Internet Job Search and Employment Outcomes: An Instrumental Variables Approach

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Introduction

The emergence of the Internet and its integration into Americans' daily lives has undoubtedly affected the US labor market. It has done so in many ways, from the widespread adoption of Internet in the workplace (Fairlie, 2005; Freeman, 2002), to an increase in worker mobility through less dependence on local labor markets (Stevenson, 2003), to the growing popularity of jobs requiring technological skills (Fairlie, 2005; Freeman, 2002). In this paper, I use the Current Population Survey (CPS) Internet and Computer Use Supplements for years 1998, 2000, 2001, and 2003 to study the effect the Internet has had on the labor market as it relates to the effectiveness of online job search and subsequent employment. Of the many avenues through which the labor market has been affected by the Internet, the matching of job to worker and the role that the Internet plays in this crucial process is of particular concern both due to its growing presence and potential implications.

Internet job search has become an integral part of the job application process in the United States. Using CPS Internet and Computer Use Supplement for 1998, I find that 7 percent of the employed and 15 percent of unemployed already used the Internet for job search[1]. Of the unemployed who had a computer at home, roughly 50% used the Internet for job search (Kuhn and Skuterud, 2000). It was already more commonly used than many regularly documented job search methods, such as contacting private employment agencies, contacting friends and relatives and placing or answering ads (Kuhn and Skuterud; 2000). By the year 2000, use of the Internet for job search had risen to roughly 25% of the unemployed and 12% of the employed. Internet job search rates continued to rise to reach 38% of the unemployed and 14% of the employed by 2003 (see Table 1 for more details). According to survey findings from a report by Pew Internet Project, by 2002, 52 million Americans had searched for information about jobs online, with around 4 million doing so daily, which, they report, represents a 60% increase in online job

[1] The percentages I report I this section for 1998 and 2000 on internet use and internet use for job search agree with Kuhn and Skuterud (2004), who also use the same supplements for the years 1998 and 2000.

searchers since 2000[2]. As noted by both Kuhn and Skuterud (2004) and Stevenson (2003), much of the increase in use of the internet for internet job search may be attributed to a large rise in home internet access, especially among the unemployed (as can be seen in Table 1). Along with the wide use of the Internet for job search, companies have provided an abundance of sites with services to aid the job searcher in their quest. Kuhn and Skuterud (2000) noted that there were already more than 2000 online job sites as of 2000. Now estimates range closer to 40,000 and up[3]. It is quite clear that Internet job search has grown extensively.

Considering the sheer magnitude of use of the Internet for online job search, understanding the effectiveness of Internet job search is an important economic concern, as there have been mixed predictions as to what kinds of effects it could have on the overall labor market. Autor (2001) suggests that Internet job search could result in quicker matches[4] due to the ease of search, frequently updated job postings, and greater efficiency created through more initial meetings and online candidate screening. Additionally, there is potential for better matches resulting in less job separation[5]. Better matching could also result in lower frictional unemployment; an idea supported by both Autor (2001) and Kuhn (2000). Autor (2001) notes, however, that the convenience and low cost of Internet job search may result in more job separations as people move directly from one job to another. Kuhn (2000) points out that the potentially better matches may lead to wages being tied more closely to productivity, which in turn, could lead to larger wage inequality. While many of the beneficial predictions focus on better matches, it is quite possible that better matches will not occur. The low cost of Internet job search may

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[2] Pew Internet Project regularly conducts surveys on Internet related issues. These particular figures were taken from a Pew Internet Project survey of 2,259 Internet users from March 1, 2006 through May 19, 2002. Pew Internet Project Data Memo, July 2002. (viewed online 9/12/2006) http://www.pewinternet.org/pdfs/PIP_Jobhunt_Memo.pdf

[3] This figure is used on many sites including: www.weddles.com/jobcatalog.htm (10-9-06), www.consumersearch.com (updated March, 2005, accessed: 9/11/06), www.careerjournal.com (10/9/06), www.nationjob.com (10/9/06) and more.

[4] Kuhn and Skuterud (2004) test whether use of the Internet for job search by the unemployed results in shorter unemployment spells and conclude that it does not. I discuss this paper in further detail later.

[5] This may make more of a difference for youths as they often experience frequent job changes in the early stages of their working life. (Osterman, 1980) Age is a significant factor in the choice to participate in Internet job search as well (my results, as well as Kuhn and Skuterud (2004), and Fountain (2005))

induce an abundance of unqualified applicants, making it a less effective means of worker to job matching as employers find it more difficult to separate the qualified employees from a large pool of applicants. Fountain (2005) emphasizes that online job search may lose its advantage as higher screening costs for employers accompany the influx of users adopting the method.

The characteristics of those who use the Internet and those who use the Internet for job search have been well documented by many sources[6]. Internet job searchers are generally better educated, previously worked in occupations with lower unemployment rates, and are more likely to be homeowners and to be within the prime working ages of 26 to 55 (Kuhn and Skuterud, 2004). These characteristics would suggest that Internet job searchers may be a positively selected group of individuals. Since use of the Internet for job search requires some level of technological skill, such as the ability to use a computer and navigate search sites, upload resumes and/or use email, this may reflect the lower relative cost (in relation to other job search methods) of using the Internet for job search for those individuals who are more equipped with such technological skills. Conversely, for those who are less technologically skilled, the use of the Internet for job search may entail a larger cost relative to traditional job search methods. Although not the main finding of her paper, Stevenson (2003) provides some supporting evidence for this reasoning. She finds that "the Internet has led the unemployed to increase total job search activity at least at the extensive margin, while it also led the unemployed to reallocate effort among various job search activities." (pg.10) Using nine traditional measures of job search contained in the CPS Computer Usage Supplements for 1998 and 2001, Stevenson runs separate regressions for the percent of unemployed by state who use each traditional job search method on various state-level characteristics and a state-level Internet penetration measure[7]. These regressions show a statistically significant decrease in use of

[6] Internet use: Fairlie, 2004, 2005; Hoffman and Novak, 1998, 1999[0]. Internet use for job search: Fountain, 2005; Kuhn and Skuterud, 2000, 2004. All use data in the range of years 1997-2000.

[7] The CPS Computer Use Supplements for 1998 and 2001 that she uses are different from the CPS Internet and Computer Use Supplements 1998, 2000, 2001 and 2003, which I use (and will describe later). The Computer Use Supplements do not ask about the use of the Internet for job search. This explains why Stevenson only explores the increase in traditional job search methods resulting from the spread of the Internet. Her penetration measure is constructed using survey data from Forrester Research for 1997-2004 and retrospective data back to 1994. All of her regressions are aggregated to the state level.

the traditional methods of sending out resumes or answering ads. They also show a statistically significant increase in use of the methods of looking at ads, contacting employers directly, and other active search. She notes that previous research[8] has shown that direct employer contact, a method that is used more, generates the most offers. She claims that this may suggest an increase in selectivity or changes in marginal costs for the unemployed.

Studying the use of the Internet for Internet job search inevitably speaks to digital divide literature. Internet job searchers are more likely to be Asian or white than black, Hispanic or Native American (Kuhn and Skuterud, 2000). Existing literature concludes that different computer and Internet use rates across demographic groups can be explained largely if not fully by different levels of access across such groups (Hoffman and Novak, 1998; Hoffman and Novak, 1999, Fairlie, 2004, Fairlie, 2005). This trend holds for different rates of online job search as well (Kuhn and Skuterud, 2000; Stevenson; 2003). In addition to the many overall effects that the Internet has had or is predicted to have in the future, it has and may continue to create a divide in opportunities along the lines of demographics. The term digital divide, coined in the 1990s, refers to the disparity in opportunities resulting from the gap between the technology "haves" and the "have-nots"[9] and is still very alive today. Fairlie (2005) notes that "the Digital Divide is large and does not appear to be disappearing soon" (pg.12). As of 2000, 16 percent of unemployed whites searched for jobs online, while only 9 percent of blacks and 7 percent of Hispanics did so (Kuhn and Skuterud, 2000).

The digital divide is only an issue in as much as it refers to a gap in opportunities across demographic lines. That a specific demographic group does not have access to or know how to use email, for example, is not a concern if email does not help provide some economic benefit to the individual. However, if technological skills are important in educational advancement (which in turn aids in future job placement), or if they aid in finding a job or facilitate finding a higher quality job than one would have had without

[8] She cites Blau and Robins (1990).
[9] The phrase was coined by Lloyd Morrisett, the former president of the Markle Foundation. Source: Hoffman and Novak, 1999.

use of technology then there are consequences to a digital divide. If Internet job search is in fact an indispensable tool for furthering one's opportunities in the labor market, then individuals with limitations to access would be most affected.

Other Empirical Studies

Limited research has gone into empirically evaluating the effectiveness of Internet job search as a means to employment. Is Internet job search, which has seen such popularity over recent years, effective in creating successful job matches? Thus far, there exist only two papers that directly test whether it is in fact beneficial, Fountain (2005) and Kuhn and Skuterud (2004). Fountain (2005) argues for a decrease in effectiveness of Internet job search as it becomes more widespread. She motivates this as the trade-off between the quality and quantity of information provided from using the Internet as a job search method. As more individuals adopt the Internet as a job search method, any beneficial signaling effects, such as Internet proficiency, are reduced, as well as the exclusivity of the information on jobs that can be gathered by the searcher. Fountain (2005) uses CPS Computer and Internet Usage Supplements for 1998 and 2000. She creates small panels by looking at only those individuals for whom subsequent employment observations exist for 4 consecutive months. Using unemployed individuals between the ages of 25 and 65[10], she runs logistic regressions for both the probability of using the Internet for job search and for finding a job within the four month period of her panel. In the regression for the probability of using the Internet for job search she finds, as would be expected, that those with higher education, higher income and white individuals are more likely to use the internet for job search. The only surprising result is that the effect of age is positive and significant in 1998 and negative and insignificant in 2000. She then runs two regressions for whether internet job searchers were more likely to find a job in the short-run. Both include age, race, sex, income, metropolitan status, education, other methods of job search used, as well as a dummy for whether the individual uses the internet and a dummy for whether they use it for job search. The second specification, however, also includes an interaction term of using the internet for job search times a year dummy to

[10] No reason for these ages is provided.

indicate if the payoff from use of the internet for job search changed between the two years. She finds that, in 1998, Internet job searchers were 164% more likely to find a job than their non-Internet searching counterparts, while in 2000 Internet job searchers were 28% less likely to find a job. In both specifications the coefficient on using the internet for job search (not the interaction) is positive, but only significant, at the 5% level, for the specification with an interaction. These results changing over time could reflect the growth in popularity of Internet job search over this time period resulting in an influx of less qualified job searchers adopting this method, therefore reducing the overall odds. Alternatively, it could reflect a change in the labor market conditions from 1998 to 2000[11].

Kuhn and Skuterud (2004) also address the effect of Internet job search on labor market outcomes using the CPS Computer and Internet Use Supplements for 1998 and 2000. The authors match respondents in the supplements to data for all possible subsequent labor outcomes.[12] For probit regressions, Kuhn and Skuterud (2004), test the effect of use of the internet for job search on employment one year later. They also estimate a discrete-time hazard model to try to take advantage of any unemployment duration information that is contained in all of the future employment matches. Their probit estimates are insignificant with three of four specifications producing positive coefficients and one producing a negative coefficient. The results for the hazard model are negative and significant. Although their probit and durations model estimates reveal that Internet job search does not find searchers a job sooner, they are unable to distinguish whether Internet job searchers are negatively selected on unobservables or whether the method of Internet job search is simply ineffective.

Estimates drawn from Kuhn and Skuterud are arguably more reliable than those presented in Fountain (2005), as they are able to make full use of the information within data for the years 1998 and 2000 by creating unemployment durations using their model for a discrete time hazard function. However, there are a few reasons to believe that this

[11] Other than the unemployment rate, which she includes in the regression.
[12] It is possible to match an individual with future outcomes from as close as 1 month later to as far as 15 months later. There are however, breaks in time where an individual cannot be observed.

result is not entirely conclusive. First, Fountain (2005) finds positive results, and three out of the four probit estimated provided by Kuhn and Skuterud (2004), although insignificant, are positive. Second, the data are discrete with many time gaps, some of them quite long, so although the method may make full use of the information on durations available within the data, it is possible that there is a limitation on the improvement that can be made simply due to limitations in what the data can tell us about unemployment durations[13].

Neither of these papers confronts the potential problem of selection into Internet job search[14]. There are many observable characteristics that determine an individual's choice to use the Internet for job search or not (as discuss earlier). It is, however, the unobservable characteristics affecting the choice to use the internet for job search that could potentially cause problems in estimation if they also affect the outcome of Internet job search that is being studied. One way in which this might occur is that individuals with higher ability levels, possibly the more technologically savvy, have a lower relative cost to internet job searching[15]. They therefore are more likely to select to use the Internet for job search. This is an example of positive selection on unobservables. It is not obvious whether positive or negative selection would occur. Since those who use the Internet for job search are more likely to use more methods overall, this could represent selection and would suggest that "these unemployed are either more resourceful, or more desperate or both" (Fountain, 2003, p.1250). This could also simply reflect the overlap of many traditional job search methods with use of the Internet, such as sending resumes, which can be done in person or over the Internet. Selection into use of the Internet for job search could also occur by desired occupation and an individual's skill set. If a potential worker is looking for a job where use of the Internet is an important requirement, it would make sense that they might apply online, as this would signal their Internet ability. Fountain (2005) points to an experimental study (Bertrand and Mullianathan, 2003) that supports this point; it shows that resumes containing email addresses received more

[13] Individuals can really only be observed very close to the initial supplement and again around 1 year later, so one could imagine that the large windows of uncertainty could limit the benefit from using the improved method.
[14] Kuhn and Skuterud acknowledge the need for an instrument, but are unable to find one in the CPS data.
[15] Kuhn and Skuterud (2004) assume this connection between the errors as their prior.

callbacks. One would expect that this is due to the signaling that email gives of one's Internet ability. Alternatively, some individuals may apply online because they are able to convey less information about themselves. If someone is a terrible interviewer or lacks some verbal communication skill that would be apparent in an interview but not necessarily over the Internet, then they may be able to hide their negative traits. This would be likely if there is some standardized measure that would be misleading, such as a foreign language ability test that one scored highly on once, and has since forgotten. There are a variety of ways in which selection may be positive or negative depending both on the job requirements and the individual's skill set.

CPS DATA

In this paper, I make use of the Current Population Survey (CPS) Internet and Computer Use Supplements for the years 1998, 2000, 2001 and 2003. As with CPS Basic Supplements, the CPS Internet and Computer Use Supplements are representative of the US population. In addition to containing the typical variables included in the Basic Supplements (household, labor force, demographic, geographic, educational, as well as industry and occupational variables), these supplements also ask a variety of questions about an individual's and household's computer and Internet use. One variable of particular interest is whether the individual uses the Internet for job search or not. Within the supplements the appropriate question to use in constructing this variable is different in 2001 and 2003 from in 1998 and 2000. In the 1998 and 2000 supplements the respondent is asked a series of questions about their "regular" use of the Internet at various locations. They are asked if they regularly use the Internet at home, then if they regularly use the Internet at home for to look for jobs, email, read the news, and more. They are then asked this same series of questions for outside the home use of the Internet. Therefore, a dummy for whether the individual "regularly" uses the Internet for jobs earch can be constructed by recording a "yes" response if the individual responded with yes to either internet job search inside or outside the home. The responses are not mutually exclusive. For 2001 and 2003, however, there is just one question asked, which is whether the respondent use the Internet for job search in the last year. These questions

should not be treated as exactly the same since the wording with "regularly" implies some judgment of frequency of use.

I limit the sample to non-military adults between the ages of 18 and 65[16]. I also look only at only the unemployed population since I am interested in whether an individual becomes employed following their search behavior. Although one could potentially test the effectiveness of Internet job search for the employed, who also frequently use the Internet for job search, there is no way to identify within these particular supplements if an individual changes jobs, which is presumably the desired result for the employed Internet job searcher. If I were to look at the effect of Internet job search on wages of the employed without knowing whether the individual changed jobs, I would be unable to tell if employed workers tend to search near when they receive a promotion at their current jobs or if their searching while on the job allows them to switch to a job with higher pay[17].

Although not intentionally designed so, the CPS supplements also have a longitudinal component to them; a useful byproduct of the manner in which the CPS re-uses respondents by rotating them in and out of the sample. I make use of this by matching the supplement containing Internet use information with subsequent supplements in order to construct future employment outcomes. Matching is done using the conventional method suggested by Madrian and Lefgren (1999). From this matching, I am able to see the individual's employment status in the months following his or her job search behavior. Each respondent is interviewed for 4 months, then spends 8 months out of the sample, before being interviewed for another 4 months (a total of 8 months in sample). Therefore, 75% of individuals can be observed as soon as 1 month after the initial interview month, 50% can be observed 1 year after and 13% can be observed as far as 15 months after the initial interview month. The largest number of observations exists when matching for 1 month later, as the only respondents who will not appear in the sample are those who

[16] 18 and over in order to limit the sample to adults only and 65 and under to avoid complications that may arise with the choice to retire.
[17] Although I would not be able to make any causal claim, the question of whether internet job search is related to higher wage may be interesting on its own.

were originally interviewed during their 4th and 8th month in sample and have rotated out of sample before the next month's observations. In this paper, I will look at employment status 1 month, 2 months and again 1 year after observing whether an individual Internet job searches or not, as they have the largest potential match rates (75%, 50%, and 50%) and therefore the largest samples to use in estimation.

Identification

Using the longitudinally matched data, I can construct variables for whether the individual is employed 1 month, 2 months, and 12 months after the original Internet and Computer Use supplement. Using one of these variables, one could run a regression for employment after some number of months on relevant individual characteristics and a measure for use of the Internet for job search in order to estimate the effect of Internet job search on subsequent employment. To clarify, suppose:

- X contains characteristics of the individual, such as race, age, gender, education, and whether he or she is married.
- E is a dummy for whether an individual is employed one month[18] after internet job search behavior is observed.
- IJS denotes use of the Internet for job search and is a binary outcome. There is no measure of frequency, particular use of the Internet in the job search process, or intensity in terms of time spent searching.
- ε and ν are error terms

The regression takes the form:

$$E = \beta \bullet X + \alpha \bullet IJS + \varepsilon \qquad (1)$$

However, this equation cannot be estimated consistently by OLS. This is because the choice to use the Internet for job search, which can be represented as:

[18] or two, or 12 months after depending on which regression I am running

$$IJS = \theta \bullet X + \nu \qquad (2)$$

is likely an endogenous choice. Specifically, there may be a correlation between the errors, Corr (ε , ν) $\neq 0$. This correlation arises from the selection into use of the Internet for job search on some unobservable characteristics of individuals that also affect their future employment prospects, irrespective of whether they use the Internet for job search. Some potential scenarios for selection have already been discussed. For example, one previously mentioned selection possibility is that the more technologically able individuals will select into Internet job search due to their lower relative costs of using this job search method. If, for example, technologically able individuals also are more likely to become employed than the lesser technologically able, regardless of whether they choose to participate in Internet job search, then not accounting for this selection will result in upwardly biased estimates. The reverse would also hold if they were instead less likely to be hired, irrespective of their use of the Internet for job search.

In the situation where selection on unobservables exists, an instrumental variable can be used to correct for this bias. The instrument in this case would need to be correlated with Internet job search in order to explain the selection, yet be uncorrelated with an individual's employment prospects otherwise. If this can be achieved, then the two-stage estimation using instrumental variable(s), IV, can be consistently estimated and takes on the form:

First Stage: $IJS = \theta \bullet X + IV + \nu$

Second Stage: $E = \beta \bullet X_{IV} + \alpha \bullet IJS + \varepsilon$

Choice of Instrument

Like the example I provide, I do in fact argue that the selection into internet job search is likely related to an individual's internet use. Those who are particularly capable or familiar with the Internet will have a lower cost to using it as a job search method (being

relatively more productive) than those who are not. They will have an additional advantage using this method if they are able to signal a certain level of technological proficiency. It is possible that the value of this signal has decreased as sites have made it easier for individuals to apply to a large quantity of jobs with less effort or technological know-how (more user-friendly sites)[19]. Although this is a possibility, most internet job search, even on the most user-friendly sites, still requires some internet navigation skills, as well as the ability to upload a resume and/or use email. Fairlie (2005) notes that the projected[20] fastest growing jobs from 2000-2010 are all information-technology related. Additionally, the use of computers and the Internet in the workplace has become commonplace. More jobs are requiring these skills and a positive link can be observed between Internet use and hourly earnings (Freeman, 2002). For these reasons it is also likely that the Internet use of an individual would influence their labor market outcomes irrespective of whether they used the Internet for job search.

Literature relating to the digital divide, as well as a few additional studies[21], has come to the consensus that internet access drives internet use. Because access equates to usage, measures of Internet access are particularly well-suited for an instrument for Internet use. In the CPS surveys, home is the most popular location to access the Internet, followed by work and then someone else's computer. All three of these locations are dependent on an individual's labor market outcomes. Since having a computer at home comes at a cost, those with higher family income, previous income, or wealth are more likely to be able to purchase the necessary physical technology. Within both the employed and unemployed, individuals come from previous jobs within a variety of pay ranges and ability levels, which would play a factor in their current unemployment duration as well as their current access to a home computer. By definition, the unemployed do not have access to a computer from work, ruling it out as an option. Even using the Internet from another person's computer is not exogenous, as people tend to live near others of similar income

[19] In this case, studying the effectiveness of different types of internet job search may provide an interesting area of research as different types of internet job search may require different degrees of ability and therefore provide different signaling.
[20] This projection is taken from the US Department of Labor's 2002-2003 Occupational Outlook Handbook.
[21] Fairlie (2005), Hoffman and Novak (1998 and 1999), Stevenson (2003), Kuhn and Skuterud (2000), among others.

levels and social status. Goolsbee and Klenow (2002) find that "spillovers could play a quantitatively important role in the spread of home computers, perhaps doubling the rate of adoption" (pg. 340). A measure of public access that is independent of an individual's income level, for example, would serve as an ideal instrument.

Public libraries fit just this description. As noted in a survey study conducted by the Gates Foundation (2004) on the role of libraries in bridging the digital divide, "Public libraries were a logical fit for a strategy to provide public access across the country. Libraries have the attraction of being: open and accessible to all residents, community-based with a history . . . of offering …educational opportunities at no cost, and structured by law to cover 97 percent of the nation's population." (pg.12) The same study also indicated that "a majority of both Internet users (76%) and non-users (60%) knew of public access sites, and 90% of those aware respondents identified the public library as a point of access." (pg.16) Kuhn and Skuterud (2000) found that of the unemployed who do not have access at home "by far the most common access point for these individuals is 'someone else's computer', at 45% of the total. Next most common is public libraries [at 24.43%]."(pg.3)[22] Of the access options open to the public, libraries dominate as the location of choice.

An ideal time period over which to study changes in public access to the Internet is during the latter half of the 1990s. The reason for this is the various policies and funding increases in the nation's public library systems over this period. The increases in access to the Internet provide a natural framework within which to look at increases in public access on job search outcomes. In July 1995, the National Telecommunications and Information Administration (NTIA) released a report, "Falling Through the Net: A Survey of the "Have Nots" in Rural and Urban America." In this report the NTIA claims that "At the core of U.S. telecommunications policy is the goal of "universal service" -- the idea that all Americans should have access to affordable telephone service." (pg.1) Although Internet as a means for communication was not added until 1996, this report

[22] The CPS supplement from which this statistic was constructed asks about the following Internet use locations in addition to work, home and someone else's home: library, community centers, cultural centers, religious facilities, social service agencies, adult education centers, senior centers, youth centers and other.

analyzed the 1994 CPS Computer Ownership/Usage Supplement and brought the "digital divide" in terms of Internet use into the public eye.

The Telecommunications Act of 1996 set forth the educational rate, or E-rate policy, which required telecommunication companies to provide affordable rates through discounts to schools and libraries who applied to advance their telecommunications (including Internet access). Such discounts are then reimbursed as part of "universal service". Up to $2.25 billion annually is available to fund discounts at schools and libraries[23]. The program has been in place since 1997. For schools, the discount is based on the percentage of students eligible for the National School Lunch Program as well as thier urban or rural status. The discount ranges from 20 to 90 percent of eligible telecommunications services. For libraries (as with non-public schools) there are a number of "alternative discount mechanisms" intended to achieve similar awarding of discounts as would occur through using the percentage of eligible National School Lunch Program students. The E-rate discounts apply only to services (such as Internet connection) and some installation of necessary equipment, but does not include computers.

The Museum and Library Services Act of 1996 contained a section, Library Services and Technology Act (LSTA), through which federal funds are allocated to State Library Agencies based on population. For example, California received over $16 million in 2003, while Arkansas received just over $600,000. The funds must then be distributed through sub-grant competitions or cooperative agreements. They can be allocated to public, academic, research, school and special libraries in each state.

In addition to federally-funded programs, philanthropic groups have supported libraries over this time period. The Bill and Melinda Gates Foundation gave $250 million through its US Library Program to provide computers to libraries across the nation. The original

[23] US Department of Education, Office of Innovation and Improvement. http://www.ed.gov/about/offices/list/oii/nonpublic/erate.html viewed (9/28/06)

goal of providing computers to libraries across all states was completed in 2004. The foundation is now focusing on maintaining and replacing older computers.

PLDF Data

For measures of internet access at libraries, I use the Public Library Data File (PLDF)[24]. The dataset is aggregated to the library system level and includes a variety of information on library systems, such as staffing, amount and source of funding, hours, number of library branches, legal service area population and most importantly the number of general public internet terminals in each library system.

It is possible to use this data in conjunction with the CPS data since state and county FIPS (federal information processing standards[25]) codes are provided, which enable matching the dataset at the county level. I then aggregate the library data to the county level and each individual is assigned the corresponding internet access measure for their county. I construct two main Internet access measures, as well as their logs: the average number of general public Internet terminal per branch by county and the average number of general public Internet terminals per person by county, which uses legal service area population. Ideally access data for each individual would be matched the most disaggregate level possible, which in this case may actually be at the county-level. The larger the region of aggregation, the less the average may accurately reflect the individuals actual local access.

[24] I use this in conjunction with the Enhanced Public Library Data File (PLDF3). Both are data from the National Center for Educational Statistics (NCES), constructed using the annual Public Library Survey. These two datasets are essentially identical, only PLDF3 includes a unique identifier for each library system, making it possible to use longitudinally, but has had other imputations and alterations made to the original data, while PLDF is the unaltered data, including imputation flags, yet does not provide a unique identifier for library systems. Because the data is otherwise identical, merging of the two datasets results in a perfect match and beneficial aspects of both versions can be used with no loss of data.

[25] Information about these codes can be seen at: http://www.itl.nist.gov/fipspubs/

Results

After merging library data to Internet and Computer Use supplements as well as subsequent employment status variables, I first run my first stage regression to illustrate the quality of my instrumental variable. Tables 2 and 3 show the first stage results as well as the second stage results (without instrumenting) for 1998 and 2000, and 2001 and 2003 respectively. For 1998 and 2000, both specifications of the instrument appear to explain internet job search well. They are both significant and positive (as were the regressions using their logs, which I don't report here). Their explanatory power comes into question, however, when I break the measure for internet job search into internet job search at home and internet job search outside the home. I do this only for the terminals per branch measure since it was more significant. The regressions show that the library access measure is significant and positive for internet job search within the home, but positive and insignificant for internet job search outside the home. This brings into question how well the instrument is really explaining the endogenous variable. The second stage regression shows a negative, insignificant, coefficient for internet job search. For positive selection on unobservables, ideally this would be positive. I run these regressions again controlling for whether the individual has internet access at home and find that library internet access is positive and significant at the 10% level for both internet job search inside the home and outside the home. (shown below)

Controlling for home internet access:

	Internet Job search at home	Internet Job search outside home
Internet terminals Per branch in the county	0.007 (0.004) t=1.75	0.004 (0.002) t=1.65

For 2001 and 2003, both specifications shown in Table 3 are negative and insignificant (as were the logs of the instruments as well). This is a puzzling result. One possibility for why the instrument appears to work better for 1998 and 2000 is the different wording of the questions. Alternatively, the insignificant result for public internet access may reflect its lessened importance for access as home computer rates and home internet access rates

increased over time. The second stage in the case for 2001 and 2003 is negative and significant. It does not appear that my instrument is as effective at explaining the endogenous variable as it would originally appear.

Further Research Ideas

There are still however an abundance of unanswered question surrounding the intersection of the Internet and the labor market. Some of which may be possible to address using different aspects of the data I have explored here, for example:

- It may be possible to evaluate the effectiveness of such technology promoting policies, such as E-rate. Did library funding actually benefit its targeted audience? Have internet use rates among the intended disadvantaged demographic groups risen due to increased public access? Have these policies done anything to shrink the digital divide between whites and blacks? What about whites and Latinos? If so, has it benefited them in terms of labor market outcomes, such as moving from unemployment to employment or in terms of wage increases? If not, then public access points may not be sufficient for these groups.
- One possible effect of increased access to internet at schools (through policies such as E-rate) may be that students have more computer-related skills, and possibly more computer-related homework assignments. Goolsbee and Klenow (2002) showed that technology spillover effects can be large. Could this also work through the channel of children? Did the boost in school access rates increase home computer ownership? Presumably, parents may be more likely to purchase a computer if their child has more homework requiring the technology?
- The 2001 and 2003 Computer and Internet Use Supplements include information on 4 ways in which one might use the internet for job search. Are there differences in what type of people use each type? I would need to account for selction into each type of Internet job search. Assuming I could account for selection, then is there any specific use of the internet for job search that is more or less effective than others?

Table 1: Internet use and internet job search use rate by employment groups (ages: 18-65)

	Fraction with home Internet access				Fraction looking for work online				Fraction looking for work online, given home internet access			
	1998	2000	2001	2003	1998	2000	2001	2003	1998	2000	2001	2003
Employed												
- at work	33.9	51.2	63.1	66.9	7.4	11.7	11.7	14.2	16.4	19.0	15.8	18.2
- absent	33.4	60.1	65.9	67.9	7.6	11.0	11.5	13.1	17.8	15.6	15.1	16.5
Unemployed												
- on layoff	16.0	38.0	43.0	47.9	5.0	10.9	15.0	18.3	17.9	22.6	27.9	34.0
- jobseeker	21.0	37.9	33.9	53.5	16.1	27.3	50.7	39.5	56.2	58.5	57.6	60.8
Not in labor force												
- retired	20.9	37.4	49.2	55.1	0.8	1.4	1.3	2.9	3.3	3.7	2.6	4.7
- disabled	11.2	21.4	29.9	35.8	1.7	2.6	2.0	3.1	10.8	10.6	6.3	7.4
- other	31.5	45.5	57.7	59.9	4.5	7.1	7.9	10.6	10.3	13.1	11.9	15.2
Total												

Source: CPS Internet and Computer Use Supplements for 1998, 2000, 2001 and 2003.

Table 2: OLS results for 1998 and 2000

	Internet Job Search		Internet Job search at home	Internet Job search outside home	Employed 1 month later
Internet job search	---	---	---	---	-0.001
					(0.047)
Year 2000	-0.028	-0.019	0.015	-0.036	0.130***
	(0.046)	(0.048)	(0.043)	(0.023)	(0.041)
On layoff	-0.182***	-0.183***	-0.185***	-0.011	0.331***
	(0.037)	(0.037)	(0.034)	(0.018)	(0.069)
Lost job	0.032	0.030	0.044	-0.022	-0.025
	(0.030)	(0.030)	(0.029)	(0.016)	(0.047)
Temporary job	0.014	0.012	-0.007	0.012	0.118*
	(0.045)	(0.045)	(0.040)	(0.030)	(0.062)
Age	0.014**	0.014**	0.011**	0.005	-0.009
	(0.006)	(0.006)	(0.005)	(0.004)	(0.009)
Age2	-0.000***	-0.000***	-0.000**	-0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.030	0.032	0.051*	-0.025*	0.000
	(0.028)	(0.028)	(0.027)	(0.013)	(0.042)
Female	0.005	0.005	0.010	-0.007	-0.038
	(0.024)	(0.024)	(0.022)	(0.014)	(0.037)
Black	-0.041	-0.040	-0.067**	0.014	-0.121**
	(0.036)	(0.036)	(0.031)	(0.025)	(0.058)
Hispanic	-0.050	-0.044	-0.058*	0.009	-0.048
	(0.039)	(0.039)	(0.033)	(0.027)	(0.060)
Native American/	0.122	0.118	0.041	0.077	0.094
Alaskan	(0.084)	(0.084)	(0.100)	(0.081)	(0.222)
Asian/ Pacific Isldr.	0.032	0.036	0.056	-0.016	-0.249***
	(0.065)	(0.065)	(0.060)	(0.040)	(0.080)
In school	0.103*	0.103*	0.014	0.114**	-0.091
	(0.062)	(0.061)	(0.052)	(0.046)	(0.083)
High school/GED	0.043	0.043	0.033	0.008	0.071
	(0.027)	(0.027)	(0.023)	(0.015)	(0.051)
Some college	0.184***	0.186***	0.157***	0.035	0.083
	(0.039)	(0.040)	(0.035)	(0.025)	(0.063)
Associates degree	0.245***	0.248***	0.179***	0.083**	0.034
	(0.063)	(0.064)	(0.060)	(0.036)	(0.074)

Bachelors or higher	0.370***	0.373***	0.319***	0.078***	-0.000
	(0.044)	(0.044)	(0.041)	(0.026)	(0.071)
Immigrant	-0.035	-0.038	-0.027	-0.010	0.057
	(0.035)	(0.035)	(0.031)	(0.023)	(0.050)
Homeowner	0.040	0.040	0.072***	-0.035**	0.030
	(0.025)	(0.025)	(0.023)	(0.014)	(0.040)
Uses traditional	-0.081*	-0.079	-0.109**	0.034	0.063
job search methods	(0.048)	(0.048)	(0.048)	(0.024)	(0.084)
Internet Terminals	0.014***	---	0.010**	0.003	---
Per branch in the county	(0.005)		(0.005)	(0.002)	
	t=2.76		t=2.13	t=1.37	
Internet Terminals	---	456.898**	---		---
Per person in the county		(185.590)			
		t=2.51			

Note: results are without instrumenting. The sample is the sub-sample that matches with library data in both the first stage and the second stage. The second stage can also be done on the entire sample (Table 5)

* significant at the 10% level

** significant at the 5% level

***** significant at the 1% level**

Table 3: OLS results for 2001 and 2003

	Internet Job Search		Employed 1 month later
Internet job search	---	---	-0.058**
			(0.029)
Year 2003	0.108***	0.083***	-0.025
	(0.029)	(0.028)	(0.030)
On layoff	-0.189***	-0.190***	0.287***
	(0.032)	(0.032)	(0.048)
Lost job	0.096***	0.097***	-0.048
	(0.029)	(0.029)	(0.035)
Temporary job	-0.030	-0.029	0.007
	(0.044)	(0.044)	(0.060)
Age	0.009	0.009	0.004
	(0.006)	(0.006)	(0.007)
Age2	-0.000**	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)
Married	-0.016	-0.018	-0.025
	(0.023)	(0.023)	(0.028)
Female	0.007	0.008	-0.009
	(0.020)	(0.020)	(0.025)
Black	-0.119***	-0.118***	-0.034
	(0.030)	(0.030)	(0.037)
Hispanic	-0.148***	-0.147***	-0.074**
	(0.032)	(0.032)	(0.038)
Native American/	-0.007	-0.008	-0.156
Alaskan	(0.080)	(0.080)	(0.126)
Asian/ Pacific Isldr.	-0.079*	-0.078*	-0.082
	(0.048)	(0.048)	(0.052)
In school	0.018	0.019	-0.035
	(0.051)	(0.051)	(0.060)
High school/GED	0.054**	0.054**	-0.003
	(0.027)	(0.027)	(0.037)
Some college	0.222***	0.222***	0.028
	(0.034)	(0.034)	(0.043)
Associates degree	0.309***	0.311***	-0.038
	(0.049)	(0.049)	(0.055)

Bachelors or higher	0.481*** (0.033)	0.482*** (0.033)	0.092** (0.045)
Immigrant	-0.077*** (0.030)	-0.078*** (0.030)	0.063 (0.035)
Homeowner	-0.026 (0.021)	-0.027 (0.021)	0.010 (0.027)
Uses traditional job search methods	-0.098* (0.053)	-0.984* (0.053)	0.022 (0.052)
Internet Terminals Per branch in the county	-0.009 (0.006) t=-1.62	---	---
Internet Terminals Per person in the county	---	-17.557 (157.954) t=-0.11	---

Note: results are without instrumenting. The sample is the sub-sample that matches with library data in both the first stage and the second stage. The second stage can also be done on the entire sample (Table 5)

* significant at the 10% level

** significant at the 5% level

*** significant at the 1% level

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