The Internet and Job Search

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1. Introduction

As dot-coms proliferated and at home Internet use sky-rocketed, many economists began to speculate on how this new technology would change the labor market. In 2000 Alan Krueger wrote that "The Internet is rapidly changing the way workers search for jobs and employers recruit workers… [with] significant implications for unemployment, pay, and productivity." Autor (2000) outlines several of the ways in which the Internet might improve matching and provides evidence on the use of the Internet for job search. In the ensuing years the Internet has become an important part of people's lives and jobs: in 2004 73% of households had access to the Internet and 58% and 28% of adults used the Internet at home and work, respectively.[1] Yet, we still know very little about how the Internet has impacted employment.

This research focuses on the role of the Internet in matching workers and firms. The innovation of the Internet is both an increase in access to a vast amount of information and improved communication. Workers can gather information about both the availability and characteristics of jobs from information on the Internet or through email-based communication (in this way personal networks are a compliment to the Internet). They can then apply for openings and communicate with potential employers. All of which can be done 24 hours a day, without ever leaving one's home or work desk.

Workers have turned to the Web to take advantage of this new wealth of employment information with more than one in four online adults visiting job or career information sites in

[1] Data calculated from Forrester Research's 2005 Technographics Benchmark. 86% of those who use the Internet at work also use the Internet at home, however the majority (59%) of those who use the Internet at home don't have access at work.

2004.[2] And workers believe that the Internet is helping them find jobs. Figure 1 shows that among those that found a job in mid-2002 22% credited the Internet as the primary means by which they found their job. A little over half of those citing the Internet pointed to a posting on a general job board, while the rest said that specialty job search engines or company Web sites had been their primary source for finding their most recent job. Furthermore, while more people in 2002 said that newspaper ads and personal referrals were effective methods of job search, more than half of those surveyed felt that the Internet was an effective method of job search.

While these survey responses indicate that workers are integrating online job search into their regular search process, this is not evidence that online job search is better than other methods of searching for a job or that the Internet has improved worker-firm matching. Moreover, the research to date is not promising -- research measuring the effect of the Internet on job search found that unemployment duration is not lower for Internet job searchers, and may even be higher.[3] The authors conclude that perhaps those who searched on the Internet are negatively selected on unobservables. Alternatively, the negative effects of the Internet—the cheap cost of application leading to a plethora of applications for which employers have no useful sorting mechanism—may be greater than any beneficial effect. Or perhaps, there is a lengthy learning process whereby both employees and employers adjust to the new technology before it can be beneficial. And finally, perhaps the Internet changes search differentially for employed and unemployed job seekers;

[2] Data are from Forrester Research's 2005 Technographics Benchmark. Individuals who use the Internet were asked how often they use certain types of Web sites. This data is comparable to that found using the 1998, 2000, and 2001 CPS Computer Supplements which finds that among those with Internet access, online job search is used by a fifth of the employed and over half of the unemployed.

[3] Kuhn and Skuterod (2004) find that, conditional on observables, unemployment duration may be higher for Internet job searchers, something that they attribute to sorting on unobservables.

changing both who becomes unemployed and the subsequent matching process. In this case, examining only unemployment duration may give a very incomplete picture.

This research examines how the Internet has impacted job search. First focusing on job search activities and then turning to employment transitions: employment-to-employment, employment-to-unemployment, and unemployment-to-employment. If on-the-job search has risen, we should see an increase in employment-to-employment flows. Furthermore, we might see fewer employment-to-unemployment transitions if employed workers who search using the Internet are more successful at locating new work before their current job ends. In this case, the negative selection of those who do move from employment-to-unemployment would bias any analysis of unemployment duration upwards. In other words, it is not that those who search the Internet for employment are negatively selected on unobservables, but that those who search the Internet *conditional on being unemployed* are negatively selected on unobservables. This research uses data from the 1998, 2000, 2001, and 2003 CPS Computer Supplements to examine the relationship between employment transitions and use of the Internet both generally and specifically for job search purposes.

The paper proceeds as follows: the first section starts by examining growth in online usage and Internet-based job search using data from the CPS computer supplements. The next section considers how the availability of the Internet has impacted the type of job search activity undertaken by the unemployed examining trends in these activities over time. This research demonstrates that over the past ten years the variety of job search methods used by the unemployed has increased and then examines the relationship between changes in job search activity by the unemployed over time and across states with changes in state-level annual Internet penetration rates. The latter approach demonstrates that the Internet is association with a reallocation of effort

among various job search activities in that job search activity grows as a state's Internet penetration rate expands. In particular, higher Internet penetration is associated with a significantly higher probability of contacting an employer directly and/or looking at job ads.

The next few sections consider the relationship between Internet job search and employment flows. This line of inquiry begins by examining worker mobility patterns using the longitudinal aspect of the CPS to follow employed workers in the CPS Computer Supplements. These data provide information on current employer, household and individual computer and Internet use, and whether or not they have changed employers in subsequent months and finds that workers who are online are 15% to 30% more likely to change jobs than those who are not online, controlling for observable worker and job characteristics. Similarly, workers who are online are 25% more likely to change jobs within the same firm. Among employed workers, employment-to-employment flows are found to increase, particularly for those in the private sector with a college degree or higher.

The rest of the paper pursues an empirical strategy that analyzes changes in state online penetration rates to investigate effects of the Internet on labor market outcomes. The timing of Internet diffusion across states is analyzed revealing from aggregate state-level data that a 10 percentage point increase in a state's Internet penetration leads to a 5% increase in state-level employer-to-employer flows and a more than 15% increase in job changing by the college educated. In discussing the causes of state level variation in Internet penetration, a novel instrument for consumer Internet usage is identified: adoption rates of previous consumer technological advances. Interacting this instrument with year fixed effects provides an instrument for the state-level annual growth in Internet penetration rates. Instrumenting for changes in state online penetration yields estimates that are similar, albeit less precisely estimated, than those found using ordinary least squares.

2. Data and Descriptive Statistics

The December 1998, August 2000, September 2001, and October 2003 Current Population Statistics (CPS) Computer and Internet Use Supplements ask respondents about their and their households' computer and Internet use in addition to the usual battery of employment questions. These data reveal that online job search has grown rapidly among the employed, unemployed, and even those not in the labor force. Panel A of Table 1 shows that in 1998 5.7% of adults searched online for jobs, rising to 11.5% by 2003. Of those online, over half of the unemployed and 17% of the employed engaged in online job search in both 1998 and 2001; much of the increase in online job search during this period was proportional to the rise in access to the Internet such that the total share of those online using the Internet to search for a job was unchanged. Between 2001 and 2003 the increase in online job search activity was somewhat greater than the increase in Internet usage overall and, by 2003, nearly two-thirds of the online unemployed and a fifth of the online employed reported engaging in job search activities on the Web.

Panel B of Table 1 shows descriptive statistics for home and total online usage among the employed, unemployed, and those not in the labor force for 2003. Total access to the Internet is greater than home access for all groups. The non-home access comes from a variety of sources and raises access for the unemployed and employed by 12 and 14 percentage points respectively. It is worth noting that access to the Internet through work drives very little of the difference between the Internet access of the employed and unemployed. More than 80% of the employed in 2003 who have regular Internet access at work also have access at home, however the opposite is not true: many people get access through home who do not have access at work.

Among those employed, 57.3% used the Internet at home and 13.7% searched for a job online. While only 46.5% of the unemployed have online access at home, they are much more likely to search for work online (37.8%). However, the large difference in the stock of the employed relative to the unemployed means that the unemployed are a very small share of online job searchers. In 2003, the unemployed represent only 11% of those searching for a job online, while the employed comprise 77% and those not in the labor force comprise 12%. These descriptive statistics illustrate the importance of the employed in assessing the potential overall effect of the Internet on job matching.

Among Internet users there is surprisingly little heterogeneity between demographic groups in the tendency to use the Internet to search for a job. Appendix Table 1 shows the proportions of different demographic groups searching for a job online and then shows the proportion searching for jobs online among those with Internet access. Among those online, income, age, race, and gender differences are only minor for those unemployed. The differences among the employed likely reflect differences in general search activity. For instance, among the employed the young are more likely to search for a job with 28% percent of employed, online individuals aged 25 to 30 searching for a job online.

Overall, the main differences worth noting are that those with more education are more likely to search for a job online and that employed blacks, conditional on access, are more likely than employed whites to search for a job online. While the former suggests that Internet job search may reflect sorting on observables, the latter suggests the possibility of sorting on unobservables.

These differences may partially reflect differences in the potential benefits of Internet job search across groups. For instance, the benefits may be greater for the employed; reducing the cost of on-the-job search more than it increases the efficiency of search by the unemployed. The

technology allows ads to be scanned quickly, detailed job information can be gained without physically visiting the firm, and communication can occur during non-business hours via email. This both reduces the need to take time off from work and, potentially, reduces the probability that the current employer overhears the job seeking behavior.[4] Furthermore, "surfing" the Web may be more enjoyable or may be done more efficiently by taking advantage of slow periods at the office, making on-the-job online job search less expensive in terms of foregone leisure. Finally, as previously mentioned, the Internet has made it easier for firms and headhunters to identify potential candidates among those who are not actively searching.

In addition to differences between employed and unemployed workers, one would expect that the Internet benefits high skilled workers more than low-skilled workers as the former may face more heterogeneous matching characteristics. The Internet may benefit the time-constrained middle-aged more than the young—who are already in a thick matching market in which they are well-informed about their options—or the old—who are unlikely to benefit much from a job change. In investigating the relationship between Internet job search and employment transitions the potential heterogeneity in benefits among groups will be considered.

Another source of variation in Internet use occurs simply through differences in how the Internet diffused across the United States. There exists tremendous variation in online penetration rates across state economies. Proprietary data obtained from Forrester Research provides data from large annual surveys on whether an individual is actively online (defined as accessing the Web at least 3 times in the past 3 months). While the Forrester data is quite similar to the CPS computer supplement data, it provides a larger time period over which to examine online access and to look at job search behavior. The Forrester surveys commenced in 1997 and contain roughly 100,000

[4] In contrast, posting resumes online is likely to increase the probability that one's current employer discovers the job seeking activity relative to mailing resumes to select employers.

respondents per year through 2001 and 60,000 per year thereafter. Additionally, Forrester captures retrospective information about when a person first went online allowing data to be constructed back to 1994. I combine current and retrospective data from these surveys to measure annual state online penetration rates.[5] Measurements for 1992 and 1993 are interpolated following Goolsbee and Brown (2002).[6] Prior to 1992, Internet penetration, while unmeasured, is effectively zero. Table 2 shows the mean, standard deviation, minimum, and maximum of state online penetration rates defined to include those who regularly used the Internet.[7] By 2002 70% of the US used the Internet, but across states this varied from 53% to 80%.

3. Job Search by the Unemployed

We now turn to asking whether job search activity has increased as a result of the Internet. By making it cheaper to apply for jobs and to find job ads, the Internet should cause people to read more ads and apply for more jobs.[8] As such, we should expect an increase in search intensity for job search activities that are made cheaper by the Internet. However, while "search intensity" has a clear meaning in matching models, we lack a good empirical counterpart for this concept. Theory has less clear implications for easily measured job search metrics. For instance, time spent searching for a job may either go up or down depending on the elasticity of substitution between job search and other activities. The most readily available data covering the period of rapid Internet adoption measures job search activity at the extensive margin—the number of search activities in

[5] Forrester provides data for 48 states plus the District of Columbia, omitting Hawaii and Alaska from their surveys.
[6] Goolsbee and Brown calculated rates for 1992 and 1993 by scaling 1994 online usage by the overall rate of growth of domain names. I applied their scaling to my estimates of 1994 online usage; my estimate differs from theirs because I obtained access to a larger set of surveys.
[7] Those who regularly use the Internet can do so either at home or work, but much of the variation occurs because of differences across states in home use.
[8] Implicitly this assumes that job search is not a Giffen good.

which a person engages. Whether the Internet causes individuals to search more or less extensively depends on the relative price changes of the different job search methods. For example, if emailing friends and contacts is now much easier than before, individuals may decide to forgo another activity such as contacting a union or professional organization.

It is important to note that even if the Internet has led job seekers to increase job search activity, the overall effect on the labor market need not be positive. For example, the lower cost of applying for jobs could have ambiguous effects on unemployment, as there may be an offsetting increase in the cost of employers' selection of candidates from the applicant pool.[9] Furthermore Internet technology has also made it easier for firms to identify potential candidates among those who are not actively searching. If firms become more likely to make offers to those who are currently employed, overall match quality may increase at the same time that unemployment duration rises.

Over the relevant time period—1994 through 2003—the monthly CPS consistently captures the types of job search activities undertaken by the unemployed. Specifically, the unemployed are asked to list all the things that they have done in the previous four weeks to look for a job. The categories do not include Internet job search, but they don't exclude them either. For example, the category "submitted resume" could apply to electronic submission and those who "looked at job ads" could have done so via online or newsprint advertisements.

The Internet is likely to have changed job search at the extensive margin if either Internet search makes methods more complementary—for example if reading job ads online makes you more likely to submit resumes because it can be easily done electronically—or if Internet search changes the relative costs of different job search methods. Looking at the US as a whole, Figure

[9] This point is made in Mortensen (2000), Krueger (2000), and Lang (2000).

2 shows that there has been a steady and significant increase in job search by the unemployed—at least at the extensive margin—over the past decade. The national unemployment rate through this period is shown on Figure 2 and it is clear that these increases are not driven by macroeconomic conditions as the average number of search methods rises not only through the recent downturn but also through the long boom.[10] In contrast to what would be expected given the changes in the broader economy over the period, the percentage of the unemployed who sent out a resume in the previous four weeks rose from 36% in 1994 to 48% at the peak of the boom in 2000, and continued to rise to 55% in 2003 as unemployment rose. Similarly, the proportion looking at job ads rose from 17% to 23% and ultimately 30% over the same period. Moreover, the anonymity of the Web does not appear to be being replacing traditional networking, as the percentage of the unemployed contacting friends or relatives went from 16% to 19% over the period.

Table 3 further explores the relationship between the job search methods of the unemployed and state-level Internet penetration rates. Column B shows the result of the following regression run for each search method:[11]

$$\%\ of\ unemployment\ using\ job\ search\ method\ j_{s,t} = \beta\ Online\ Penetration_{s,t} + \sum_{i=0}^{2} \mu_i\ unemployment\ rate_{s,t-i} + \sum_{k} \varphi_k State\ demographic\ characteristics^{k}_{s,t} + \psi\ \%\ of\ workers\ in\ large\ firms_{s,t} + \sum_{s} \eta_s State_s + \varepsilon_{s,t} \quad (1)$$

where β is the coefficient of interest and online penetration is a measure of annual average online use across states. These regressions show that each type of job search method

[10] Blau and Robbins (1990) show that individuals search more extensively with high unemployment.

[11] State demographic characteristics include the proportion of the population who are white, female, married, ages 18 to 30, ages 30 to 50, ages 50 to 65, over age 65, and the share by years of education completed for those with less than 12, 12, 13-15, 16, and 17-20

became more popular as Internet penetration deepened.[12] All methods had large, statistically significant increases: a change from no Internet to 50% Internet penetration is associated with a 15% increase in the probability of sending out a resume, a 37% increase in the probability of looking at job ads, a nearly 50% increase in the probability of contacting a private employment agency, a 37% increase in the probability of looking at job ads, and a two-thirds increase in "other active search." Summing all search methods shows that on average the unemployed have used two of the methods queried. As expected given the increase shown over the period for all search methods, running equation (1) for total search methods shows a statistically significant and large increase in the extensiveness of job search.

Column C adds year fixed effects to the previously run regressions. These results show that the effects in Column B are largely identified off of the aggregate time series variation: controlling for year fixed effects yields more imprecise estimates—standard errors triple or quadruple in most cases. The within state variation yields a less clear story but suggests that perhaps relative prices of the different search methods have changed. Three of the job search methods – looking at ads, contacting an employer directly, and other active search – remain statistically significant and positive. Furthermore, the point estimate is now 4 times larger for contacting an employer directly. Because contacting an employer directly is the most common method of job search used and because previous studies have found that direct employer contact

[12] Because the unemployed, by definition, don't have Internet access from work, I use a slightly different definition of Internet access for these results, restricting online penetration to that at home only. This alternative definition is extraordinarily similar to the broader measure – a regression coefficient of the two is .90 and the two measures yield a correlation coefficient of .99.

generates the most offers, this change alone could potentially have a large impact on job search activity.[13]

The two methods that show a statistically significant decrease in activity – sending out resumes or answering ads – suggest that increased search is also leading to increased selectivity by the unemployed. Alternatively, given relative price changes it is possible that this pattern simply reflects changing marginal costs with workers increasingly contacting an employer directly rather than sending in a resume.

Ultimately, the goal of assessing how Internet job search has changed job search behavior is to ascertain whether it has affected the matching process and thereby changed important labor market outcomes such as reservation wages, match quality, and the duration of unemployment. While Kuhn and Skuterod (2003) have shown that unemployment duration is not lower for Internet job searches, the greatest impact of the Internet may be on the employed if Internet job search increases on-the-job search, leading current workers to make better matches.[14] If on-the-job search has risen, we should see an increase in employment-to-employment flows. If the Internet facilitates better matches then productivity may rise leading to higher wages. Alternatively, the increased access to information about outside offers may simply represent a shift in bargaining power toward workers, leading to an increase in wages. We now turn to examining workers flows.

[13] As in the CPS data presented here, Blau and Robins (1990) find that the most frequently used method of job search is direct employer contact and that this method generates the most employment offers.

[14] Kuhn and Skuterod (2003) find that, conditional on observables, unemployment duration may be higher for Internet job searchers, something that they attribute to sorting on unobservables.

4. Worker Flows and Internet Use: Matching Workers in the CPS

The longitudinal component of the CPS allows approximately 75% of the respondents to the Computer and Internet Use Supplements to be examined in the subsequent month.[15] I followed all people who were employed in the August 2000 and September 2001 Supplements into the September 2000 and October 2001 monthly surveys, respectively. The CPS (since 1994) employs a dependent interviewing technique in which interviewees are read back their employment details from the preceding month and asked to confirm them. These questions allow employment flows to be calculated including those who are still employed with the employer from the previous month and those who are still employed, albeit with a new employer.

Table 4 shows the one-month employment flows of those employed in August 2000 and September 2001 broken into those who had searched for a job online in the previous month and those who had not. The first column reports results for the 88.7% who had not searched for a job online in the preceding month: 93.3% are employed in the same job one month later, 2.7% are employed with a new employer, 1.0% are unemployed, and 2.9% are no longer in the labor force. The second column shows the employment flows for the 11.3% of workers who were looking for a job online in the first month: 91.2% are employed in the same job one month later, 4.5% are employed with a new employer, 1.9% are unemployed, and 2.4% are no longer in the labor force.

Comparing the first two columns in Table 4 reveals that those who were searching for a job online were more likely to change jobs and more likely to become unemployed. However, this comparison ignores the counterfactual of offline job search. To compare online on-the-job search the counterfactual of any on-the-job search we turn to the February 2001 CPS Contingent Worker

[15] While the survey is designed to be able to follow 75%, roughly only 95% of the 75% can actually be matched from one month to the next. For more information on matching in the CPS see Madrian and Lefgren (1999). Details about the match used in this paper are available from the author by request.

Supplement.[16] Workers in the February 2001 supplement are matched to the March 2001 CPS and their employment status one month later is shown in the third and fourth columns of Table 2. The third column shows employment flows for the 95.3% of workers who were not engaged in on-the-job search: 95.3% are employed in the same job one month later, 1.8% are employed with a new employer, 0.9% are unemployed, and 1.9% are no longer in the labor force. While these results are similar to those found for workers who had not engaged in online on-the-job search, striking differences arise in the fourth column when examining employment flows for the 4.7% of workers who were seeking a job the previous period.[17] Among these seekers only 83.9% remained with their previous month's employment, 9.5% were employed with a new employer, 3.7% were unemployed, and 2.9% were no longer in the labor force. Clearly those who are searching for a job while employed are negatively selected—in other words searchers seem to have private information about the possibility of their job ending.

Taken together Table 4 illustrates that examining the impact of online job search on the employment outcomes of the job seekers will reveal that they are more likely to have a change in employment outcomes, as those engaged in online on-the-job search will be more likely to have negative information about the likelihood of their employment continuing into the future. Yet more workers engage in online on-the-job search compared with traditional measures of search and traditional on-the-job seekers appear to be more negatively selected on average on their likely future employment outcomes as they transition to unemployment much more frequently than do online on-the-job seekers.

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[16] Fallick and Fleischman (2004) use the Contingent Worker Supplements to examine the difference in employer flows for those who engage in offline on-the-job search. This table follows their examination in Table 6 of the 1997 & 1999 Contingenet Worker Supplements.

[17] The contingent worker surveys use similar definitions as the monthly CPS uses to assess unemployed job search activity. The questions are not designed to capture method of action (for instance, emailing versus postal mailing of resumes).

The difficulty with looking at workers who are searching online is that there is no direct way to measure the counterfactual – what would have happened had they not been able to search online. One way to get around this is simply to compare employment outcomes for those who use the Internet with those who do not. To the extent that Internet use itself is uncorrelated with the unobserved characteristics that cause on-the-job search (such as private information about current match quality), then comparing employment outcomes among Internet users with non-users (controlling for observables) will capture the effect of the additional search induced by the Internet on employment outcomes. However, this introduces a similar selection problem if those who use the Internet are more (less) likely to change employers for reasons unrelated to the Internet, this will bias the coefficient upward (downward). An additional benefit of this measure is that it captures the total net effect of using the internet on employer-to-employer flows, regardless of whether a worker perceives him or herself to be actively searching online (those who communicate by email with a friend about a potential job lead and then submits an application online may very well be more likely to change jobs as a result of the Internet, but may not answer "yes" to a survey question regarding online job search).

To test whether Internet use itself is associated with a change in the probability of changing employers we follow workers in the 2001 and 2002 CPS Computer Use Supplements and assess whether the probability of moving from one employer to another employer in the subsequent month (EE) depends on Internet use in the previous month (I) controlling for demographics (current age, age-squared, marital status, race, education, gender, income, family type), industry and occupation, and state and year fixed effects. That is, probit regressions were run for:

$$EE_{i,t} = \alpha + \beta I_{i,t} + X_{i,t}\phi + \sum_k \chi_k Occupation_k + \sum_p \varphi_p Industry_p + + \sum_s \eta_s State_s + \sum_t \lambda_t Year_t + \varepsilon_{i,t} \quad (2)$$

where EE=1 if the worker changed employers in the subsequent month, I=1 if the worker uses the Internet, and X is a vector of demographic variables. The parameter of interest is β.

The regression results are reported in Table 5. Column 1 reports the results for the entire sample of those who were employed in the Supplement surveys. The coefficient on Internet represents the change in the probability for a discrete change from no Internet use to using the Internet evaluated at the mean of the dependent variable. The coefficient evaluated at the predicted mean implies that those who use the Internet are 15% more likely to have changed employers the following month.

In addition to individual behavior the CPS Computer and Internet Supplement asks respondents about the use of computers and the Internet by anyone in the household. This allows one to examine Internet use within households that have a computer and those that have Internet access. Among the employed who live in a household with a computer 75% use the Internet and among those who live in a household with Internet access 83% use the Internet. The last two columns in Table 5 show coefficients that are larger, albeit not statistically different from, that shown in the first column. Evaluating the effect of Internet use at the mean of the dependent variable shows that Internet use is associated with a 28% increase in job changing. While the last two columns potentially reduce selection problems at the household level, they also potentially exacerbate individual selection issues.

Table 6 looks at whether those who use the Internet are more or less likely to become employed if they are unemployed and whether they are more or less likely to become unemployed if they are employed. These results show coefficients that indicate that those who use the Internet are 7% less likely to become unemployed conditional on being employed. Examining those who

are unemployed we see a positive, yet statistically insignificant relationship between Internet use and the likelihood of becoming employed. This latter result is consistent with the findings in Kuhn and Skuterod (2004).

5. State-Level Variation in Internet Penetration and Worker Flows

Individual data suggests that the Internet is affecting worker flows, yet it is difficult to know if any of this is causal. One potential source of exogenous variation in Internet access comes from the different rates at which the Internet diffused across US states. Much of the variation in Internet use at the state level reflects long-standing patterns in their speeds of technological adoption. However using variation in state online penetration rates over time to identify changes in worker flows rests on an assumption that the changes in state online penetration rates are not themselves caused by something that would be correlated with changes in worker flows. Section 6 will explore potential confounding mechanisms.

For state level variation employment-to-employment flows is measured using the March CPS from 1988 to the present. The March CPS asks the employed "For how many employers did ... work in [previous year]?"[18] To measure individual employment-to-employment flows at a monthly rate for each person *i*, I calculated[19]:

$$\textit{Job-to-job flow}_i = (\textit{Number of employers last year}_i - 1)/12$$

[18] Respondents are given instructions that if they have more than one employer at same time, they should only count it as one employer.
[19] This measure follows Shimer (2003).

where the sample was restricted to those who worked full-year. Aggregating this measure to state-year averages, I then ran: [20]

$$Job-to-job\ flows_{s,t} = \beta\ Online\ Penetration_{s,t} + \sum_{i=0}^{2} \mu_i\ unemployment\ rate_{s,t-i} + \sum_{k} State\ demographics_{s,t} + \psi\ \%\ of\ workers\ in\ large\ firms_{s,t} + \sum_{s} \eta_s State_s + \sum_{t} \chi Year_t + \varepsilon_{s,t} \quad (3)$$

Table 7 shows estimates for both the population-weighted and unweighted OLS regressions. The results yield coefficients that are similar in magnitude and statistically significant. The results for all full-year employed workers suggest that an increase in Internet penetration of 10 percentage points led to a nearly .06 percentage point increase in monthly employment to employment flows, which is roughly a 5% increase. The second row restricts the sample to full-year workers who work in the private sector, slightly increasing the estimated response to .08.

It is unlikely that Internet job search has affected the employment-to-employment flows of all workers equally. For instance, low skill workers already operate in thick labor markets, and the returns to search are unlikely to be large. Additionally, there is substantial variation in the types of jobs that are advertised online, and again there are few low-skill jobs advertised, potentially reflecting the fact that not all workers have similar access to the Internet and, therefore, propensities to search for jobs online. Thus, if Internet job search is the mediating mechanism for the increase in employment-to-employment flows, we should see a much smaller effect, or no effect, on those with a high school degree or lower and we should see a larger effect for those with some college education and beyond.

Panel A of Table 8 runs these regressions for those full-year employed in the private sector by education level while continuing to control for state-level worker demographics. The estimated

[20] State demographic characteristics include the proportion of the population who are white, female, married, ages 18 to 30, ages 30 to 50, ages 50 to 65, over age 65, and the share by years of education completed for those with less than 12, 12, 13-15, 16, and 17-20.

effects of Internet access on employment-to-employment job flows are largely as expected, with large effects on those who have been to college and smaller effects on high school graduates. A 10 percentage point increase in Internet access for a full-year employed college graduate working in the private sector leads to more than 15% increase in job change.

Similarly, we should expect that the Internet has had a larger impact on younger workers who have adopted the Internet more rapidly. Panel B of Table 8 runs the regression for those full-year employed in the private sector by age group. The largest effect is seen on those ages 30-39, with large standard errors around the estimate for those ages 18-29. Taken together, these results suggest an increase in employment-to-employment flows resulting from higher state-level Internet penetration particularly for those with college degrees.

6. Instrumenting for State-Level Variation in Internet Penetration

The empirical strategy used in the previous section and used in investigating changes in job search activity in section 3 raises several questions. The first is whether state consumer Internet use merely reflects state commercial Internet usage. If this were true then the mediating mechanism explaining any association between changes in state Internet penetration and changes in job market outcomes may simply reflect the adoption of Internet technology by industry. For example, states with bigger changes in Internet penetration might be states with faster productivity growth due to commercial use.

The second question this strategy raises is whether the mediating mechanism is simply variation in regional business cycles. For example, states with faster growing economies may have citizens with more rapidly increasing purchasing power, some of which may be used to

acquire Internet access. In this case, a finding of more employment-to-employment flows, for example, may be caused by macroeconomic conditions rather than Internet job search.

To address the first concern I compare the adoption of the Internet by consumers with that by firms.[21] While adoption by both consumers and firms has occurred at a rapid pace, the adoption patterns have not been at all similar.[22] Forman, Goldfarb, and Greenstein (2002) construct a measure of commercial adoption using the Harte Hanks Market Intelligence Survey. They construct two measures of commercial adoption: "participation" and "enhancement". The former represents investment in and adoption of Internet technology by firms while the latter captures the use of technology specifically for competitive advantage such as electronic commerce. Neither of the measures is particularly well-correlated with consumer use: Figure 3 illustrates the relationship between commercial and consumer Internet adoption in 2000 using the more broadly defined "participation" measure of commercial adoption.[23] Regressions of consumer online participation for each year from 1994 through 2003 on commercial penetration in 2000 show no statistically significant relationship, confirming that commercial adoption neither leads nor lags consumer adoption.[24]

The second concern is less easily resolved. While controls can help resolve whether Internet usage is a cause or consequence of changing conditions, the best solution is to develop an instrument that would be correlated with changes in Internet penetration, but not correlated with changes in the business cycle (or other potential mediating mechanisms). To identify a

[21] Data on commercial penetration refer to the measure of commercial participation developed in Forman, Goldfarb, and Greenstein (2002).
[22] Not surprisingly, Web domain registration and household Internet use are correlated; the more people there are online the more firms there are trying to capture their attention. But Web domain registration does not represent commercial Internet use more generally.
[23] The finding that commercial participation is uncorrelated to household adoption using data from Forrester Research's Technographics Benchmark data matches that found by Forman, Goldfarb, and Greenstein using NTIA estimates of Internet household use.
[24] Earlier years actually show a negative, albeit insignificant, relationship between the two.

potential instrument, I consider the hypothesis that consumer Internet adoption would follow long-standing patterns in the adoption of household appliances. To test this hypothesis, I examine the relationship between Internet use and adoption of other basic consumer technological improvements. In 1960 only 23% of households had an automatic washer and 76% had a telephone. Figure 4a shows state Internet penetration rates in 2000 graphed against the predicted Internet penetration using a linear combination of state ownership rates of automatic washing machines and telephones in 1960.[25] The predictive power of these historical patterns of adoption of household appliances for Internet penetration is remarkable. This figure strongly suggests that the Internet is diffusing to households in a pattern similar to other household innovations. As a communication technology, it is unsurprising that Internet penetration closely mirrors that of the telephone (moreover, most Interact access occurs over telephone lines). However, because telephones were further along in the adoption process, the diffusion of automatic washing machines, which were a newer technology in 1960 and therefore were much earlier in the adoption process, provides separate, useful variation.

The fact that automatic washing machine and telephone diffusion in 1960 predict state-level Internet adoption in a given year suggests that there are some state-characteristics that impact household technology diffusion that are relatively stable over time, this naturally raises the question of what those characteristics are. One hypothesis for why diffusion patterns emerge is because of neighborhood effects. The purchase and use of new technology may be influenced by the degree to which the state housing characteristics facilitate diffusion. As such we can look

[25] Automatic washers differ from manual washing machines. The 1960 census captured information about washing machine ownership and categorized ownership into auto or semi-automatic and those with a wringer or separate spinner. Television and radio are both predictive of Internet use, but are sufficiently correlated with telephone penetration as to add no marginal predictive power. Other appliances, such as dryers and air conditioners were not considered because of the influence of climate on their adoption.

at states where houses are farther apart because they are on large plots of land and see if diffusion is slower in such states.

Figure 4b shows a relationship similar to that seen in Figure 4a, Internet penetration rates in 2000 are now graphed against that predicted by a linear combination of the percentage of people in a state living on plots of land between one and ten acres and the percentage of people in a state living on farms. Not surprisingly, states with more people on large acres have less Internet access, while farms mitigate some of this effect.

The relationships shown in Figures 4a and 4b exist for all years of Internet penetration. However, a useful instrument to test the results in Section 4 needs a time-varying component. As such, I use the 1960s measures interacted with year effects to instrument for online access. By using the *interaction* of the fixed state characteristics predicting adoption and the annual average diffusion, it is possible to plausibly identify the impact of the exogenously determined growth of consumer use of the internet, while separately controlling for fixed state and year characteristics. Appendix Table 2 shows the first stage of this regression. The instrument resulting from using automatic washing machines and telephones in 1960 interacted with year fixed effects is a stronger instrument and results in coefficients that are similar in magnitude to those seen in the OLS. Disaggregating by education level yields results that are consistent with the OLS; showing a large and significant increase in flows among college graduates and little, if any, effect for those with less than a college degree.

Table 9 shows these results for all full-year employed, those in the private sector, and by education and age using the acre and farm measures in 1960 interacted with year fixed effects to instrument for online access.[26] The coefficients are broadly similar, although slightly larger. A

[26] The results are similar to those attained using telephone and automatic washing machine penetration in 1960 interacted with year fixed effects.

10 percentage point in Internet access results in a .1 percentage point increase in employment-to-employment flows for those employed in the private sector full-year. For educational groups, the coefficients are broadly consistent with the OLS, but with larger standard errors. The results among age groups are also similar, with the results for those 30-39 remaining both the largest and most statistically significant.

Turning back to Table 3, the same instrumental variables technique can be applied to investigating the relationship between Internet access and job search activities. Columns D and E replace the OLS estimates in columns B and C with instrumental variables estimates. The first stage uses the ownership rates of automatic washers and telephones in the 1960s interacted with year fixed effects as exogenous predictor for state online penetration through time. Instrumenting yields estimates that are qualitatively similar although typically of slightly larger magnitude. Specifications of year fixed effects are less precisely measured and in most cases we can reject neither a zero effect, nor the large effects estimated in columns B and D. Overall the IV regressions suggest 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.

In sum, the IV results yield results that are less precise although broadly consistent with the OLS results providing weak, yet supporting, evidence for their findings.

7. Concluding Remarks

In the past ten years Internet usage has risen from effectively zero to 70% of the population. This rapid rise in information technology has the potential to dramatically alter labor market outcomes. The Internet is perceived to have made job search more efficient for workers, yet

research has lagged popular perception. This paper makes two main contributions. First, I uncover the driving forces of changing state Internet penetration rates. Second, I trace the effects of this variation on job search activity.

Because this paper analyzes the effect of changing state online penetration rates over time on job search behavior, I consider two alternative explanations for such a relationship. The first is whether state consumer Internet use merely reflects state commercial Internet usage, suggesting that the mediating mechanism may be the use of the Internet by industry (which may lead to sectoral shifts or productivity gains among other things). However, consumer penetration rates are shown to be uncorrelated with commercial penetration rates. Perhaps most revealing of the relevant driving forces is the fact that previous household appliance adoption predicts consumer Internet use, while state patent rates in 1975 predict commercial participation. Thus, household appliance ownership rates in 1960 provide a strong instrument that is used throughout the paper to attempt to disentangle whether changes in state labor markets reflect Internet usage or drive Internet adoption.

I find that over the past ten years the variety of job search methods used by the unemployed has increased and that the Internet has led to reallocation of effort among various job search activities. Perhaps most importantly, this paper points to an increase in employment flows resulting from the Internet. This finding suggests that the Internet is indeed leading to better job matches and highlights the need for further work to examine the implications of increased match quality.

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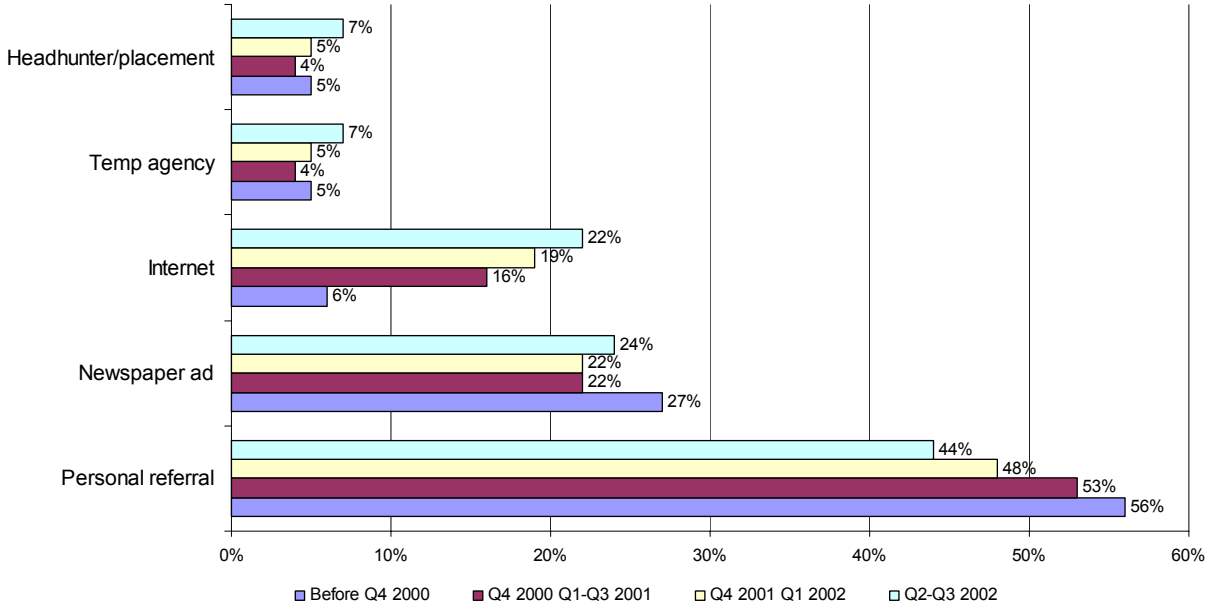
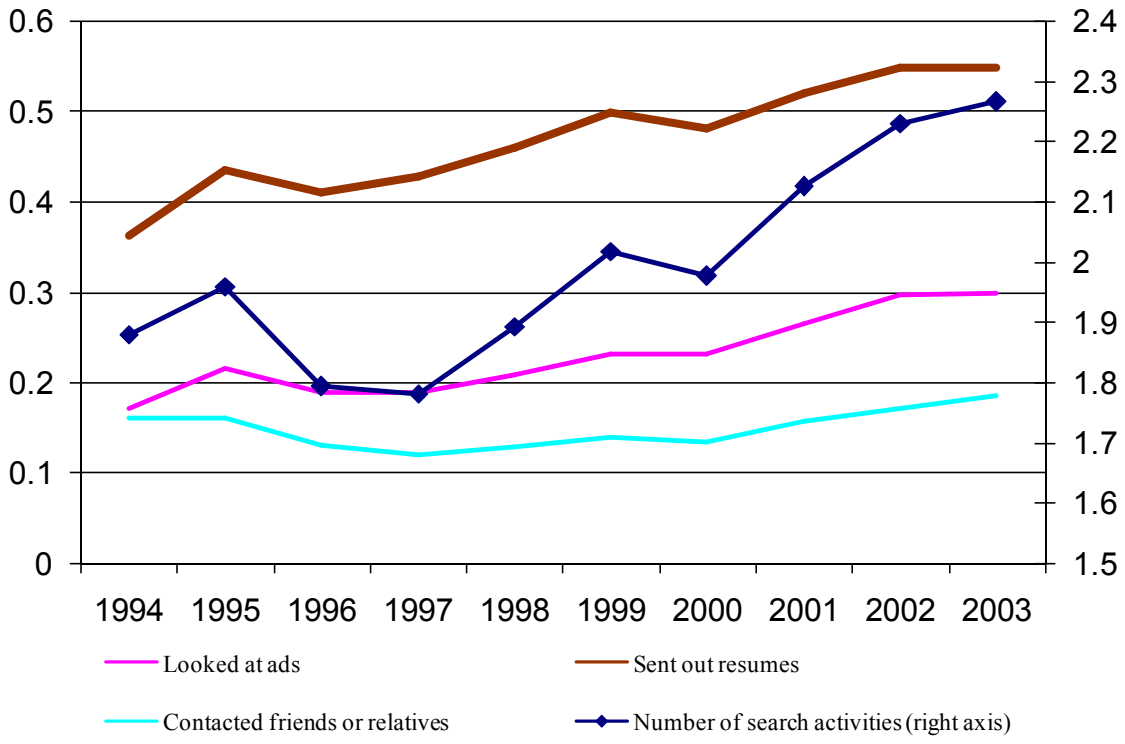
Figure 1: Primary Method Used to Find Current Job



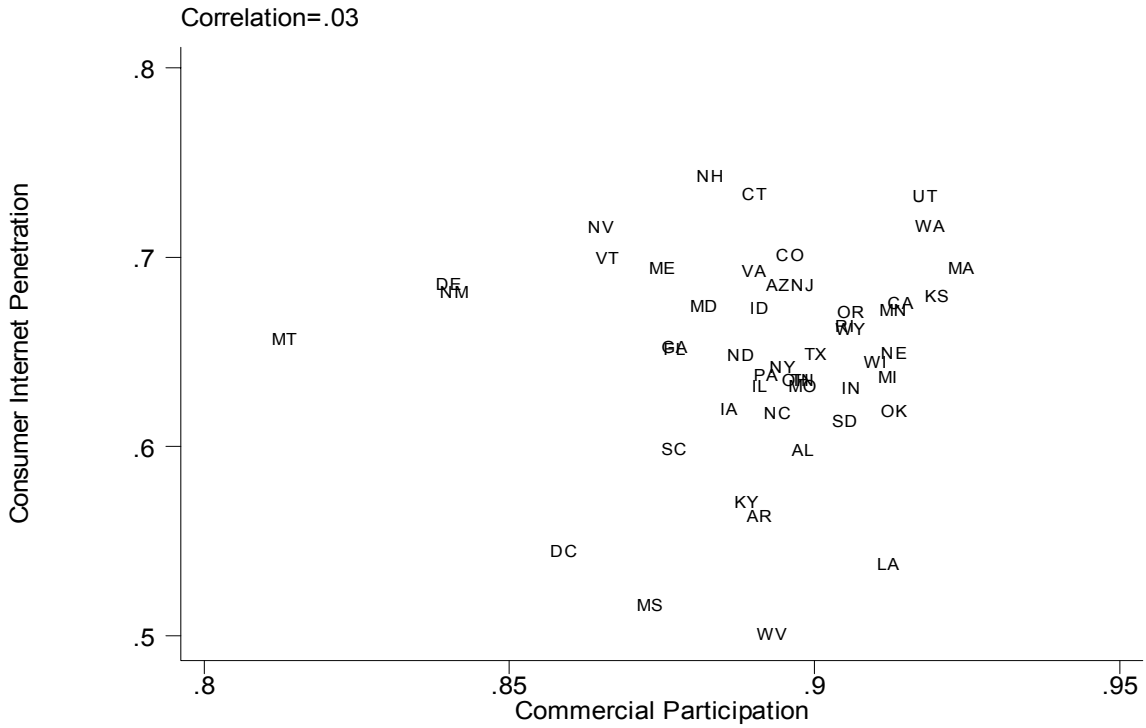
Source: Forrester Research survey (November 2002). Question was only asked to those who were currently employed and use the Internet. Individuals are divided by when they started their current job.

Figure 2: Job Search Methods of the Unemployed



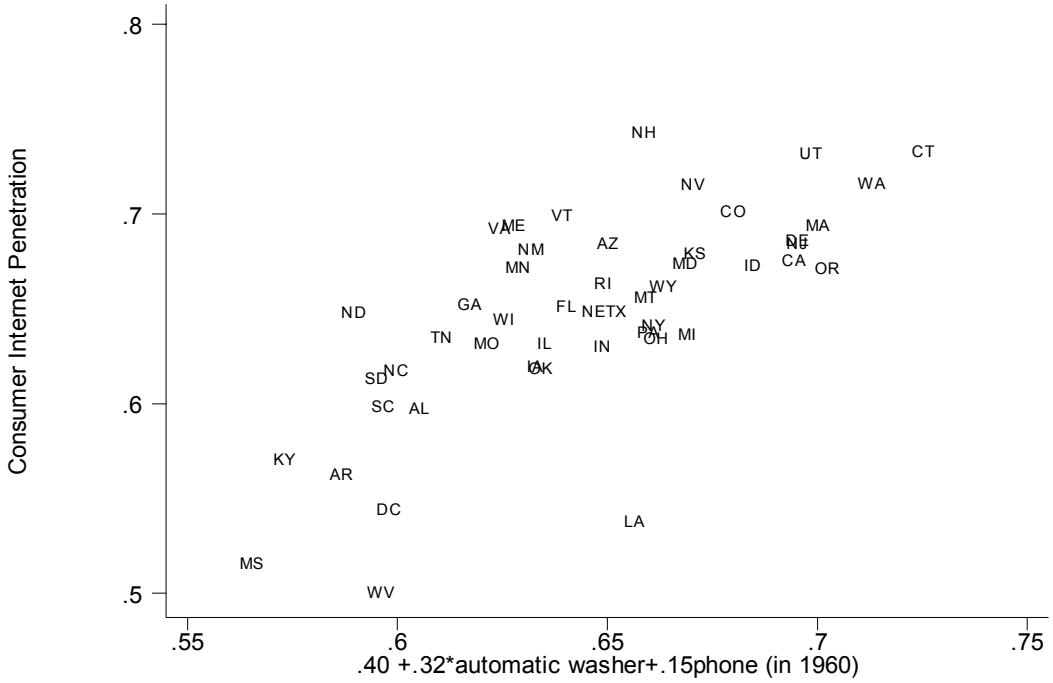
Source: Monthly Current Population Statistics annual averages of the job search methods by those who are unemployed and looking for work in the four weeks prior to the interview. National unemployment rate is from the Bureau of Labor Statistics.

Figure 3: Internet Use: Consumers Versus Firms



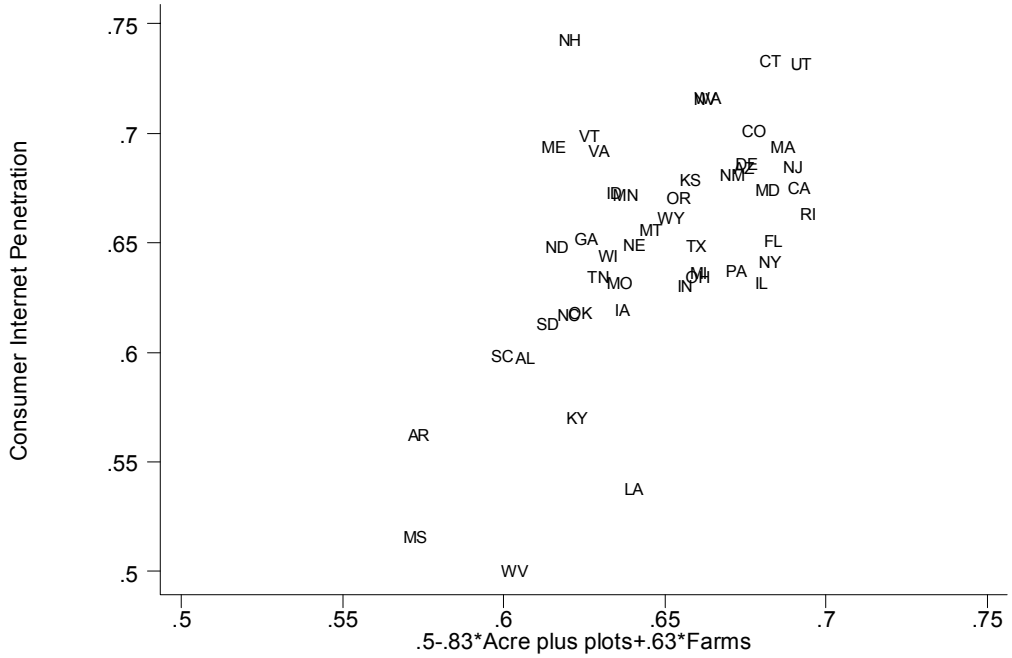
Source: Consumer online penetration is state average online use by individuals for 2000 using data from Forrester Research. Commercial Internet participation rates are from Forman, Goldfarb, Greenstein (2002).

Figure 4a: Consumer Internet Penetration Predicted by 1960 Phone and Automatic Washing Machine Ownership Rates



The graph compares actual online penetration measured in 2000 (shown on the y-axis) with that predicted by the following regression shown on the x axis: Online $_{s,\ t=2000} = \alpha + \beta$*Own Phone$_{s,\ t=1960} + \delta$*Own Automatic Washing Machine$_{s,\ t=1960} + \varepsilon$

Figure 4b: Consumer Internet Penetration Predicted by 1960 Land Characteristics



The graph compares actual online penetration measured in 2000 (shown on the y-axis) with that predicted by the following regression shown on the x axis: Online $_{s,\ t=2000} = \alpha + \beta$*Live on 1-10 acre plot$_{s,\ t=1960} + \delta$*Live on farm$_{s,\ t=1960} + \varepsilon$
Source: Online penetration is from Forrester Research's proprietary Technographics Benchmark 2001 data. Online is defined to be "online at least 3 times in the last three months" from any location. Automatic washer, phone penetration, plot size and farm data are from the Public Use Micro Sample (PUMS) of the 1960 Census of Population.

TABLE 1: Online Job Search from 1998 to 2003

	Panel A: Percent Searching for Jobs Online				
	Year	Employed	Unemployed	Not in the labor force	Total
Total Population	1998	7.2%	14.0%	1.9%	5.7%
	2001	11.4%	31.2%	3.3%	9.4%
	2003	13.7%	37.8%	4.3%	11.5%
Those who use the Internet	1998	17.1%	52.6%	11.2%	16.9%
	2001	17.2%	58.8%	9.6%	16.9%
	2003	19.1%	65.1%	11.4%	19.0%

Panel B: Descriptive Statistics: Internet Use and Online Job Search in 2003				
	Employed	Unemployed	Not in the labor force	Total
Percent Online from home	57.3%	46.5%	33.2%	49.2%
Percent Online from anywhere	71.7%	58.0%	37.8%	60.3%
Proportion of adult population	64.3%	3.3%	32.4%	100%
Share of online job searchers	76.8%	11.0%	12.2%	100%

Source: Data are from the Current Population Statistics Computer Supplements conducted in December 1998, September 2001, and October 2003. Online are individuals who access the Internet from any location.

TABLE 2: State Online Penetration Rates

	Mean	Standard Deviation	Minimum	Maximum
1992	2%	1%	1%	3%
1993	4%	1%	2%	7%
1994	7%	2%	4%	12%
1995	12%	3%	7%	18%
1996	20%	4%	12%	27%
1997	30%	5%	19%	39%
1998	44%	5%	31%	54%
1999	56%	5%	41%	65%
2000	65%	5%	50%	74%
2001	68%	5%	54%	77%
2002	70%	6%	53%	80%

Source: Online penetration numbers are from come from Forrester Research's proprietary data where online is defined to be "online at least 3 times in the last three months" from any location. State-year penetration numbers are calculated from 5 years of survey data including retrospective data on how long the respondent had been online. For example, state data for 1999 is calculated by combining current reports in 1999 and retrospective reports in 2000-2003. Data for 1992 and 1993 is interpolated following Goolsbee and Brown (2002): by scaling 1994 online usage by the overall rate of growth of domain names. I applied their scaling to my estimates of 1994 online usage.

TABLE 3: Job Search Methods: The Effect of the Internet on the Extensiveness of Job Search

		Effect of the Internet on the probability of using each method			
Dependent Variable	**Mean**	**OLS Results**		**IV Results[#]**	
	Column A	*Column B*	*Column C*	*Column D*	*Column E*
Contacted employer directly	63%	.039**	.166***	.029	.176
		(.019)	(.064)	(.020)	(.136)
Contacted public employment agency	21%	.068***	-.019	.080***	.260*
		(.018)	(.061)	(.018)	(.148)
Contacted private employment agency	6%	.059***	-.012	.064***	-.028
		(.009)	(.027)	(.009)	(.066)
Contacted friends or family	13%	.070***	-.075	.083***	.047
		(.010)	(.050)	(.015)	(.123)
Sent resume	48%	.139***	-.159**	.169***	.210
		(.026)	(.077)	(.027)	(.207)
Contacted union or professional org	2%	.007*	-.016	.009*	.026
		(.004)	(.015)	(.004)	(.030)
Placed ad or answered ad	15%	.056***	-.167***	.071***	-.242***
		(.018)	(.051)	(.019)	(.111)
Looked at ads	23%	.170***	.114*	.174***	.125
		(.019)	(.070)	(.019)	(.132)
Other form of active search	5%	.066***	.077***	.065***	.101*
		(.008)	(.026)	(.008)	(.060)
Number of methods used	2.0	.681***	-.101	.766***	.663*
		(.058)	(.177)	(.061)	(.411)
Controls					
State unemployment rate		√	√	√	√
State demographic characteristics		√	√	√	√
Percent of state workers in firms with 1,000 or more employees		√	√	√	√
State fixed effects		√	√	√	√
Year fixed effects			√		√

*** and ** indicate statistically discernible from zero at the 1% and 5% levels, respectively.

[#] First stage regression for IV estimates**:**

Robust standard errors are in parentheses. State-level demographic characteristics control for the fraction of the state's total population who are white, married, ages 18 to 30, ages 30 and 50, ages 50 and 65, over age 65, and the share by years of education completed for those with less than 12, 12, 13-15, 16, and 17-20.

Source: Job search data reflect annual data from 1994 through 2003 created from the monthly Current Population Statistics by aggregating over 12 months, with the exception of 2003 for which only the first 9 months were available. Online penetration numbers are from come from Forrester Research's proprietary data where online is defined to be "online at least 3 times in the last three months" from any location. State-year penetration numbers are calculated from 5 years of survey data including retrospective data on how long the respondent had been online. Data on online use gathered in December were matched to job search behavior in January through December of the following year.

TABLE 4: Employment Flows By Previous Months On-the-Job Search Status for Online and Offline Search

	2000 & 2001 CPS Computer Supplements		2001 CPS Contingent Worker Supplement	
Employment Status One Month Later	No online on-the-job search	Online on-the-job search	No traditional on-the-job search	Traditional On-the-job Search
% of Total Employed in the First Month	88.7%	11.3%	95.3%	4.7%
Same Employer	93.3%	91.2%	95.3%	83.9%
New Employer	2.7%	4.5%	1.8%	9.5%
Unemployed	1.0%	1.9%	0.9%	3.7%
Not in the Labor Force	2.9%	2.4%	1.9%	2.9%

Source: Data for columns 1 and 2 are generated using the August 2000 and September 2001 CPS computer supplements matched with the September 2000 and October 2001 monthly CPS, respectively. Data for columns 3 and 4 are generating using the 2001 February Contingent Worker Supplement matched with the monthly March 2001 CPS. Flows represent employment status one month later for those employed in the original supplement month.

TABLE 5: Probit Estimates of Employer Changes and Internet Use

Independent Variable	All Workers	Households With Computers	Households With Internet Access
Individual Internet Use Dummy	.003*** (.002)	.005* (.002)	.004** (.002)
Pseudo R^2	.036	.042	.045
Number of observations	88,681	61,136	52,673
Mean of Dependent Variable	.024	.023	.024
Percent Effect of Internet Use on Job Changing Evaluated at X bar	15%	28%	28%

Notes: Each column is a probit regression evaluating the probability that a worker changes jobs between the two months conditional on Internet use in the first month and control variables. The dependent variable =1 if the respondent uses the internet. Coefficients represent the change in the probability for a discrete change from no Internet use to use evaluated at the mean of the dependent variable. Robust standard errors are in parentheses. *, **, and *** indicate statistically discernible from zero at the 1%, 5%, and 10% levels respectively. Controls include state and year fixed effects, occupation and industry, and demographics. Demographic controls include age, age squared, marital status, race, family type, income, education, and gender. Source: August 2000 and September 2001 CPS computer supplements matched with the September 2000 and October 2001 monthly CPS, respectively.

TABLE 6: Probit Estimates of the Likelihood of having an Unemployment Spell

	Dependent variable: Prob. Of experiencing an unemployment spell	Dependent variable: Prob. of becoming employed
Sample	Workers who were employed in September 2001	Workers who were unemployed in September 2001
Independent Variable:		
Individual Internet Use Dummy	-.002*	.026
	(.001)	(.060)
Pseudo R^2	.110	.099
Number of observations	15,506	628
Mean of Dependent Variable	.036	.509
Percent Effect of Internet Use on Unemployment Evaluated at X bar	-7%	5%

Notes: Each column is a probit regression evaluating the probability that a worker either becomes unemployed or becomes employed between the two months conditional on Internet use in the first month and control variables. The coefficient of interest=1 if the respondent uses the internet. Coefficients represent the change in the probability for a discrete change from no Internet use to use evaluated at the mean of the dependent variable. Robust standard errors are in parentheses. *, **, and *** indicate statistically discernible from zero at the 1%, 5%, and 10% levels respectively. Controls include state and year fixed effects, occupation and industry, and demographics. Demographic controls include age, age squared, marital status, race, family type, income, education, and gender. Source: September 2001 CPS computer supplements matched with the October 2001 monthly CPS, respectively.

TABLE 7: Employment-to-Employment Flows

$$Job-to-job\ flows_{s,t} = \beta\, Online Penetration_{s,t} + \sum_{i=0}^{2} \mu_i\, unemployment\ rate_{s,t-i} + \sum_{k} State\ demographics_{s,t} + \psi\ \%\ of\ workers\ in\ large\ firms_{s,t} + \sum_{s} \eta_s State_s + \sum_{t} \chi Year_t + \varepsilon_{s,t}$$

	All Full-year Employed		Full year employed in the private sector	
Regression coefficients are multiplied by 100 to aid interpretability. [27]	**States weighted equally**	**Population-weighted**	**States weighted equally**	**Population-weighted**
	Column A	*Column B*	*Column C*	*Column D*
Mean Flow				
Online Penetration Rate	.582**	.528*	.773***	.729**
	(.257)	(.287)	(.308)	(.331)
State unemployment rates	-.031**	-.020*	-.025**	-.013
	(.014)	(.012)	(.012)	(.010)
R^2	1.71***	1.39***	1.94**	1.69*
	(.575)	(.619)	(.950)	(.981)
Controls				
State fixed effects	√	√	√	√
Year fixed effects	√	√	√	√
Demographic characteristics of labor force	√	√	√	√
Percent of state workers in firms with 1,000 or more employees	√	√	√	√
Two lags of the state unemployment rate	√	√	√	√

*** and ** indicate statistically discernible from zero at the 1% and 5% levels, respectively.

Robust standard errors are in parentheses. State-level demographic characteristics control for the fraction of the state's employed population who are white, female, married, ages 18 to 30, ages 30 to 50, ages 50 to 65, over age 65, and the share by educational attainment for those with a high school degree or less and for those with a college degree or above.

Source: Job changing data reflect annual data from 1988 through 2003 created from the March CPS. Online penetration numbers are from come from Forrester Research's proprietary data.

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TABLE 8: Employment-to-Employment Flows by Age and Education

Sample	Mean[28]	OLS Result
Panel A: By education Status (full-time employed in private sector)		*Coefficient on Online Penetration*
High School Graduate	1.0%	-.030 (.449)
Some college	1.3%	1.23** (.625)
College degree or higher	1.1%	1.71*** (.575)
Panel B: By age (full-time employed in private sector)		
Ages 18-29	1.9%	.815 (.722)
30-39	1.0%	1.03** (.439)
40-49	0.7%	.846* (.443)
50 and over	0.5%	-.058 (.459)
Controls		
State fixed effects		√
Year fixed effects		√
Demographic characteristics of labor force		√
Percent of state workers in firms with 1,000 or more employees		√
State unemployment rate		√
Two lags of the state unemployment rate		√

*** and ** indicate statistically discernible from zero at the 1% and 5% levels, respectively.

Robust standard errors are in parentheses. State-level demographic characteristics control for the fraction of the state's employed population who are white, female, married, ages 18 to 30, ages 30 to 50, ages 50 to 65, over age 65, and the share by educational attainment for those with a high school degree or less and for those with a college degree or above.

Source: Job changing data reflect annual data from 1988 through 2003 created from the March CPS. Online penetration numbers are from come from Forrester Research's proprietary data.

[28]Regression coefficients are multiplied by 100 to aid interpretability.

TABLE 9: Employment-to-Employment Flows: Instrumental Variables

Panel A: Aggregate Results	All full-year employed	Full-year employed in private sector *Column B*	*By education*	*By age*
	0.995	1.22*		
	(.630)	(.741)		
High School Graduate			.340	
			(.968)	
Some college			1.15	
			(1.38)	
College degree or higher			1.84	
			(1.23)	
Ages 18-29				1.90
				(1.65)
30-39				2.20**
				(1.10)
40-49				1.35
				(1.02)
50 and over				.325
				(.930)
Controls				
State fixed effects	√	√	√	√
Year fixed effects	√	√	√	√
Demographic characteristics of labor force	√	√	√	√
Percent of state workers in firms with 1,000 or more employees	√	√	√	√
State unemployment rate	√	√	√	√
Two lags of the state unemployment rate	√	√	√	√

*** and ** indicate statistically discernible from zero at the 1% and 5% levels, respectively.

Robust standard errors are in parentheses. State-level demographic characteristics control for the fraction of the state's employed population who are white, female, married, ages 18 to 30, ages 30 to 50, ages 50 to 65, over age 65, and the share by educational attainment for those with a high school degree or less and for those with a college degree or above.

APPENDIX TABLE 1: Percent Searching For A Job Online Among Demographic Groups: 2001

			Percent Searching for Jobs Online Total Population			Percent Searching for Jobs Online Among those Online		
			Employed	Unemployed	Not in the labor force	Employed	Unemployed	Not in the labor force
Gender	**Total population**	Women	11.8%	31.1%	3.4%	16.8%	54.9%	9.2%
		Men	10.9%	28.6%	3.1%	17.0%	54.7%	8.5%
Race	**Total population**	White	11.2%	32.2%	3.1%	16.2%	54.8%	8.1%
		Black	11.3%	20.0%	4.2%	21.8%	52.3%	16.9%
		Asian	13.9%	43.9%	5.2%	19.8%	65.5%	10.2%
Education Categories	**Total population**	High School Drop-Out	3.2%	8.3%	1.6%	9.5%	23.5%	6.2%
		High School Graduate	6.9%	20.1%	2.3%	13.1%	45.7%	8.3%
		Some college	12.6%	40.1%	5.7%	17.1%	60.9%	11.3%
		College	19.3%	68.8%	5.8%	21.6%	77.5%	9.7%
		Post graduate	16.4%	66.6%	4.7%	17.9%	75.2%	8.1%
Household Income Categories	**Total Population**	Less then $20K	9.2%	18.0%	2.0%	24.2%	54.1%	12.4%
		$20K to $40K	11.4%	30.4%	2.9%	21.2%	58.7%	9.1%
		$40K to $60K	11.9%	32.4%	4.4%	17.1%	48.6%	8.5%
		Above $60K	13.9%	49.5%	5.5%	15.3%	59.0%	7.8%
Age Categories	**Total Population**	18-25 year olds	16.6%	28.7%	9.9%	24.3%	46.8	15.0
		25-30 year olds	19.3%	36.0%	7.7%	27.5	66.0	15.6
		30-35 year olds	14.8%	34.7%	7.6%	20.9	67.7	14.3
		35-40 year olds	11.5%	31.0%	6.5%	16.6	63.1	13.7
		40-45 year olds	10.0%	33.5%	4.9%	14.5	68.2	11.4
		45-50 year olds	8.9%	32.8%	5.4%	13.1	69.6	12.8
		50-55 year olds	6.1%	36.2%	2.4%	9.4	71.2	6.5
		55-65 year olds	4.0%	25.7%	1.1%	7.2	59.1	3.6
		65 year olds	3.1%	27.9%	.8%	3.9	31.6	1.4

Source: Data are from the Current Population Statistics Computer Supplement September 2001.

Appendix Table 2: First Stage: Instrumental Variables Approach

$$Online\ Penetration_{s,t} = \alpha + \sum_t \eta_t Year_t * Percent\ on\ 1\text{-}10\ acre\ plots + \sum_t \eta_t Year_t * Percent\ on\ farms + \varepsilon_{s,t}$$

	Column A	*Column B*
	First stage without additional controls	First stage with all controls included in second stage
Acre*Year=1994	-1.51** (.633)	-.134 (.161)
Acre*Year=1995	-1.02 (.665)	-.203 (.161)
Acre*Year=1996	-.353 (.651)	-.268* (.159)
Acre*Year=1997	.788 (.690)	-.305* (.165)
Acre*Year=1998	2.49*** (.678)	.367** (.165)
Acre*Year=1999	3.22*** (.615)	.465*** (.160)
Acre*Year=2000	3.83*** (.665)	.534*** (.164)
Acre*Year=2001	4.62*** (.662)	.573*** (.163)
Acre*Year=2002	4.20*** (.692)	.675*** (.167)
Farm*Year=1994	-1.51** (.633)	.094 (.177)
Farm*Year=1995	-1.02 (.665)	.155 (.179)
Farm*Year=1996	-.353 (.651)	.150 (.177)
Farm*Year=1997	.788 (.690)	.147 (.182)
Farm*Year=1998	2.49*** (.678)	.151 (.183)
Farm*Year=1999	3.22*** (.615)	. .264 (.174)
Farm*Year=2000	3.83*** (.665)	.418*** (.18)
Farm*Year=2001	4.62*** (.662)	.539*** (.177)
Farm*Year=2002	4.20*** (.692)	.676*** (.183)
Adjusted R^2	.67	.99

*** and ** indicate statistically discernible from zero at the 1% and 5% levels, respectively.
Robust standard errors are in parentheses.

Source: Online penetration numbers are from come from Forrester Research's proprietary data. Plot size and farm data are from the Public Use Micro Sample (PUMS) of the 1960 Census of Population.