from Buddin (1984) and Grissmer and Kirby (1984). Minorities have lower attrition rates. The marginal effect for Hispanics is -3.4 percentage points, for African Americans it is -2.4 percentage points, and for other minorities it is -4.7 percentage points. These findings are in line with previously published literature.

Soldiers who have a bachelor's degree were least likely to drop out. Compared with the reference group, high school graduates, college graduates had 3.5 percentage points lower probability of attrition. Enlistees without a high school diploma (GED diploma) had the highest dropout rate, which confirms findings from Buddin (1981,1984), Kohen (1984), Means and Heisey (1986), and Grissmer and Kirby (1984). Specifically, the findings indicate that probability of attrition for GED holder is 4.7 percentage points higher than for high school graduates. Next, te enlistees with some college education are not different from high school graduates in terms of attrition rates. In line with expectations, the state-level unemployment rate seems to correlate negatively with the attrition probability. The estimated model estimates indicate that a 1 percentage point increase in the state unemployment rate decreases the probability of attrition by 0.2 percentage points. This result may suggest that alternative labor opportunities have an impact on the decision to leave the Army.

Regression findings also indicate inverse relationships between AFQT category and attrition rate. Similar to earlier findings by Buddin (1984, 1988) and Black and Fraker (1986) the study finds that enlistees with AFQT I have the lowest attrition rates. Attrition increases

gradually for lower AFQT categories. For instance, enlistees in the AFQT IIIB category have 3.8 percentage points higher probability of attrition than enlistees in the AFQT I category. Enlistees with combat MOSs are more likely to drop out, with a marginal effect of 0.7 percentage points.

The second specification produces very similar results. Internet recruits have 1 percentage point lower attrition rate in comparison with other enlistees. Parameter estimates and marginal effects for the remaining variables are identical or very similar to those in specification 1.

Propensity score matching reduces the sample to 60,144 observations. Thus, specification 3 uses a dataset that is one-fifth as large as the one used in specifications 1 and 2. Nevertheless, coefficient and marginal effect estimates produced by a logistic regression in the third model are very similar to estimates in model 2. The study finds that, compared with other enlistees, Internet recruits have 1.1 percentage points lower attrition rate. Coefficient estimates from model 3 indicate robustness of the findings in model 1 and 2.

As discussed earlier, first-term attrition rate is the key indicator of soldiers' early performance from a manpower management and planning perspective. Lower attrition rates are desirable, as they allows the Army to recoup its recruiting and advertising expenditures as well as cost of initial basic training. In this regard, the findings are optimistic, as they indicate that enlistees who used the Internet in the recruitment process are less likely to drop out within first 24 months of service.

5.5 Recruitment channels and pace of one-grade promotion

Very few studies have analyzed promotion as a dependent or explanatory variable in the context of U.S. Army or other services. Early studies on the speed of promotion in the U.S. Army were focused on the demographic characteristics of enlistees. Differences between African American and white enlistees were frequently assessed in the literature. Butler (1976) and Nordlie and Carroll (1976) find that, even controlling for civilian education, AFQT score, and occupation type, blacks consistently take more time to make grade than whites. Findings are robust across to pay grade category.

Nordlie and Carrol also find that education level seems to have an inverse U shape relationship with time to promotion. Low (no high school) and high education (some college) levels were correlated with a faster promotion rates than those with medium (high school only) education. Interestingly, Nordlie and Carrol's findings also suggest

that high AFQT score was associated with a faster promotion for white enlistees. For African American soldiers, high AFQT did not lead to faster promotion. In contrast, blacks with better aptitude scores had a slower promotion speed than their colleagues with lower scores.

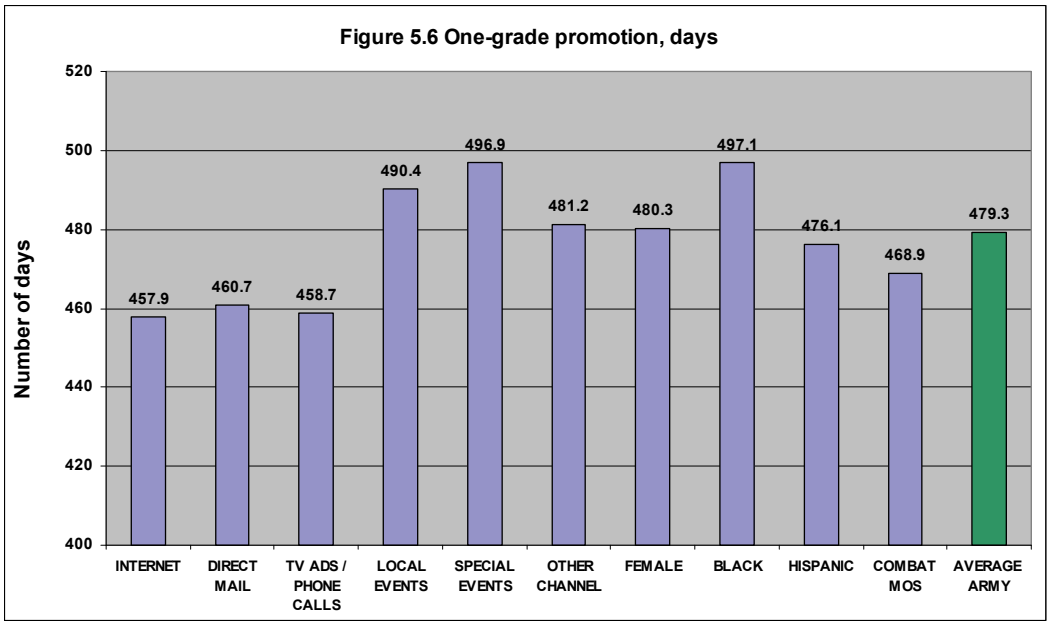
A number of recent studies have assessed promotion speed as function of education level, aptitude scores, and demographic characteristics. By far, the most comprehensive study on promotion was conducted by Buddin et al. (1992). The study finds that that promotion speed slowed down considerably in the late 1980s and early 1990s. Historically, by the end of the first term most enlistees reach pay grade E4 and are eager to get to grade E5. Focusing on expected timing to pay grade E5, Buddin et al. find that the Army soldiers with some college education have a promotion time 7 percent faster than high school graduates. Interestingly, GED holders perform as well as high school graduates. Finally, enlistees without a high school diploma tend to proceed much (16 percent) more slowly than high school graduates. AFQT scores perform as expected. A 10 percentage point increase in AFQT is associated with about a one-and-a-half month decrease in expected promotion time.

Promotion times vary significantly by occupation. Soldiers with combat occupations have at least a 10 percent faster pace than other enlistees. Buddin et al. also find that medical, dental, and craftsman occupations have a 20 percent lower promotion rate tempo than do combat occupations. Furthermore, a one-month increase in wait time for pay grade E4 implies a one-month increase in expected time to pay grade E5. The study concludes that the promotion pace plays a crucial role in soldiers' career choices and therefore it should be a part of retention analysis.

Chae (2008) estimates the effect of graduate education on the promotion of a U.S. Army field grade officers. Using probit estimation methods, Chae finds that graduate education increase officers' promotion probabilities by 0.148 and 0.132 for the grades of lieutenant colonel and colonel, respectively.

The U.S. Army uses separate pay grade systems for the enlisted soldiers, warrant officers, and officers. Pay grades are closely linked to military rank and used to determine remuneration (basic pay rate and bonuses) and benefits of the enlistee. Table A.5.1 in the appendix lists the U.S. Army pay grades for the enlisted personnel together with corresponding military rank, basic pay, and years of service as of January 1, 2009. Initial pay grade depends on a set of various pre-enlistment factors such as enlistee's education, prior professional

experience, and available job skills. Initial pay level also varies across the AFQT categories and MOS characteristics.



In the group of the soldiers who enrolled between January 2002 and September 2008, 29.9 percent were assigned to pay grade E-1, 42.1 percent to pay grade E-2, 23.2 percent to pay grade E-3, and 4.8 percent to pay grade E-4. At an early stage of the military service, subject to satisfactory performance, many soldiers are promoted to the next level on a regular basis. Almost all of the non-attrited enlistees received at least a one-grade promotion within the analyzed timeframe. Therefore, rather than examining the level of the promotion per se, this study utilizes the change in level. Figure 5.6 displays the mean number of days in service until the first one-grade promotion for each group of soldiers. On average, it takes 479 days for the enlistees to receive such promotion. Soldiers in the group of Internet leads are promoted significantly faster, with an average of 457.8 days. Direct mail and TV/phone leads are on a faster track as well; they are promoted around 20 days earlier than enlistees in "Other" category. On the contrary, soldiers who initiated contact at the local and special events stay somewhat longer in the original pay grade.

The results show no sizable gap between men and women in the pace of the first one-grade promotion. The data show no delay in promotion for Hispanics; however, it seems that it takes African American considerably longer (497.1 days) to get their first one-grade promotion. Finally, the data also show that enlistees with combat MOSs get the

first promotion more quickly, in 468.9 days as opposed to non-combat MOSs' 487.1 days.

To determine the relationship between recruitment channel and days until one-grade promotion of enlistees, the study estimates three different models. In the first model, right-hand side variables include those for recruitment channels and the set of SES variables used earlier (Equation 3.1). In second model, Internet recruits are compared with all other enlistees.

For various reasons, many enlistees leave the Army before they get a promotion in pay grade. If this issue is unchecked in the analysis, it can cause a major problem because the estimation using ordinary least squares (OLS) may produce biased and inconsistent parameter estimates. This problem is approached by using attrition weights. For each enlistee, probability of attrition is based on the parameter estimates from the attrition regression. Next, these probabilities are utilized to calculate analytic weights w_i:

$$w_i = \frac{p_i}{1 - p_i}$$

where p_i is the probability of attrition for soldier *i*.

Table 5.4 lists findings from the OLS regression of the number of days until one-grade promotion. The set of covariates variables include variables for recruiting channels, age, race, civilian educational attainment, AFQT category, and MOS.

Table 5.4 Number of days till first one-grade promotion

	Number of days till first one-grade promotion		
	Spec. 1 All recruitment channels	Spec. 2 The Internet vs. other channels	Spec. 3 The Internet vs. other channels, Propensity score method
INTERNET	-3.65**	-3.91***	-3.43**
	[1.43]	[1.43]	[1.54]
DIRECT MAIL	3.89		
	[2.47]		
TV ADS / PHONE	3.69		
	[2.76]		
LOCAL EVENTS	-3.96		
	[6.61]		
SPECIAL EVENTS	13.51**		
	[6.66]		
Female	-13.19***	-13.21***	-6.54***
	[1.26]	[1.26]	[1.98]
Age at enlistment	-2.21***	-2.22***	-1.65***
	[0.15]	[0.15]	[0.22]
Black	12.85***	12.82***	5.90***
	[1.49]	[1.49]	[2.27]
Hispanic	-1	-1.01	-2.1
	[1.36]	[1.36]	[2.23]
Other Race	-2.14	-2.18	1.03
	[1.90]	[1.90]	[3.34]
GED/No HSD	16.76***	16.75***	9.97***
	[1.23]	[1.23]	[1.66]
Some College	-6.47***	-6.48***	-4.93**
	[1.47]	[1.47]	[2.35]
Bachelors/Graduate/ Professional Degree	-20.29**	-20.28**	-5.43
	[9.55]	[9.55]	[16.16]
AFQT Category II	6.51***	6.52***	7.22**
	[1.93]	[1.93]	[3.11]
AFQT Category IIIA	12.05***	12.08***	9.89***
	[1.99]	[1.99]	[3.12]
AFQT Category IIIB	14.68***	14.73***	11.46***
	[2.01]	[2.01]	[3.16]
AFQT Category IV	19.99***	20.07***	18.91***
	[2.98]	[2.98]	[4.21]
Combat Primary MOS	-12.69***	-12.66***	-10.16***
	[0.91]	[0.91]	[1.41]
Observations	171220	171220	41823
R-squared	0.50	0.50	0.62

*significant at 10%; ** significant at 5%; *** significant at 1%
Constant coefficients and coefficient for year dummies, pay grades, and U.S. geographic divisions are present in all three models but not shown in the table.

The results show that Internet leads tend to be consistently on a faster track; however, the size of the effect is almost negligible. For instance, from Model 2 the effect is limited to -3.91 days. In other words, Internet enlistees receive their first one-grade promotion roughly 4 days earlier than enlistees who didn't use the Internet in the recruitment cycle. Estimates indicate that enlistees recruited at special events have somewhat slower promotion pace. It takes them about two weeks longer, on average, to obtain a one-grade promotion. Findings for other recruiting channels are not statistically insignificant.

These estimates also indicate that female enlistees consistently get a promotion in slightly shorter period of time. Results from the first and second models show that they achieve a first one-grade promotion about 2 weeks earlier than men. The pace of promotion for men and women somewhat converges once the controls for covariate overall condition in model 3 are introduced.

Next, African Americans seem to have a slower pace of promotion. As reported earlier, Butler (1976) and Nordlie and Carroll (1976) found a similar relationship. Regressions identify an inverse relationship between educational attainment and time to one-grade promotion. Servicemen with GED or without a high school diploma tend to progress much slower. The relationship is statistically significant, and the delay is about 17 days. Once again, the size of the delay somewhat shrinks in the third model. College attendance and graduation tend to quicken the promotion pace. From the first model, its estimated that college attendees get promoted about a week earlier and college graduates get promoted about 3 weeks earlier than enlistees with just a high school diploma. These findings are in agreement with Buddin et al. (1992).

Estimates for the coefficients of the AFQT categories are in line with findings from past literature. Category I servicemen tend to get all levels of promotion in a shortest period of time. AFQT Category II personnel also perform better than enlistees with lower AFQT scores. Next, soldiers with AFQT IIIA have shorter periods than do those categories IIIB and IV. Finally, AFQT IIIB enlistees outperform soldiers with AFQT IV. Findings presented in Table 5.4 also confirm Buddin et al.'s (1992) findings that enlistees with a combat MOS tend to have shorter periods between promotions in pay grade.

5.6 Recruitment channels and reenlistment

A large number of studies have explored retention and reenlistment decisions. As reported earlier, no empirical literature has attempted to link Internet recruiting efforts with retention or reenlistment rates.

In contrast, recruiting bonuses and educational benefits are major parts of most of the retention and reenlistment studies. Almost all studies found a positive relationship between bonuses and longer stay in the Army. Hosek and Peterson (1985) explored the efficiency of lump sum and installment payments in countering the effects on retention of declining unemployment rates and other unfavorable conditions for recruiting. They analyze FY1976—1981 U.S. Army administrative data. Findings indicate that an additional $1,000 bonus paid in installment increases retention rate in the U.S. Army by 0.81 percentage points. Lump sum bonuses are more cost-effective than installment payments. On average, an additional $1,000 bonus paid as a lump sum increases reenlistment rate by 0.98 percentage points. Military wages also have a positive impact. A unit increase of a ratio of military to civilian (manufacturing) pay increases retention rate by 0.8 percentage points. Hosek and Peterson also find that African American soldiers are more likely to reenlist. Higher unemployment rate is also a key factor. A percentage point increase in the unemployment rate increases the retention rate by 1.04 percentage points. More recent study by Hosek and Martorell (2009) finds that a unit raise in the special reenlistment bonus (SRB) multiplier increases reenlistment probability by 1.3 percentage point for first-term soldiers and 2.5 for second-term army soldiers.

Lakhani (1988) reports that a one percentage point increase of the SRB decreases the attrition rate by 0.20 percentage points. Pay increases have a much stronger impact. According to Lakhani, a one percentage increase in military pay decreases the attrition rate by 6.31 percentage points. Additionally, the effects are stronger for combat occupations. This is mostly explained by a fact that their skills are less marketable in the civilian world.

Military pay rate or its ratio to civilian pay have been frequently used as explanatory variables to predict retention. Buddin et al. (1992) and Asch et al. (2002) find a positive relationship. In 2007, Asch, Hosek, and Warner updated the manpower chapter in the *Handbook of Defense Economics*. Their chapter provides a comprehensive review of the theoretical models used in recent studies on reenlistment and retention. Further, the authors summarize reenlistment elasticities of pay and bonuses. They find that estimated pay elasticities in the U.S. Army varied between 1.0 and 2.5.

Buddin et al. (1992) utilize FY1983–1989 data for Army soldiers approaching the end of their first terms to assess the link between soldiers' promotion rate in ranks and their decision to reenlist. They find that army men with a good promotion track are more likely to reenlist at the end of the first term.

Brown(1990) and Buddin et al. (1992) find a negative effect of AFQT scores. Specifically, Buddin et al. find that a percentage point increase in AFQT decreases reenlistment probability by 0.309 percentage points. More recently, Hosek and Martorel (2009) find that soldiers in the AFQT IIIA group were most likely to reenlist upon completion of a first term of service.

Reported unemployment effects are also in line with expectation. Buddin et al. (1992) estimate that a percentage increase in the unemployment rate increases reenlistment by 0.14 percentage points.

Buddin et al. (1992) also explore an impact of pre-enlistment educational level. Interestingly, compared with enlistees in the reference group (high school diploma holders), enlistees with no high school diploma have 11.2 percentage points lower probability of reenlistment. In contrast, GED holders tend to have higher reenlistment rates. On average, compared with enlistees in the reference group, enlistees with no high school diploma have 16.7 percentage points higher probability of reenlistment. Hosek and Martorell's (2009) findings on GED effect are similar. Compared to high school graduates, enlistees with a GED diploma have 6.7 (3.3) percentage points higher probability of a first (second) reenlistment.

A number of studies report that African Americans tend to have higher retention rates. Hosek and Peterson (1985) and Buddin et al. (1992) find that African Americans have higher reenlistment rates. For example, in study by Buddin et al. (1992) findings indicate that, compared with white soldiers, black enlistees have 9.5 percentage points higher probability of reenlistment. In addition, Buddin et al. (1992) find that married soldiers tend to have higher reenlistment rates as well. Compared with single soldiers, married enlistees have 10.8 percentage points higher probability of reenlistment.

Encouraging the reenlistment of currently serving personnel is a major part of U.S. Army Retention Program. The Army encourages reenlistment for eligible personnel as cost- and time-saving mechanisms. Experienced soldiers have valuable skills and knowledge that are crucial to achieve various missions. The Army commonly permits eligible soldiers to reenlist during the reenlistment window, that is, the period within 24 months to three months of their expiration term of service date. Guidelines regulating reenlistments are summarized in AR 601-280 (Army Retention Program). Soldiers must commit for three, four, five, or six years. If applicable, experienced servicemen with more than 10 years of service are allowed to sign up for an indefinite enlistment. For

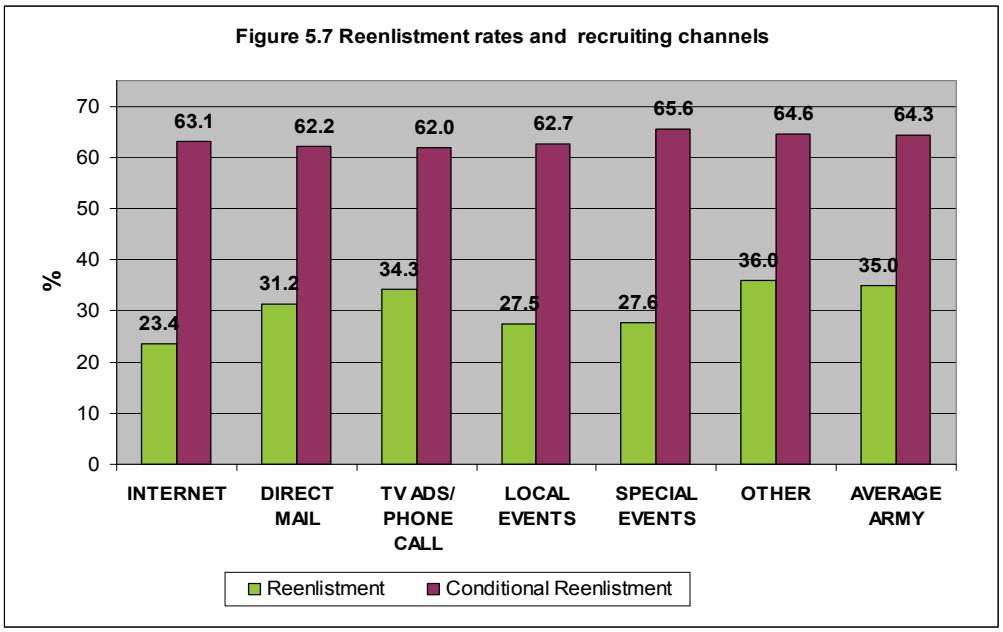
soldiers who are not on indefinite reenlistment, the U.S. Army offers several options to chose from.[12]

The conceptual framework of the reenlistment decision has been extensively covered in the literature. Reenlistment models tend to focus on military pay and reenlistment bonuses. Empirical analysis of retention is based on several types of economic models. Perhaps the most common is a one-period model in which reenlistment depends on a measure of military/civilian pay, such as the current pay ratio or the current value of the annualized cost of leaving. The models discussed at some length in Warner and Asch (1995) include a random utility model focusing on a one-time occupational choice. Large numbers of explanatory variables, including the availability and amount of a reenlistment bonus, the unemployment rate, and controls for pay grade, occupational specialty, AFQT, education level, race, ethnicity, gender, and marital status are frequently included in the estimated models.

To provide additional incentives for the soldiers, the U.S. Army runs the Selective Reenlistment Bonus program, which features lump sum tiered payments capped at $10,000, $15,000, $20,000, $30,000, and $40,000 as of November 2008. The exact amount of reenlistment bonus depends on many factors, including (i) reenlistment option, (ii) whether the soldier's MOS is in critical or high demand, (iii) military rank, and other performance characteristics.

Figure 5.7 compares first-term reenlistment rates by recruiting channels. Bars in green show an observed reenlistment rate from the dataset. The figure does not take into account either duration of service of the soldier or attrition rate over the course of service. In other words, reenlistment rates are calculated based on a number of reenlistments of the soldier over the course of his career.

[12] The reenlistment options are described in the Appendix.



Raw reenlistment rates are not attractive for this analysis, since they (i) are right-censored, (ii) ignore attrition, and (iii) less relevant for policy implications. For instance, the low reenlistment rate (23.4 percent) among the Internet leads is explained by the fact that a large portion of these soldiers were not eligible for reenlistment, as they joined the Army quite recently. Therefore, the focus on the analysis is the conditional reenlistment rate, which is calculated based on the number of soldiers who completed their initial term of service and are eligible for reenlistment. Thus, the conditional reenlistment rate factors in the problem of attrition and incomplete term of service. Figure 5.7 shows conditional reenlistment rates across all recruitment channels, ranging between 62.0 and 65.6 percent.

Table 5.5 illustrates finding from the logistic models. Similar to the attrition and promotion analysis, model 1 distinguishes between all recruitment channels. In model 2, Internet recruits are compared with other enlistees. Finally, in model 3, the estimation uses propensity score matching to trim the treatment group so that the sample has better covariate overlap. In addition to SES variables, all three models incorporate controls for the special reenlistment bonus (SRB) eligibility, changes in manufacturing wage in the home state as a proxy for civilian wage trends, and home state unemployment rate.

Table 5.5 Logistic regression of conditional reenlistment

	Spec. 1 All recruitment channels		Spec. 2 The Internet vs. other channels		Spec. 3 The Internet vs. other channels, Propensity score method	
	Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
ARMY WEBSITE/INTERNET BANNERS	0.13***	0.029***	0.12***	0.028***	0.11***	0.025***
	[0.03]		[0.03]		[0.03]	
DIRECT MAIL	0.14***	0.032***				
	[0.04]					
TV ADS / PHONE CALL	0.10**	0.023**				
	[0.04]					
LOCAL EVENTS	0.07	0.017				
	[0.13]					
SPECIAL EVENTS	0.24**	0.053**				
	[0.10]					
Female	-0.16***	-0.036***	-0.16***	-0.037***	-0.15***	-0.036***
	[0.02]		[0.02]		[0.04]	
Age at enlistment	0.01***	0.003***	0.01***	0.003***	0.02***	0.004***
	[0.00]		[0.00]		[0.00]	
Black	0.26***	0.057***	0.25***	0.057***	0.24***	0.055***
	[0.02]		[0.02]		[0.04]	
Hispanic	0.02	0.005	0.02	0.005	0.02	0.005
	[0.02]		[0.02]		[0.04]	
Other Race	0.08***	0.018***	0.08***	0.017***	0.03	0.007
	[0.02]		[0.02]		[0.05]	
GED	0	0.000	0	0.000	0.07*	0.016*
	[0.02]		[0.02]		[0.04]	
Some College	-0.10***	-0.024***	-0.10***	-0.024***	-0.17***	-0.040***
	[0.02]		[0.02]		[0.04]	
Bachelors/Graduate/ Professional Degree	-0.36***	-0.087***	-0.36***	-0.087***	-0.39***	-0.096***
	[0.03]		[0.03]		[0.06]	
State unemployment rate at enlistment	-0.01	-0.002	-0.01	-0.002	-0.03	-0.006
	[0.01]		[0.01]		[0.02]	
Annual change in Manufacturing wages	0	0.000	0	0.000	-0.02**	-0.005**
	[0.00]		[0.00]		[0.01]	
AFQT Category II	0.05**	0.011**	0.05**	0.011**	0.14***	0.033***

	[0.02]		[0.02]		[0.04]	
AFQT Category IIIA	0.07***	0.016***	0.07***	0.017***	0.19***	0.044***
	[0.02]		[0.02]		[0.05]	
AFQT Category IIIB	0	0.001	0	0.001	0.23***	0.053***
	[0.02]		[0.02]		[0.05]	
AFQT Category IV	0.46***	0.099***	0.46***	0.099***	0.79***	0.165***
	[0.04]		[0.04]		[0.09]	
Combat Primary MOS	-0.30***	-0.069***	-0.30***	-0.068***	-0.31***	-0.073***
	[0.01]		[0.01]		[0.03]	
Eligibility for Special Reenlistment Bonus	0	-0.001	0	-0.001	0.02	0.004
	[0.01]		[0.01]		[0.03]	
Observations	191102		191102		32912	

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%
Variables for enlistment year dummies and U.S. geographic divisions are present in the models but parameter estimates are not shown in the table.

Internet recruits are, by 2.5 percentage points, more likely to reenlist than recruits in the reference category. Across the recruitment channels, the largest marginal effect is associated with the enlistment at special events. Those soldiers have 5.3 percentage points higher probability of the conditional reenlistment compared with the reference recruitment category.

Compared to men, women are 3.6 percentage points less likely to reenlist. Next, the probability of conditional reenlistment for African American is 5.7 percentage points higher than that of white enlistees. These results are comparable with findings by Hosek and Peterson (1985) and Buddin et al. (1992). There is also a clear inverse relationship between educational attainment and reenlistment probability. Soldiers with some college classes have 2.4 percentage points lower probability than soldiers in a base category. For those who completed college, the gap increases to 8.7 percentage points.

Regression findings also demonstrate the negative effect of AFQT scores. Results are similar to those of Brown (1990) and Buddin et al. (1992). For instance, soldiers in AFQT IIIA group had 1.6 percentage points higher probability of reenlistment than soldiers in AFQT I group. The soldiers with the combat MOSs have significantly lower (6.9 percentage points) probability of reenlistment. Somewhat surprisingly, the models indicate no statistically significant effect of unemployment

rate and SRB eligibility. In contrast, the results positively indicate that increase of the manufacturing wage is associated with lower reenlistment rate. More specifically, based on the model 3 one percentage change in the manufacturing wage reduces reenlistment probability by 0.5 percentage points.

Similar to the cases of attrition and promotion analysis, results from empirical models show that the effects of Internet recruits are relatively robust across models. In model 3, which uses the propensity score matching to trim treatment group so that the sample has better covariate overlap, the marginal effect for Internet recruits on the probability to reenlist is 2.5 percentage points.

5.7 Length of service

In many ways, active duty service in the U.S. Army is similar to a full-time civilian job. In civilian settings, duration of employment exemplifies key job success indicators such as loyalty, performance, and job satisfaction. In the U.S. Army, the related concept is length of service. The U.S. Army welcomes longer length of service from eligible soldiers, since it allows the Army to fully recoup its investment on recruitment and training as well as to preserve critical skills acquired over the years of service. Initial term for most of the soldiers in the Active Component varies from two to six years. Upon completion of the initial term, an eligible soldier can be retained in the service via reenlistment or extension of the initial contract. As a result, the length of service for soldiers varies significantly. Therefore, this section focuses on the relationship between the recruitment channel and total length of service.

To examine whether Internet recruits differ from other recruits in terms of the length of active service, this study applied the techniques of duration analysis. Duration analysis has its origin in survival models frequently used in medical science, epidemiology, and other natural disciplines. U.S. Army data used to analyze attrition, reenlistment, and promotion of soldiers also contain duration spells for each enlisted personnel. Data are right-censored, since for many of the soldiers the time of the departure is not observed as of September 30, 2008. The key constructs of the survival analysis are survival function and hazard function. Let T denote the number of months in service. The distribution of T can be described by the cumulative density function $F(t) = P\{T \le 1\}$. The survival function is the probability that the soldier will serve past t and can be written as

$$S(t) = 1 - F(t) = P\{T > t\}$$

The hazard function is the instantaneous rate of leaving the initial state (or in this study, departing from the Army). It is formally defined as:

$$h(t) = \lim_{\Delta t \to 0} \frac{P\{t \le T < t + \Delta t / T \ge t\}}{\Delta t}$$

From (3.1) and (3.2) one can derive $h(t) = \frac{f(t)}{S(t)}$. Frequently used classes of the duration models are the so-called proportional hazard models, in which the hazard function is presented as a product of the baseline hazard function, which doesn't depend on the characteristics of the observation and non-negative function of these characteristics. Or more formally:

$$h(t, x_i) = h_0(t) \exp\{x_i' \beta\} \qquad (3.3)$$

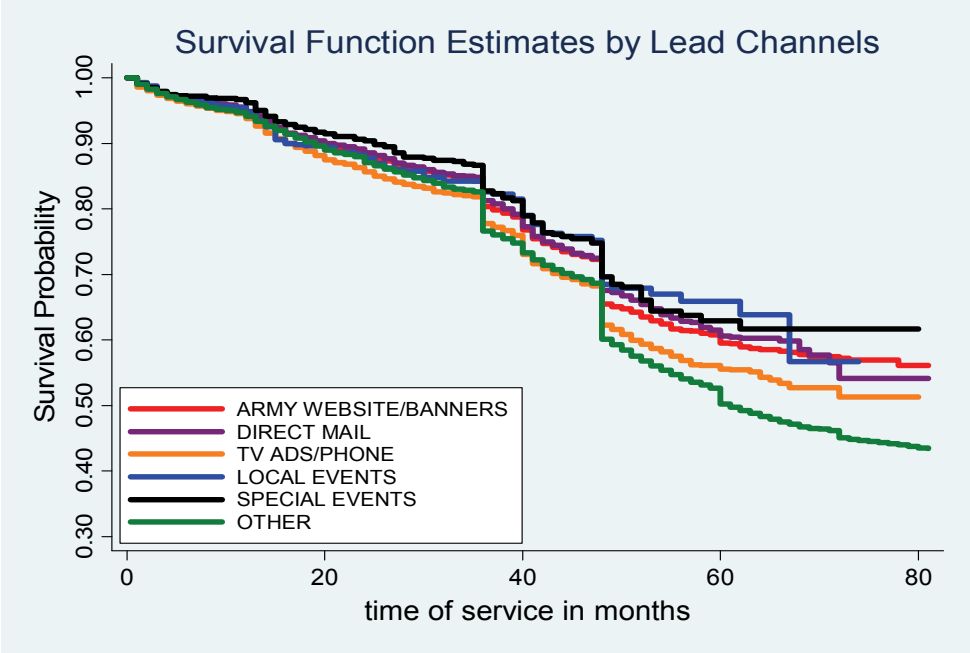
Where $h_0(t)$ is a baseline hazard function and x_i is a vector of personal characteristics. Baseline hazard is usually defined using various functional forms. In the Weibull model, the baseline hazard function takes the form of $h_0(t) = \gamma \alpha t^{\alpha - 1}$, where $\alpha > 0$ and $\gamma > 0$ are unknown parameters. The second model used in the duration analysis was developed by Cox in 1972. The Cox proportional hazard model estimate β in the proportional hazard settings without simultaneous estimation of the baseline hazard function $h_0(t)$. An attractive feature of the proportional hazard model is the fact that the estimation approaches also use the right-censored observations, an important feature for data that feature high retention rates.

Figure 5.8 shows non-parametric estimates of the survival function for the enlistees by the recruiting channels. Calculation of the non-parametric estimates ignores the set of other observable characteristics. Overall, the chart is in line with earlier findings in the reenlistment analysis.

Over the first 36 months of service, soldiers enlisted via the TV/phone recruiting channel were most likely to end their service. Soldiers in the special events group had the lowest hazard rate and were less likely to terminate the contract. After 36 months of service, soldiers in the "other" category were less likely to remain in the service. TV/phone leads continued to have significantly lower survival rates. In contrast, recruits from special events were the most loyal

group of soldiers. Internet recruits tend to have somewhat lower hazard rate, which is consistent with findings from reenlistment models.

Figure 5.8 Survival Function Estimates by Lead Channels



Non-parametric estimates of the survival function disregard observable attributes of the individuals. If such attributes are correlated with the hazard rate and overall duration, non-parametric charts are of limited utility. Semi-parametric and parametric models, on the other hand, can factor in these attributes in the analysis. Therefore, this study utilizes Weibull and Cox duration models. Similar to logistic models reported earlier, three models for each of type of duration models (Weibull and Cox PH) are estimated. In model 1, the specifications distinguish among all recruitment channels. Model 2 aims to compare Internet recruits with other enlistees. Finally, in model 3, the estimation involves the propensity score approach, which helps to trim treatment group so that the sample has better covariate overlap.

All three Cox PH models produce similar results, despite the fact that model 3 was reduced via matching process to 140,695 observations. This finding reassures that results are very robust to changes in the sample size. TV/phone leads have the highest hazard rate. Compared with soldiers in the reference category, TV/phone recruits have 4 percentage points higher hazard rate. In contrast, the rest of recruiting channels were less likely to depart from the service, compared with enlistees in the reference category. Soldiers enlisted via special events have the

highest survival rate. Direct mail and Internet leads also have lower hazard rates (0.89).

The hazard rate for female soldiers is 86 percent higher than for their male colleagues. This finding is in line with the earlier analysis of the conditional reenlistment. Soldiers tend to serve slightly shorter period with age, as the hazard rate increases by 1 percentage for each additional year. All minorities are less likely to leave the active service, with hazard rates around 17-19 percentage points lower than for base category, white soldiers.

Educational attainment has a U-shape relationship with the hazard rate. Soldiers with a GED have the highest hazard rate. High school graduates and enlistees with some college education tend to have lower hazard rates and higher survival rates. In contrast, for enlistees with a bachelor's degree, the hazard rate significantly increases to 1.05. Hazard estimates also show that AFQT scores are positively correlated with duration of service. Soldiers in the highest AFQT category are more likely to stay longer. For instance, enlistees in the AFQT IIIB group have a 26 percentage points higher hazard rate than soldiers in the AFQT I group. As expected, combat MOSs tend to have shorter duration, with a hazard rate of 1.17. Finally, results indicate that the eligibility for SRB during first-term reenlistment actually increases the hazard rate.

Table 5.6 Proportional hazard models of duration of service

	Duration model Weibull distribution			Cox proportional hazard model		
	Spec. 1 All recruitment channels	Spec. 2 The Internet vs. other channels	Spec. 3 The Internet vs. other channels, Propensity score method	Spec. 1 All recruitment channels	Spec. 2 The Internet vs. other channels	Spec. 3 The Internet vs. other channels, Propensity score method
INTERNET	0.89***	0.90***	0.90***	0.89***	0.90***	0.90***
	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]
DIRECT MAIL	0.90***			0.89***		
	[0.02]			[0.02]		
TV ADS / PHONE	1.04			1.04		
	[0.03]			[0.03]		
LOCAL EVENTS	0.93			0.92		
	[0.08]			[0.08]		
SPECIAL EVENTS	0.83***			0.83***		
	[0.06]			[0.06]		
Female	1.85***	1.85***	2.12***	1.86***	1.86***	2.13***
	[0.01]	[0.01]	[0.03]	[0.01]	[0.01]	[0.04]
Age at enlistment	1.01***	1.01***	1.01***	1.01***	1.01***	1.01***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Black	0.81***	0.81***	0.79***	0.81***	0.81***	0.80***
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
Hispanic	0.83***	0.83***	0.79***	0.83***	0.83***	0.79***
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
Other Race	0.81***	0.81***	0.80***	0.81***	0.81***	0.80***
	[0.01]	[0.01]	[0.03]	[0.01]	[0.01]	[0.03]
GED	1.30***	1.30***	1.40***	1.32***	1.32***	1.41***
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
Some College	0.99	0.99	0.97	0.99	0.99	0.97
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.03]
Bachelors/Graduate/ Professional Degree	1.05***	1.05***	0.90***	1.05***	1.05***	0.90***
	[0.02]	[0.02]	[0.03]	[0.02]	[0.02]	[0.03]
State unemployment rate at enlistment	1	1	0.99	1	1	0.99
	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.01]
AFQT Category II	1.10***	1.10***	1.10***	1.10***	1.10***	1.10***
	[0.01]	[0.01]	[0.03]	[0.01]	[0.01]	[0.03]
AFQT Category IIIA	1.16***	1.16***	1.17***	1.16***	1.16***	1.17***
	[0.02]	[0.02]	[0.03]	[0.02]	[0.02]	[0.04]

AFQT Category IIIB	1.24***	1.24***	1.24***	1.26***	1.26***	1.26***
	[0.02]	[0.02]	[0.04]	[0.02]	[0.02]	[0.04]
AFQT Category IV	0.98	0.98	0.95	1	1	0.97
	[0.03]	[0.03]	[0.05]	[0.03]	[0.03]	[0.05]
Combat Primary MOS	1.16***	1.16***	1.13***	1.17***	1.17***	1.13***
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
MOS is eligible for SRB	1.04***	1.04***	1.08***	1.05***	1.05***	1.09***
	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
Observations	411455	411455	140695	411455	411455	140695

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%
Variables for U.S. geographic divisions are present in the models but parameter estimates not shown in the table.

CHAPTER 6 – DISCUSSION AND POLICY IMPLICATIONS

This chapter reviews some of the key findings of the study. It also discusses possible policy implications in the context of both civilian labor markets and the U.S. Army.

Empirical findings from Chapter 4 indicate that Internet use increased the likelihood of 12-month reemployment for unemployed job-seekers. Table 6.1 presents estimates of probability of being employed in 12 months for unemployed job-seekers in all three countries. U.S. estimates are calculated for a hypothetical unemployed married male job-seeker with a high school diploma, aged between 26 and 35, with no self-employment, layoff, or union membership records, who resides in a non-metropolitan area of the Northeast Region. In the German case, the outcome is calculated for an unemployed married male job-seeker with a secondary school diploma and no vocational training, aged between 26 and 35, with no union membership or unemployment benefits records. Finally, the hypothetical South Korean job-seeker is a married male with a secondary school diploma, aged between 26 and 35, with no union membership or unemployment benefits records, who resides outside the capital city of Seoul. Estimates in Table 6.1 are based on more conservative parameter estimates from probit models. As shown in Table 6.1, incorporating the Internet into the job search process notably improves the search outcome in all three countries.

Table 6.1 Predicted probability of being employed in 12 months for unemployed job-seekers

	For Internet non-users	**For Internet users**
USA		
White	0.618	0.685
African American	0.492	0.604
Hispanic	0.609	0.692
Germany		
Non-immigrant	0.387	0.427
Immigrant	0.312	0.397
South Korea	0.47	0.527

For African American job-seekers, the Internet helps to significantly shrink the gap in reemployment odds. In fact, in this hypothetical example, the black-white gap in reemployment probability has been reduced from 0.126 to 0.081. Somewhat similar effects are observed for Hispanic job-seekers. Interestingly, in this example, Hispanic job-seekers who use the Internet in the job search process had

a higher probability of being employed than a white job-seeker who also used the Internet to search for jobs. In the German case, which uses more recent data, the results indicate that Internet usage had a greater impact on immigrant job-seekers and helped to reduce the gap between immigrant and non-immigrant job-seekers from 0.075 to 0.03. As discussed earlier, such findings show that the Internet may provide minorities and immigrant populations with access to a larger and more diverse pool of job postings and career opportunities. For instance, the Internet may induce applicants to change occupation, industry affiliation, or geographic location. Reduced cost of job search may partially explain the story as well. A significantly lower cost of job search may induce more minorities and immigrants, who are likely to be more cost-sensitive, to search for job with an increased intensity. In other words, the Internet may be helping to overcome the cost barrier of job search.

As discussed earlier, Internet use is strongly influenced by the intersection of public sector policies, such as broadband access and regulation, school curricula that have IT-based programs, and job search technologies utilized by employment agencies, as well as private sector investments. However, it is essential to emphasize that developing a course of policy actions based on these findings could be limited in several ways. First, the data used in the study are somewhat outdated. This aspect is especially important for the U.S. analysis, as October 2003 was the last CPS wave that included a detailed questionnaire on the use of the Internet for job search activities. Given the incredible pace of Internet penetration in the United States since 2003, it is likely that extrapolation of marginal effects to the contemporary period will yield inaccurate and misleading results.

Second, the signaling mechanism that prompts the positive effect of the Internet is likely to be very sensitive to the penetration rate in the country. In earlier years, the use of the Internet signaled to employers that the job-seeker was proficient in using computers, browsing online, and adopting newer technologies. This message, however, is likely to have eroded as time passes and more and more people go online. In other words, the marginal effects that are driven by the signaling mechanism may be very sensitive to the penetration levels over the longer period of time.

Third, the impact of the increased popularity of the Internet as a job search tool doesn't benefit every job-seeker equally. Using the Internet obviously helps those job candidates who are able to use it. However, as more people turn to the Internet due to, say, government-supported interventions, the utility of using the Internet declines

relative to what it had been in earlier years. This study did not intend to estimate overall societal benefits, therefore the positive marginal benefits (from Table 6.1, for instance) need to be interpreted in the context of a particular job-seeker with certain characteristics at a given level of Internet penetration. Similarly, discussion on the role of the Internet on a transition to new industry and occupation ought to be limited to a particular job-seeker, because the analysis in this dissertation leaves aside the repercussions of the increased Internet usage rates and related occupational and inter-industry mobility on the welfare of job-seekers who already have those occupations or work in those industries.

The issues related to the impact of the increased use of the Internet by job-seekers on societal welfare, in general, are more complex and need further consideration and more comprehensive data on the subject. Further policy research on the subject could also focus on the implications of policy interventions, such as the National Broadband Plan[13] in the United States, on the welfare changes across different groups of population.

From a policy perspective, another key finding is a positive correlation between job search on the Internet and occupational and inter-industry mobility. Although more research is required in this area, the Internet may have an important role in targeting industries that are high-growth or high-demand in the local, regional, and national economies. Social networking is another key area where the Internet plays a growing role. Due to lack of recent data on the use of the Internet for social networking, this study wasn't able to incorporate social networking phenomena into analysis of job search activities. However, it is apparent that the Internet is major driver of this development and that social networking plays an increasing role in obtaining new job leads, connecting with potential employers, and sharing interviewing skills.

The analysis of Internet recruits in the U.S. Army yielded some important findings that can help to us to understand the use of the Internet at large. Despite the fact that Internet penetration has been on a sharp rise for a while, this study shows that Internet recruits are still selected on some observable characteristics. Compared with other

[13] By 2020. the National Broadband Plan envisages implementation of four deliverables. First, it aims to provide a least 100 million U.S. homes with affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second. Second, it provides more resources to implement faster and most extensive wireless networks. Third, the broadband plan envisages training and technical support for American who wishes to acquire IT skills. Finally, the plan calls for more extensive access to broadband Internet in public places. In particular, it aims to provide every community with affordable access to 1 gigabit per second service in libraries, schools, hospitals, and government buildings.

recruits, they are more likely to have better pre-enlistment educational level, be older, and be white. The relationship between use of the Internet and AFQT categories seems to be more complicated. Female enlistees are more likely to use the Internet as a recruitment channel. Another important finding is related to the relationship between use of Internet and military occupation. The results suggest that, compared with other enlistees, Internet recruits are more likely to enlist into combat MOSs. These empirical relationships could be cautiously used to target enlistees with desired educational and occupational profile.

The results also indicate that recruits hired via the Internet demonstrate very favorable patterns of service. In comparison with other soldiers, they are less likely to drop out prematurely, more likely to reenlist after first term of service; on average, they have a faster pace of one-grade promotion and longer duration of service.

Although this study doesn't intend to quantify in monetary terms the value of Internet recruiting, it may be useful to apply a basic framework of the cost-benefit analysis (CBA) to some of the results from the Army analysis. This exercise may also help to improve interpretation of study findings.

The relationship between Internet recruitment and first-term reenlistment rate discussed in Chapter 5 may be further considered for this purpose. Table 5.6 of section 5.6 indicates that the probability of first-term reenlistment of Internet recruits is 2.5 percentage points greater than for other enlistees. As discussed earlier, this finding is noteworthy, since the first-term reenlistment rate is a key indicator of soldiers' early performance. Higher reenlistment rates of eligible recruits are desirable, as they allow the Army to recoup its recruiting and advertising expenditures as well as the costs associated with initial basic training.

Direct estimation of the monetary value of a 2.5 percentage point increase in the probability of reenlistment is problematic. However, indirect valuation of such a benefit is possible. Handily, CBA offers the so-called "analogy method" of valuation, which utilizes the market price of a comparable benefit. With some adjustment, this method may be applied to monetize the value of additional percentage points in the probability of reenlistment among Internet recruits.

To promote reenlistment, the Army heavily relies on a set of pay, bonus, and educational incentives. The cost of such policies is explicit. The impact of these policies on reenlistment rate is also thoroughly discussed in the empirical literature. The estimated benefits and related costs of such incentives can be used to calculate the value

of a 2.5 percentage point increase in the probability of reenlistment associated with Internet recruitment in monetary terms.

The special reenlistment bonus (SRB) is the most convenient incentive for this purpose, as it is paid in a lump sum at the outset of the new term. This eliminates the need for discounting the future inflows associated with other benefits, such as pay and educational programs. SRBs are designed to help the Army sustain the desired force level in occupations with higher demand. SRBs vary by zone level, where zone A is 21 months to six years of service, zone B is 7–10 years of service, and zone C is 11–14 years of service. SRBs are not paid for soldiers with indefinite reenlistment (i.e., for soldiers with more than 14 years of active service).

The size of SRB is the product of the years of service obligated in a new contract (N), current basic pay at the time of reenlistment (Pay), and the SRB multiplier (M_{SRB}). The most recent study that involves estimation of the marginal effect of the multiplier (M_{SRB}) was conducted by Hosek and Martorell (2009)[14] They find that for first-term recruits the marginal effect of the SRB multiplier is equal to 1.3 percentage points. In other words, a unit increase in the SRB multiplier increases the reenlistment probability, on average, by 1.3 percentage points. Using readily available pay schedules (Table A.5.1) one can calculate the range of values for $Pay * N$, which represents the cost of the unit increase in the SRB multiplier for the Army. Table 6.2 lists the results of these calculations.

Table 6.2 Cost of the unit increase in SRB multiplier for the Army as of January 1, 2009 (in US$)

Pay grade level	Basic monthly pay of a soldier with 3 years of service	*(Pay*N)* - Cost of unit increase in SRB multiplier for a soldier reenlisting	
		for 2 years of service	for 3 years of service
E-2	1568.7	3137.4	4706.1
E-3	1859.8	3719.6	5579.4
E-4	2025	4050	6075

The size of basic monthly pay depends on the number of years in service. The second column of Table 6.2 shows monthly pay for enlistees

14 Hosek J. and F. Martorell, (2009), *How Have Deployments During the War on Terrorism Affected Reenlistment?* Monograph Report, RAND Corporation

with three years of service.[15] As mentioned earlier, the cost associated with a unit increase of the SRB multiplier is also a function of the number of years of service stipulated in a new contract. Overall, for E-2, E-3, and E-4 soldiers with three years of service reenlisting for two or three years of additional service, a unit increase of the SRB multiplier is equivalent to an additional bonus in the range of $3,137–$6,075. From the U.S Army standpoint, these numbers represent the direct cost of the unit increase in the SRB multiplier, which according to Hosek and Martorell (2009) is associated with an increase probability of reenlistment of 1.3 percentage points.

Next, it is possible to utilize these estimates to monetize the marginal effect of Internet recruiting on retention, which is equal to 2.5 percentage points. Table 6.3 contains these numbers.

Table 6.3 Value of 2.5 percentage point increase in the reenlistment probability of Internet recruits for the U.S. Army (in US$)

Pay grade level	Reenlistment for	
	2 years of service	3 years of service
E-2	6033.5	9050.2
E-3	7153.1	10729.6
E-4	7788.5	11682.7

With certain assumptions (described below), the numbers in Table 6.3 can be interpreted as some of the benefits of the Internet recruitment.

The costs associated with Internet recruitment has been recently analyzed by Dertouzos (2010). According to his estimates, the Army spends, on average, $7,500–$8,600 to recruit a soldier via Internet banners and its main website, www.goarmy.com. Under these settings, the monetary value of the reenlistment benefits of Internet recruiting is comparable with the cost of Internet recruiting incurred by the U.S. Army. In fact, reenlistment of Internet recruits at any of the pay grades in Table 6.3 for an additional three years of service will have a benefit that surpasses the corresponding cost. The underlying logic for the analogy method used in this case is as following. If the Army is ready to spend $3,137–$6,075 (Table 6.2) for SRB bonuses that increase the probability of reenlistment by 1.3 percentage points, it is plausible that the value of a 2.5 percentage points increase in

15 In most cases, initial contracts expire by the end of three years of active duty service.

reenlistment probability of Internet recruits is in the range of $6,033.5—11,682.7.

There are several assumptions and limitations that have to be used in this analysis. First, these calculations assume that the monetary value of the reenlistment odds for the Army is proportional to the marginal effect of the incentive or treatment. Although this assumption is feasible, one may argue that the relationship takes a concave or other form.

Second, the study by Hosek and Martorell (2009) and the analysis above utilize average marginal effects. Obviously, marginal effects would differ by MOS and educational and demographic characteristics. Differentiation of marginal effects would definitely improve the analysis and hence may be a focus of future research efforts.

Most importantly, the analysis disregards the fact that the cost of SRB may be higher, since once SRBs are approved they have to be paid to everyone who qualifies, regardless of the initial intention to reenlist. It is likely that some of the qualified soldiers would have reenlisted in the absence of the SRB. Estimates in the Table 6.2 would have been several times larger if such additional costs were assessed. Consequently, Table 6.3 would have included much larger numbers, increasing the monetary value of benefits associated with Internet recruiting.

Despite these limitations, it's more likely that the estimates of benefits of Internet recruitment listed in Table 6.3 are conservative, because these calculations reflect only one positive feature of Internet recruits, namely, their higher probability of reenlistment. As discussed earlier, Internet recruits also have lower attrition rate and longer overall duration of service. Unfortunately, these features of Internet recruits are very difficult to quantify in monetary terms. It is plausible to claim though that such calculations would further increase the total benefit of Internet recruitment.

As in most CBA exercises, quantification of the benefits is complicated, as it relies on certain assumptions and indirect comparisons. Nonetheless, the analysis in this section provides some evidence that the monetary benefit of improved reenlistment odds of the Internet recruits are comparable in magnitude with the cost related to the maintenance of the Army's Internet website and placement of online banner ads.

The better match of the Army with enlistees recruited via the Internet may be intuitively explained by better access to more detailed information about service terms and Army requirements available on the

Internet. Internet recruits are more likely to seek information online. As discussed earlier, the amount of information posted on the Internet is very impressive. The Army's websites and other related online portals are very rich in both traditional content and multimedia materials. In fact, in 2007 the Army maintained over 15,000 pages of discrete Army-related information, which obviously substantially exceeds the amount of information provided at recruitment events or in the material sent directly to potential enlistees. A well-informed enlistee is more likely to have adequate level of expectations for the Army and be aware of more opportunities related to a soldier's career.

Overall, findings on the relationship between recruitment channel and performance indicate that soldiers enlisted via one of the recruitment channels perform somewhat better than soldiers who enlist to the service without prior contact. The notable exception is those soldiers who enlisted in a response to TV advertisement and placed a phone call for additional information. Soldiers in this group were more likely to attrit and had shorter duration of service. From the U.S. Army management perspective, it seems that soldiers recruited at special events demonstrate the best pattern of service. They are least likely to drop out in the first 24 months of service, most likely to reenlist upon completion of first term, and have longer overall duration of service. It should be noted, however, that they tend to have the slowest pace of one-grade promotion. In contrast, enlistees recruited during school visits and other local events are not different from enlistees in the reference category in any of the performance indicators. The results also indicate a somewhat favorable performance profile for soldiers recruited via direct mail campaigns. In comparison with soldiers in the reference group, they are less likely to drop out, more likely to reenlist, and have longer duration of service, although the pace of one-grade promotion for this group of soldiers doesn't differ from that of soldiers in the reference group.

The Army has made incredible progress in its utilization of the Internet in order to enhance its recruitment efficiency. Recruiting websites such www.goarmy.com and representation on popular social networking sites, including Facebook, MySpace.com, and Twitter, indicate the Army's considerable depth of understanding of today's youth and a strong commitment to innovation.

The results from this study indicate that the Army's efforts are well exerted and are associated with a good payoff. The U.S Army is recommended to continue implementing its aggressive approach on the Internet. As today's youth find the Internet to be the primary medium of communication, maintaining an active presence on the web and on social

networks and using Internet advertising will help to maintain the Army's influence in a cost-effective manner.

Although the U.S. Army is unique in terms of its mission, objectives, and daily operations, findings from this study may provide useful guidance for other employers. It is widely recognized that the Internet provides employers with an additional cost-effective way to hire new employees. The main concern of many employers has been a quality and job stability of Internet recruits. Empirical results from this study indicate that these concerns have a little ground in the U.S. Army context, as Internet recruits have shown solid retention and promotion records. In fact, by most performance metrics considered in this work, Internet recruits exceed their peers.

APPENDIX

Table A.3.1 Job search on the Internet by the unemployed, marginal effects from probit models (annual breakdown), United States

	Job search on the Internet in the U.S.			
	Dec-98	Aug-00	Sep-01	Oct-03
Female	-0.017*	-0.049**	-0.012	-0.038*
Single	-0.015	-0.074***	-0.033	-0.047*
Incomplete High School	-0.064***	-0.107***	-0.149***	-0.187***
Associate Degree	0.037	0.142***	0.128***	0.125***
Bachelors' degree	0.047**	0.151***	0.282***	0.260***
Graduate or Professional Degree	0.112***	0.156***	0.158***	0.310***
Aged 16 25	-0.004	0.020	0.002	0.014
Aged 36 45	0.003	-0.075***	-0.087***	-0.037
Aged 46 55	-0.005	-0.075***	-0.072**	-0.110***
Aged 56 and older	-0.039***	-0.123***	-0.194***	-0.227***
Black	-0.007	-0.123***	-0.103***	-0.121***
Hispanic	-0.026***	-0.088***	-0.111***	-0.128***
Asian or Pacific Islanders	0.031	-0.063**	-0.042	-0.137***
Other Race	0.030	-0.072*	-0.095*	-0.085
Household income: more than 14,999 and less than 25,000	0.023	0.094**	0.072*	-0.004
Household income: more than 24,999 and less than 35,000	0.066**	0.208***	0.095**	0.030
Household income: more than 34,999 and less than 50,000	0.066**	0.195***	0.097**	0.058*
Household income: more than 49,999 and less than 75,000	0.143***	0.215***	0.089**	0.050
Household income: more than 74,999	0.142***	0.245***	0.168***	0.051
Metropolitan Area	0.023**	0.011	0.107***	0.083***
Number of traditional job search channels	0.016***	0.063***	0.081***	0.082***
Union Member	0.042	-0.102***	-0.035	-0.140**
Management, business, and financial occupations	-0.006	0.049	0.162***	0.018
Professional occupations	-0.007	-0.002	-0.006	0.017
Service Occupations	-0.037***	-0.039	-0.148***	-0.170***
Sales and related occupations	-0.011	-0.004	-0.006	-0.071**
Farming, fishing, and forestry occupations	-0.036***	-0.086**	-0.228***	-0.224***

Construction and extraction occupations	-0.034***	-0.093***	-0.094**	-0.188***
Installation, maintenance, and repair occupations	-0.046***	-0.068**	-0.103***	-0.052
Production occupations	-0.027***	-0.050*	-0.127***	-0.130***
Transportation and material moving occupations	-0.032***	-0.036	-0.148***	-0.165***
Armed Forces occupations	0.011	0.335	-0.103	0.201
Observations	1940	1892	2564	2754
Pseudo R2	0.278	0.238	0.245	0.190
* significant at 10%; ** significant at 5%; *** significant at 1%				

Table A.3.2 Job search on the Internet by the unemployed, marginal effects from probit models (annual breakdown), Germany

	Job search on the Internet in Germany, 2003-2007				
	2003	2004	2005	2006	2007
Female	-0.017	-0.046	-0.001	0.038	-0.104
Single	0.127*	0.015	-0.031	0.120*	0.053
No Secondary School	0.125	-0.198*	-0.169	-0.045	-0.220
University Degree	0.080	0.210***	0.024	0.287***	0.118
Vocational/Technical Degree	0.106*	0.053	0.096	0.074	0.130*
Aged 16 25	-0.007	0.067	0.026	-0.067	-0.026
Aged 36 45	-0.031	0.008	-0.113	-0.138*	-0.054
Aged 46 55	-0.090	-0.125*	-0.189**	-0.187**	-0.212**
Aged 56 and older	-0.169**	-0.328***	-0.185*	-0.243***	-0.223**
Immigrant	-0.072	-0.206***	-0.013	-0.147**	-0.117
Union Member	0.113	0.140	0.047	0.132	0.063
Number of traditional job search channels	0.092***	0.094***	0.108***	0.113***	0.096***
Unemployment benefits	-0.037	-0.074	-0.020	-0.147***	-0.130**
Management, business, and financial occupations	0.595***	0.077	0.072	0.373***	-0.130
Professional occupations	0.275***	0.086	0.166	0.003	0.059
Technicians	0.215***	0.019	0.203***	0.044	0.119
Service and Retail Trade Occupations	-0.156**	-0.045	0.096	0.043	-0.050
Farming, fishing, and forestry occupations	-0.176*	-0.296***	-0.170	-0.147	-0.255*
Craftsmen and other trades	-0.104*	-0.087	-0.012	-0.047	-0.303***
Plant, Machine Operators and Assemblers	-0.163**	-0.232***	-0.227**	0.034	-0.286**
Elementary Occupations	-0.087	-0.080	0.050	-0.032	-0.182**
Military Member	-0.006	-0.148	0.060	-0.126	

Observations	978	1005	1007	1019	755
Pseudo R2	0.177	0.187	0.152	0.177	0.183
* significant at 10%; ** significant at 5%; *** significant at 1%					

Table A.3.3 Job search on the Internet by the unemployed, marginal effects from probit models (annual breakdown), South Korea

	Job search on the Internet in South Korea, 1999-2006		
	1999-2001	2002-2004	2005-2006
Female	0.005	0.022*	-0.003
Single	0.003	0.032	0.060
No Secondary School	0.021	-0.077**	-0.079**
Some College / 2-year College	0.078**	0.136**	-0.007
Bachelor degree or higher	0.091***	0.122**	-0.091**
Aged 16 25	-0.004	0.028	0.032
Aged 36 45	-0.015***	-0.100***	-0.186***
Aged 46 55	-0.014***	-0.044	-0.242***
Aged 56 and older	-0.054***	-0.114***	-0.199***
Number of traditional job search channels	0.007***	0.056***	0.125***
Household Income (Log)	0.000	-0.001	0.040**
Unemployment Benefits	0.166	-0.008	0.195**
Seoul Resident	0.010	0.114***	0.121***
Management, business, and financial occupations	0.989***		-0.229***
Professional occupations	0.037	-0.087***	0.085
Technicians		-0.052	-0.039
Service Occupations	0.027	-0.063*	-0.081
Sales and related occupations		-0.090***	-0.108**
Farming, fishing, and forestry occupations			-0.085
Craftsmen and other trades	-0.002	-0.047	0.041
Plant, Machine Operators and Assemblers		-0.041	-0.128***
Elementary Occupations	0.022	-0.055	-0.080
Observations	642	522	1020
Pseudo R2	0.256	0.235	0.204
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table A.4.1. Job search on the Internet by the unemployed: first-stage IV regression (OLS coefficients)

	Usage of the Internet in job search
Percentage of population in residing zip code with an access to the high-speed Internet	0.01**
	[0.00]
Female	0.01
	[0.03]
Single	-0.02
	[0.04]
Black	-0.01
	[0.04]
Hispanic	-0.09**
	[0.03]
Asian or Pacific Islanders	0.03
	[0.08]
Other Race	-0.16
	[0.10]
Aged 16 25	0.04
	[0.04]
Aged 36 45	0.04
	[0.04]
Aged 46 55	0.01
	[0.05]
Aged 56 and older	-0.14***
	[0.05]
Incomplete High School	-0.12***
	[0.03]
Associate Degree	0.17***
	[0.06]
Bachelors' degree	0.34***
	[0.05]
Graduate or Professional Degree	0.26***
	[0.08]
Year 2000	0.04
	[0.04]
Year 2001	0.14***
	[0.04]
Year 2003	0.18***
	[0.05]
Constant	0.04
	[0.05]

Observations	2133
R-squared	0.20
Robust standard errors in brackets	
* significant at 10%; ** significant at 5%; *** significant at 1%	

Table A.4.2 Hazard rates of unemployment duration in South Korea

	Unemployment duration, 1999-2006	
	Cox Proportional Hazard Model	Weibull Model with Unobserved Heterogeneity
Internet	1.22	1.29
	[0.11]**	[0.15]**
Female	0.88	0.88
	[0.06]*	[0.08]
Single	0.8	0.78
	[0.07]***	[0.09]**
No Secondary School	0.82	0.75
	[0.06]**	[0.08]***
Some College / 2-year College	1.17	1.21
	[0.11]	[0.15]
Bachelor degree	1.06	1.07
	[0.10]	[0.13]
Graduate/ Professional Degree	0.79	0.73
	[0.22]	[0.26]
Aged 16 25	1.06	1.02
	[0.09]	[0.11]
Aged 36 45	1.01	1.01
	[0.10]	[0.14]
Aged 46 55	0.84	0.87
	[0.10]	[0.14]
Aged 56 and older	0.57	0.52
	[0.08]***	[0.09]***
Unemployment Benefits	1.04	1.06
	[0.17]	[0.23]
Seoul Resident	1	0.99
	[0.07]	[0.09]
Union Member	1.2	1.59
	[0.64]	[1.19]
Search: Public Employment Office	1.07	1.09
	[0.13]	[0.18]

Search: Private Employment Office	1.61	1.81
	[0.27]***	[0.41]***
Search: Friends and Family	1.07	1.11
	[0.09]	[0.12]
Search: Other Media Ads	0.93	0.92
	[0.07]	[0.09]
Search: Contacted Employers	1.07	1.09
	[0.09]	[0.12]
Search: Other Methods	1.17	1.17
	[0.11]*	[0.14]
Observations	**1731**	**1731**
Robust standard errors in brackets		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Table A.4.3 Hazard rates of unemployment duration in Germany

	Unemployment duration, 1999-2006	
	Cox Proportional Hazard Model	Weibull Model with Unobserved Heterogeneity
Job Search on the Internet	1.28***	1.29***
	[0.08]	[0.08]
Female	1.04	1.03
	[0.06]	[0.06]
Single	0.85**	0.85**
	[0.06]	[0.07]
No Secondary School	0.89	0.9
	[0.15]	[0.15]
University Degree	0.60***	0.59***
	[0.04]	[0.05]
Vocational/Technical Degree	1.01	1
	[0.07]	[0.07]
Aged 16 25	0.79***	0.77***
	[0.07]	[0.07]
Aged 36 45	0.77***	0.76***
	[0.06]	[0.06]
Aged 46 55	0.53***	0.52***
	[0.05]	[0.05]
Aged 56 and older	0.34***	0.33***
	[0.05]	[0.05]
Immigrant	0.85*	0.84*
	[0.07]	[0.08]

Union Member	1.05	1.04
	[0.10]	[0.10]
Unemployment benefits	0.86**	0.82***
	[0.06]	[0.06]
Search: Federal Employment Office	0.65***	0.63***
	[0.05]	[0.05]
Search: Private Employment Agency	0.93	0.93
	[0.08]	[0.08]
Search: Friends and Family	1.07	1.08
	[0.09]	[0.09]
Search: Contacted Employers	1.19**	1.20**
	[0.09]	[0.10]
Search: Ads at Other Media (newspapers, etc)	0.88	0.88
	[0.08]	[0.08]
Search: Other Methods	0.92	0.93
	[0.07]	[0.07]
Observations	2645	2645
Standard errors in brackets		
* significant at 10%; ** significant at 5%; *** significant at 1%		

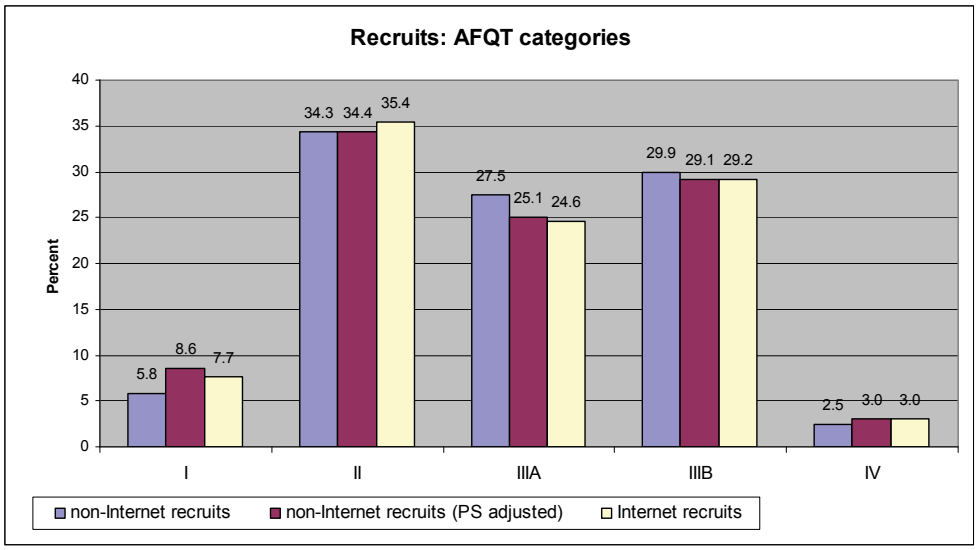
Table A.5.1 U.S. Army basic pay levels for enlisted personnel as of January 1, 2009.[16]

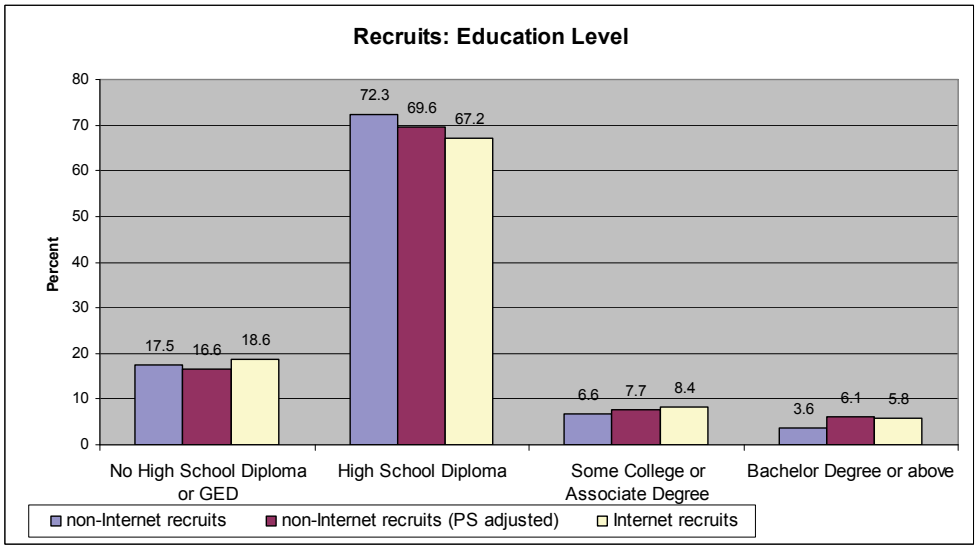
Pay Grade	Rank	Years of service						
		Less than 2	2	3	4	6	8	10
E-9	Sergeant Major/Command Sergeant Major/ Sergeant Major of the Army							4420.5
E-8	Master Sergeant/First Sergeant						3618.6	3778.8
E-7	Sergeant First Class	2515.5	2745.6	2850.6	2990.1	3098.7	3285.3	3390.3
E-6	Staff Sergeant	2175.6	2394	2499.6	2602.2	2709.3	2950.8	3044.7
E-5	Sergeant	1993.5	2127	2229.6	2334.9	2499	2670.9	2811
E-4	Specialist/Corporal	1827.6	1920.9	2025	2127.6	2218.5	2218.5	2218.5
E-3	Private First Class	1649.7	1753.5	1859.7	1859.7	1859.7	1859.7	1859.7
E-2	Private	1568.7	1568.7	1568.7	1568.7	1568.7	1568.7	1568.7
E-1	Private	1399.5	1399.5	1399.5	1399.5	1399.5	1399.5	1399.5

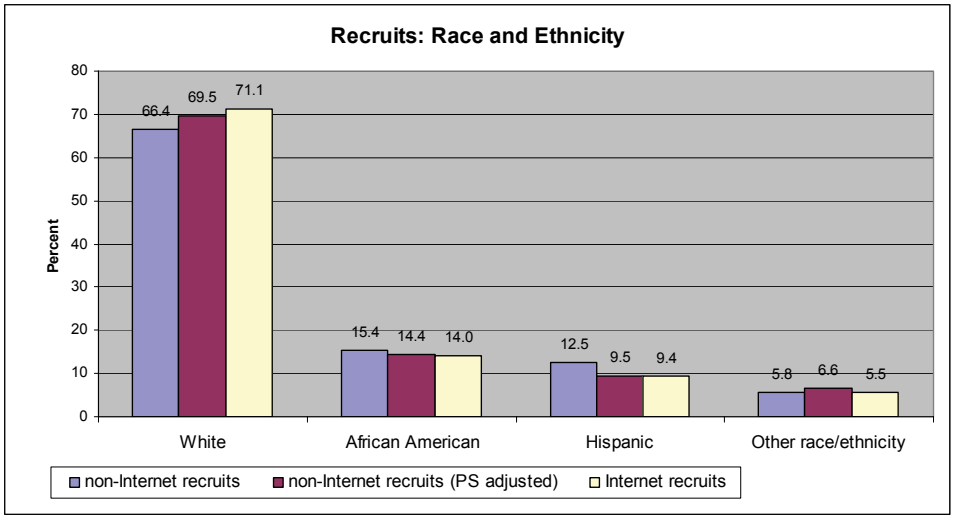
Soldiers have several reenlistment options. Under option E-1, eligible soldiers, regardless of grade or amount of service completed, can reenlist for 2, 3, 4, 5, or 6 years. This option carries no guarantee of assignment, training, or service in certain location. Soldiers under this option are assigned according to the current needs of the Army. Under option E-2, soldiers are not removed from their current location for at least 12 months. Option E-3 allows eligible soldiers to attend service school of choice. The terms of the reenlistment are 3, 4, 5, or 6 years as well. Similar to options E-1 and E-2, this option is designed for soldiers with fewer than 10 years of service experience. Finally, option E-4 guarantees assignment to one of the following overseas areas of choice for 3, 4, 5, or 6 years: (i) South Korea, (ii) Pacific area, (iii) Alaska, (iv) Caribbean area, (v) Europe, and (vi) Hawaii.

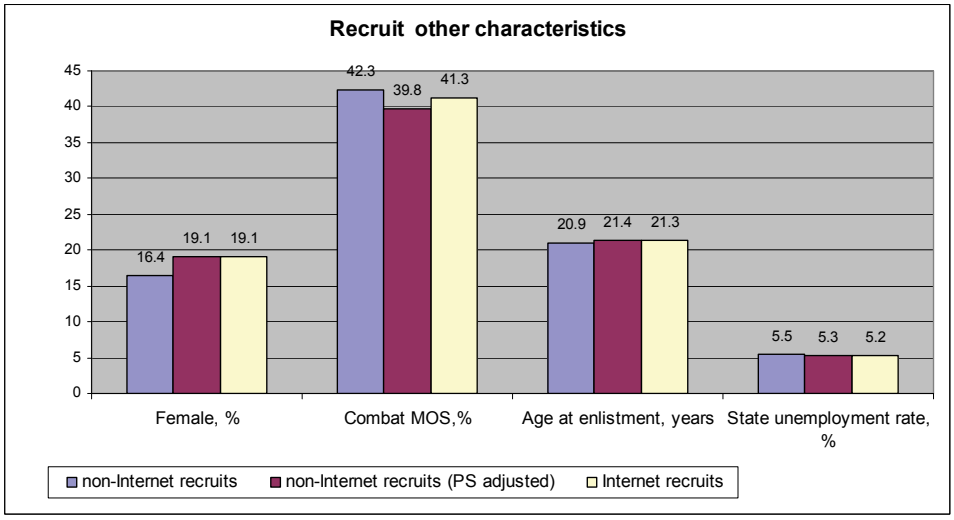
[16] Table A.5.1 is limited to enlisted personnel with 10 or fewer years of service.

Figure A.5.1 Distribution of SES characteristics in the sample of Internet recruits, non-Internet recruits, and PS matched non-Internet recruits






Recruits: Race and Ethnicity
Percent
80
70
60
50
40
30
20
10
0
66.4
69.5
71.1
15.4
14.4
14.0
12.5
9.5
9.4
5.8
6.6
5.5
White
African American
Hispanic
Other race/ethnicity
non-Internet recruits
non-Internet recruits (PS adjusted)
Internet recruits


Recruit other characteristics
45
40
35
30
25
20
15
10
5
0
16.4
19.1
19.1
42.3
39.8
41.3
20.9
21.4
21.3
5.5
5.3
5.2
Female, %
Combat MOS,%
Age at enlistment, years
State unemployment rate, %
non-Internet recruits
non-Internet recruits (PS adjusted)
Internet recruits

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