

The Intensity of Job Search and Search Duration

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Abstract

We use micro data on applications to job openings by individuals on a job search website to study the relationship between search intensity and search duration. Our data allow us to control for several factors that can affect the measured relationship between intensity and duration, including the composition of jobseekers and changes in the number of available job openings over the duration of search. We find that jobseekers send fewer applications per week as search continues. We also find that long-duration jobseekers tend to exert the most search effort. Controlling for the local stock of vacancies does little to affect the result, mainly because jobseekers continue to apply to older vacancies well into their search spell.

Keywords: Job applications, vacancies, labor market search effort, search duration.

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1. Introduction

A large literature documents a negative relationship between unemployment duration and the probability of finding a job (Jones, 1988; Machin and Manning, 1999; van den Berg and van Ours, 1996). Several factors have been put forth as causes of this negative duration dependence. Some attribute the negative relationship to heterogeneity in either the productivity or employers' perception of jobseekers, while others attribute the negative relationship to a decline in the job-finding probability during an individual jobseeker's search.¹ Variations in the search intensity of jobseekers, whether they be across jobseekers or over the duration of a jobseeker's search, can also be an important factor for explaining negative duration dependence in job finding probabilities. While there are models that incorporate a role for search intensity, little empirical evidence exists on the relationship between search intensity and search duration.

In this paper, we use a large, novel set of longitudinal micro data on the application behavior of jobseekers from an online job search engine to examine the relationship between search intensity and search duration. Our data include all applications made by jobseekers to vacancies on the website at the daily frequency over one year. The data are nationally representative, and include basic information on the geography and characteristics of both jobseekers and vacancies. Our findings are twofold. First, using the weekly number of applications sent on the engine as our measure of search intensity, we find that an individual jobseeker sends fewer applications per week as search continues. Second, we find that jobseekers who search on the website longer, on average, send *more* applications per week throughout the length of their search spell than those who end their search on the website earlier.

¹ The studies includes models of unemployment duration as a signal of worker productivity (Blanchard and Diamond, 1994), models of unemployment duration as a stigma (Lockwood, 1991; and Pissarides, 1992; with empirical support by Addison and Portugal 1989; and Kroft, Lange, and Notowidigdo, 2012), and models of heterogeneity in the employability of jobseekers (Hornstein, 2012).

Our results arise after addressing several measurement issues that our data are uniquely suited to deal with. One issue is that unobserved characteristics can affect the probability of finding a job and generate a relationship between search intensity and duration through a selection effect. For example, jobseekers who search most intensely may find work faster. The longitudinal panel nature of our data allow us to control for unobserved characteristics, either through the use of jobseeker fixed effects or through controls for completed spell length. Prior to these controls, we obtain a relationship between search effort and duration that is declining at first, but then flat to slightly increasing thereafter. When including these controls, we find that search effort declines monotonically with duration. Another issue is that search intensity may vary with the stock of available vacancies. For example, Coles and Smith (1998) model job search as a stock-flow process. That is, at the start of their search jobseekers search through the existing stock of vacancies but, thereafter, only search through newly-posted vacancies. Our data contain information on all vacancies ever applied to on the website. This allows us to construct measures of the stock of active vacancies within a jobseeker's labor market. It also allows us to distinguish between newly-formed and pre-existing vacancies. Adding these controls, however, does little to affect our key findings. This is because most applications are to pre-existing vacancies throughout a jobseeker's search spell. The fraction of applications to a newly-posted vacancy rises with duration, consistent with a stock-flow model, but it does so only slightly, representing only 17 percent of applications during a jobseeker's sixth month of search. In comparison, jobseekers send a similar fraction of their applications in the sixth month to vacancies that they applied to previously.

The data include rich detail on the location of each jobseeker and each job opening, as well as basic demographic and industry information for each, respectively. The online data, however, do not have information on the outcome of any job application. Consequently, we do know whether a jobseeker stopped searching because they found work, they switched to another search method, or they stopped searching altogether. To address this issue, we replicate our analysis using a sample of "potential

matches” that consists of jobseekers who applied to an expiring vacancy the same week we identify as the end of their search spell. We provide compelling evidence that this sample reflects individuals who likely found jobs through the website. Our two key results hold, with estimates that are very similar to those we obtain with our full sample.

Our finding of a decline in search intensity with duration rejects a simple search and matching model that implies constant search effort. The finding suggests a need for richer search models that generate jobseeker behavior that varies with the duration of search. These models might, for example, include changes in a jobseeker’s outside option, jobseekers learning about their own skills (or the depreciation of their skills), or jobseekers learning about the state of their labor market.

Our finding that long-duration jobseekers exert the most search effort, at first look might appear at odds with search theoretic models that imply a positive effect of search effort on the probability of finding a job. At closer examination, it highlights an important dimension of jobseeker heterogeneity. In particular, we interpret the finding as evidence that unobserved heterogeneity in jobseeker characteristics is quantitatively more important than differences in search effort in explaining why some jobseekers have long search spells. The heterogeneity may take one of two forms –heterogeneity in employability or heterogeneity in the jobseeker’s search efficiency. First, long-duration jobseekers may be viewed by potential employers as being low-productivity or otherwise unqualified for the job. These jobseekers may exert greater search effort to increase their chances of finding a job. Second, long-duration jobseekers may consistently apply to jobs that they are poorly-suited for, so that, despite their substantially high effort, their job-finding probability remains low. This can occur due to imperfect information about a jobseeker’s own ability or about the labor market.

Our paper fits within the literature that studies the relationship between jobseeker search behavior and job-finding outcomes. Krueger and Mueller (2011), which focuses on search effort and

unemployment duration, is the study most related to our own. In contrast to ours, they examine search effort using survey data on a cohort of unemployed workers in New Jersey. They conclude that the unemployed spend less time searching for work as search continues. It is not clear, however, how much measurement issues related to the repeated use of their survey instrument for reported time spent on job search affects their conclusions. More broadly, our work is also related to studies that examine the relationship between the job-finding rate unemployment duration. The salient finding among these studies is the presence of negative duration dependence for the exit rate from unemployment. Finally, our paper is related to the growing literature that studies online job search (Kuhn and Skuterud, 2004; Kroft and Pope, 2012; Brown and Matsa, 2012; Marinescu and Wolthoff, 2012), and to the literature that studies hiring and vacancies (Barron, Bishop, and Dunkelberg, 1985; Holzer, Katz, and Krueger, 1991; Davis, Faberman, and Haltiwanger, 2013).

2. Data and Measurement

2.A. Data and Sample

We use proprietary data from SnagAJob, an online private job search engine. The data contain information about jobseekers and their applications to online job postings (vacancies). Jobseekers can browse information on the website at no cost. To apply for a job, however, a jobseeker must register with the website. Registration is free. At registration, jobseekers provide their basic demographic and geographic location information. Once registered, jobseekers are able apply for posted job openings on the website by clicking an application link associated with the online job posting (which we refer to as a vacancy). The jobseeker's interest and information, including any resume they may have uploaded to the website, are then transmitted to the employer that posted the vacancy.

Employers pay a fee to post vacancies on the website on a per-period rather than a per-vacancy basis.² Each vacancy posting contains basic information on the geographic location and sector of the job. Postings also contain a general description of job duties that can vary widely in its detail on skills required, compensation offered, etc., though our data do not contain this information. Most job postings provide at least basic information on job duties (including a job title, or occupation), skills required, and hours, including whether the job is full-time or part-time. Listed skill requirements can vary from including detailed education, experience, and certification requirements, to only requiring that one be “highly motivated” or “committed to quality customer service.”

An important feature of the job search engine is that the jobs posted there are predominantly hourly paid jobs. Hourly jobs tend to be lower-skilled jobs and tend to be concentrated in services. These jobs have been growing in importance and constitute a major part of the U.S. labor market (Autor et al., 2003; Acemoglu and Autor, 2012). Thus, the data provide a unique opportunity because, while the jobseekers on the website tend to be lower-skilled and less educated than the general population, they are representative of many of the unemployed.

Our dataset contains daily micro data on all application-vacancy matches between September 2010 and September 2011, including detailed information on both applicants and vacancies during this period. We also have supplemental information on application behavior after September 2011, and on total time spent on the website, including the total number of webpage views and website visits, by each applicant, though we do not have this information available by week. We have demographic

² First time customers to the website may also post a single vacancy for free for up to 10 days. In addition to the limited duration, the free trial period does not provide for some of the other services, such as the opportunity to screen applicants with an assessment test. The trial period is nontrivial because other empirical work has found that the mean duration of a vacancy is about 3 weeks (Burdett and Cunningham, 1998; Davis, Faberman, and Haltiwanger, 2013). Unfortunately, we have no way to distinguish between these vacancies and ones posted by employers who paid to post their vacancies. In the data, we observe that 42 percent of vacancies receive all their applications within a one-week period and that 56 receive all their applications within a two week period. This, however, only provides an upper bound on the number of vacancies that may have been posted using the 10-day trial period.

information on age, education, race, and gender, as well as geographic location at the zip code level, for nearly all applicants.³ For vacancies, we have geographic location at the zip code level and the website's classification of each vacancy's industry. The industry classification, though, is more an amalgamation of industry and occupation (e.g., Management is an "industry" in our data). The industry classification is job-specific rather than firm-specific, so a sales position for a construction firm will be listed as part of Sales & Marketing rather than Construction.

We do not have information on the outcome of an application by a jobseeker (i.e., contacted for an interview, hired, etc.), nor do we have any information on the job search efforts of a jobseeker outside of the website. We also do not know the employment status of a jobseeker. Finally, we do not have information on when a vacancy was first posted to the website or when it was taken down, though we can identify the first and last day that any applicant on the website applied to a position within our sample period. In our analysis, we attempt to identify potential hires as instances when an individual's search spell ends with an application to a vacancy that also ends during the same week.

The raw data in our sample period contain over 46.15 million applicant-vacancy observations for 8.00 million jobseekers and over 1.81 million vacancies. We remove matches with missing geography or industry data (a negligible amount of observations) as well as applications to postings that are to "work at home" jobs or similar postings that advertise positions that are self-employment opportunities rather than a job opportunity with a particular employer. This procedure reduces the number of individuals and vacancies in the data by a negligible amount, but it reduces the number of application observations by 14 percent. In some cases, we observe repeat applications by the same individual to the same job posting. We delete repeat posts that are within 1 week of each other on the presumption that these are the result of some form of an applicant error (i.e., multiple website clicks or forgetting that they just

applied to the same job). We retain repeat applications further than 1 week apart on the presumption that applicants may find it worth it to apply again if they observe that the job opening is still posted (and, presumably, unfilled). We also exclude applicants with missing education and gender information, and missing website visit information (i.e., time spent on the website and number of webpage views), and restrict our attention to applicants aged 16 to 75 years. These restrictions remove a negligible amount of individuals. We focus our analysis on the behavior of jobseekers who register on the website after the beginning of our sample, September 1st 2010. This reduces our sample by about 31 percent, but ensures that we only study behavior from the start of a jobseeker's search spell. As we describe below, though, we use information on the behavior of all jobseekers in our sample to generate estimates of vacancy characteristics, including total applications received.

2.B. Identifying Labor Markets and Active Vacancies

We define a labor market as the metropolitan area of a jobseeker. We restrict our sample to applicants within Core-Based Statistical Areas (CBSAs) that are not a Micropolitan Statistical Area, or Consolidated Statistical Areas (CSAs). The latter are combinations of 2 or more CBSAs that are considered part of a larger metropolitan area. The exclusion of Micropolitan areas only removes the smallest metropolitan areas, defined as having a population between 10,000 and 50,000, and is done to ensure large enough sample sizes for our defined labor markets. This gives our analysis sample 318 metropolitan areas within the U.S. While we limit the scope of our analysis to jobseekers within these areas, we keep track of all applications from these jobseekers, regardless of the vacancy's location. Similarly, when calculating statistics for vacancies applied to by these jobseekers, we use all applications to the vacancy, regardless of the origin of the application.

We use the labor market definition to identify the number of active vacancies present in a jobseeker's labor market. We define a vacancy as active from the first date we observe a jobseeker

apply to the last date we observe someone apply. We refer to the time between the first application and the current period under analysis as the vacancy's duration. We refer to the time between the first and last observations as the vacancy's total tenure on the website. Obviously, our dating method creates a censoring issue for vacancies that were potentially active before or after our sample period. To account for this, we condition out calendar week means from all of the vacancy statistics that we use.

2.C. Identifying Search Spells

Identifying the length and current duration of a jobseeker's search spell is crucial to our analysis. The micro data provide information about when a jobseeker registers with the search engine and when they are first and last observed applying to a vacancy. The data do not provide the reason for why a jobseeker stopped searching. A jobseeker may have found employment (either through the website or through other job search methods), stopped searching on the on the website, or stopped searching for job altogether and left the labor force. It is important to note, too, that we have no information on the current employment status of the jobseeker. Jobseekers may search less intensely or intermittently because they are currently employed. They may also continue to search after finding employment (and likely at a different level of intensity) in cases where the new job reflects "underemployment" relative to the type of work they were seeking. We also do not have information on what other job search methods a jobseeker is employing in addition to the website. Consequently, our analysis only speaks to the search efforts a jobseeker employs during their time on the website. We do make an effort to identify search spells that potentially end with a match to a vacancy on the website. We define these matches as spells that end with at least one application to a vacancy that ends the same week. We show below that jobseekers are much more likely to apply to an ending vacancy at the end of a search spell regardless of their total spell length, so we believe that this proxy has suitable power for identifying potential matches.

A complicating issue in identifying jobseekers' search spells is that many jobseekers exhibit long spells of non-activity. Many jobseekers in our sample spend only a short time (one week or less) on the website, either because they found work quickly or because they decided searching on the website did not suit their needs. There is a sizable fraction of jobseekers, however, that reappear in our sample after a long spell of inactivity. We have no way to identify what these jobseekers, whom we consider "marginally attached" to the website, were doing in during their period of inactivity. They may have left after finding a job, but subsequently separated from the job after a short period. They may have become discouraged with the website and decided to employ other methods for a while, or they may have become discouraged with searching for work altogether. Finally, they may be either already employed or out of the labor force (with only a marginal desire for employment), and therefore searching intermittently and less intensely relative to an unemployed jobseeker.

Taking these considerations into account, we define an individual's first search spell as the period between their first application date and any application date that is followed by more than 5 weeks of inactivity.⁴ If we observe an individual submitting an application after the cutoff, we consider that the start of a new spell. We apply this rule throughout our sample. In theory, the rule allows an individual to have up to 7 distinct spells during our 53-week sample period. In practice, the majority of jobseekers (66.4 percent) are only on the website for one week. Many (40.3 percent of all jobseekers) only apply to a single job. We identify only one search spell for most jobseekers (82.9 percent) in our sample. For our main analysis, we restrict our attention to their first search spell. We do this because jobseekers, given the range of reasons that generate multiple search spells, may not behave the same at the start of their search in subsequent spells. In the appendix, however, we show that search behavior in

⁴ We also have information on the date that a jobseeker registered with the website. Most jobseekers (90.6 percent) send an application the same day they register for the website, and all but 5.1 percent send one within the first week.

subsequent search spells is similar to behavior during the first spell, and we obtain similar regression results for these spells as we do for the first spell.

We also drop observations during the first week of our sample from our analysis because we cannot differentiate between new and incumbent vacancies during that week. We do, however, use the first week of data when calculating the aforementioned statistics. Finally, we aggregate most of our statistics for analysis to the weekly interval.⁵ This leaves us with an analysis sample consisting of 17.26 million applications to 1.41 million vacancies by 4.77 jobseekers. The sample also aggregates to 10.11 million jobseeker-week observations, of which 7.65 million have a positive number of applications that week.

2.D. Basic Evidence

Table 1 reports the composition and basic application behavior of our sample's jobseekers during their first identified search spell. Our sample has a disproportional amount of younger, minority, and less-educated jobseekers relative to the general population. Based on Current Population Survey (CPS) estimates, the demographic composition of our sample is closer to the demographic composition of the pool of unemployed, though still oversamples the young and minorities. A key difference between our sample and the unemployed is that our sample has a majority of female jobseekers while the unemployed in the CPS are mostly male.

Jobseekers send an average of 1.7 applications per week. The average job search spell lasts just over two weeks. We find that jobseekers apply to an average of 0.067 vacancies per webpage view, or about one application for every 15 webpages viewed. We view webpage views as a proxy for the number of vacancies jobseekers peruse while searching on the website. Over the course of a completed

⁵ Jobseekers tend to apply with at roughly 7-day intervals in the data, with large spells of inactivity and high volatility as to which day of the week individuals apply. For these reasons, we aggregate our data to the weekly frequency.

spell, jobseekers spend an average of 47 minutes per week searching on the website. Women send out slightly more applications per week than men, on average, but also send fewer applications per webpage view despite spending more time per week on the website. Older jobseekers exhibit a similar pattern of website behavior, though with fewer applications relative to younger jobseekers. One could interpret this as evidence that women and older workers are choosier in their job search. Such an interpretation would be consistent with women seeking more flexible employment, perhaps because of a disproportionate burden of childcare duties, and older workers who are more targeted in the types of jobs they seek, perhaps because of a greater accumulation of specific human capital. There is no discernible pattern across education groups or by race, though nonwhites appear to send somewhat more applications and spend somewhat more time per week on the website.

Table 2 lists the summary statistics for the characteristics of applications that were sent by jobseekers in our sample. Just under 95 percent of a jobseeker's applications are to vacancies within their own metropolitan area. Just under 76 percent are to a jobseeker's modal industry, defined as the broad industry they applied to most often during their tenure on the website (including subsequent search spells after the first).⁶ Just under 14 percent of a jobseeker's applications are to a newly-posted vacancy (i.e., one that was posted the same week that she applied to it). Older, white, and more educated workers are more likely to apply to jobs outside of their metropolitan area, while older workers and women are more likely to apply to their modal industry. Men and older workers are more likely to apply to newer vacancies.

Table 3 reports the composition and basic characteristics of our sample's vacancies. Retail jobs are the most plentiful in our sample, accounting for 44.2 percent of all vacancies. They are followed by Food & Restaurant jobs (16.1 percent), and Customer Service (8.9 percent). These shares are

⁶ Just over 10 percent of jobseekers have no modal industry.

disproportionately higher than the employment shares of comparable occupations in the Occupational Employment Statistics Survey, and of comparable industries in the Current Employment Statistics. The average vacancy received 31 applications and was active on the website for 6.5 weeks. There is large variation in the number of applications per week across industries, from 1.2 per week in Management positions to 9.5 per week in Warehousing positions.

Section 3. Basic Evidence on Behavior by Duration

We now turn to our analysis of application behavior over the duration of search. Figure 1 shows the mean number of applications per week by weeks spent searching.⁷ We report both the unconditional mean and applications per week after controlling for metropolitan area, the calendar week when a jobseeker began her search, whether the week represented the end of a jobseeker's spell, and whether the week represented the end of search during the sixth week of search. The latter two account for the fact that, by construction, a spell ends with at least one application, which produces a spike in the number of applications sent during the last week of search, and that spells that last exactly six weeks may have a disproportionately higher spike since they just fall within the bounds of inactivity that we use to define spell length. These controls do little to alter the pattern in the raw data. Jobseekers send about 2.3 applications in their first week of search, on average. The number of applications falls to about 1.2 per week by the fourth week of search, but then slowly starts rising. After 6 months of search, jobseekers still send about 1.5 applications per week, on average.

Figure 2 reports how the characteristics of vacancies that jobseekers applied to change over the duration of search. The upper left panel depicts the fraction of each week's applications that are to a jobseeker's own metropolitan area or modal industry. There is little change in the fraction of

⁷ Throughout our analysis, we report confidence intervals based on robust standard errors that are clustered by metropolitan area.

applications that a jobseeker sends to her metropolitan area over the duration of search, increasing by only about half a percentage point after four months of search. The fraction of applications that a jobseeker sends to her modal industry, however, falls with the duration of search. There is a sharp drop after the first week of search from 76.1 to 60.1 percent, though this drop is mostly due to the fact that jobseekers that send only one application, by definition, send it to their modal industry. Among jobseekers that search for at least two weeks, the fraction falls from 61.4 to 60.1 percent. After 6 months, only 55.0 percent of a jobseeker's applications are to her modal industry. Note, however, that Figure 2 does not account for changes in the composition of jobseekers over the duration of search. It may be the case that long-duration jobseekers are those who choose to search broadly.

If we were to ignore composition effects for the moment, the evidence would be broadly consistent with models where individuals have some sector-specific human capital that they are unwilling to forego at the beginning of their search. As search continues, jobseekers learn about the labor market and their own job prospects and may, therefore, broaden their search. The evidence would also be consistent with a model of decaying specific human capital. As search continues, a jobseeker's incentive to search only in their sector of specialization declines. Empirically, the finding in Figure 2 is consistent with related research by Kudlyak, Lkhagvasuren, and Sysuyev (2012), who, using the same data, find that the scope of a jobseeker's search widens with duration and the quality of jobs they apply to falls over time.

The top right panel of Figure 2 shows that the fraction of "repeat" applications, i.e., applications to vacancies that a jobseeker previously applied to, steadily increases over the duration of search. By the sixth month of search, nearly 1 in 6 applications are to a position that the jobseeker has already applied to. Jobseekers may interpret a vacancy that remains on the website as unfilled and send an additional application as a signal that they are still interested. It may reflect composition as well. Long-duration

jobseekers may send a higher share of their applications to the same vacancy. The lower left panel shows that the fraction of applications sent to a newly-posted vacancy rises by about 3 percentage points over the first six months of search, but never rises above 17 percent through the first six months of search. This may reflect a stock-flow pattern of search behavior—at the start of search, jobseekers survey the full set of available vacancies. After exhausting those possibilities, they only focus on newly-posted vacancies. Complicating such a story, however, is the fact that only about 1 in 7 applications are to a new vacancy even after several months of search. Finally, the lower right panel shows the application-weighted mean duration and mean number of total applications received for vacancies jobseeker applies to during each week of search. Jobseekers apply to newer vacancies, on average, as search progresses, though the mean age of a vacancy after six months of search is about 8 weeks. There is little change, however, in the number of applicants these vacancies receive. The vacancies jobseekers apply to are equally competitive over the duration of search. As with the top two panels, the composition of jobseekers may also account for the observed patterns. We examine the role of composition next.

4. The Role of Jobseeker Characteristics

Differences in the characteristics of jobseekers, both observed and unobserved, may account for at least some of the observed relationship between application behavior and search duration. We examine the role of jobseeker characteristics along three dimensions. First, we control for observed jobseeker characteristics. Then, we add fixed effects for the completed length of a jobseeker's spell. We explore alternative specifications to examine the extent that total spell length captures unobserved jobseeker behavior, including potential job finding. Finally, we control for time-invariant jobseeker characteristics with jobseeker fixed effects.

We estimate the effect of observable characteristics on application behavior by regressing applications for each duration week on our baseline model from Figure 1 with additional controls for demographics (sex, a quadratic in age, and fixed effects for 4 education categories and 4 race categories) and whether the jobseeker had any subsequent search spells. We report the estimated coefficients on each week of search from this model, along with the estimates from the original baseline model from Figure 1, in Figure 3. There is little change in the basic relationship between application behavior and search duration, at least during the first few months of search. From the third month forward, controlling for observable characteristics produces a slightly steeper rise in applications per week than the baseline model.

The length of a completed search spell, to the extent that we can identify one in our data, is likely correlated with a variety of unobservable jobseeker characteristics. Jobseekers can have a long search spell for several reasons. First, individuals may differ in their search effort, leading low-search effort individuals to take longer to find work. Second, individuals may differ in their employability. Jobseekers that are less desirable to prospective employers will take longer to find work. Third, jobseekers may differ in their search efficiency. Individuals who repeatedly apply to jobs that they are poorly-suited for will take longer to find work. Finally, search spells may end in an outcome other than new employment, and do so for myriad reasons. For example, some jobseekers may already be employed, and may exert nominal and infrequent search effort in the hopes of finding better employment. The same pattern may hold for individuals who are out of the labor force but entertain the idea of finding work. Other jobseekers may simply give up on searching altogether. For example, Clark and Summers (1979) find that nearly half of all completed unemployment spells end with an exit from the labor force. Online job search has the added possibility that individuals continue searching for work, but not on the website. It is likely that a sizable fraction of the individuals we observe sending only one application are individuals who experimented with the website and decided it was not for them. It is

unclear, though, how many individuals who stopped search in subsequent weeks came to the same conclusion.

The ambiguity surrounding the reasons we may observe the end of a job search spell at a particular time limits our ability interpret our results more broadly with respect to jobseekers' success in finding employment. We can, however, examine whether the length of a completed spell conveys any information about the relationship between jobseekers' application behavior and search duration.

We examine the relationship between applications and search duration, conditional on the length of the completed spell in two ways. First, we replicate the unconditional relationship between applications and duration from Figure 1 separately for jobseekers of differing completed spell lengths. Second, we build on the model in Figure 3 by including fixed effects for a jobseeker's completed spell length.

The results of the first approach are in Figure 4. A striking pattern emerges: individuals with longer spell lengths send more applications per week, on average, *throughout the duration of their search spell*.⁸ The average number of applications per week is consistently monotonic in completed spell length. For example, in the third week of search, those with completed spells of 4 weeks send an average of 0.8 applications, those with completed spells of 13 weeks send an average of 1.3 applications, while those with completed spells of 10 months or more send an average of 2.3 applications. The pattern holds throughout later weeks of search as well. Thus, jobseekers who search on the website longer send out more applications per week, on average, throughout their entire search spell.

⁸ Note that the figure excludes the last week of search because, by construction, every jobseeker sends at least one application on the last week of their identified search spell.

One may be concerned that the result is an artifact of how we define search spells. Our identification method requires that individuals apply for work at least once every 5 weeks, and imposes that the spell starts and ends with the first and last application observed, respectively. Two results, however, cut against such an interpretation. First, the mean applications per week for the longest-duration jobseekers is well above two for most of their search. Individuals who were intermittently searching just enough to generate a long spell duration would likely have mean applications per week below one because a higher frequency of zero-application weeks would bring down the average. Second, the sheer magnitude of the difference in application behavior between long-duration and short-duration jobseekers should lead to a higher probability of finding employment for the long-duration jobseekers. Within the first month of search, individuals who search for 10 months or more send *triple* the number of applications as those who search for 4 weeks or less. Nevertheless, we test the robustness of our result by replicating Figure 4 among the subset of jobseeker-week where jobseekers send at least one application. This eliminates the ability of variations in the probability of zero-application weeks to drive the results shown in Figure 4. The results of this exercise are in Figure 5. The results show that the patterns in Figure 4 hold even when we eliminate observations when jobseekers sent no applications during the week.

We also replicate Figure 4 for the subset of individuals who potentially ended their search spell with a match from the website. We define these individuals as those who applied to at least one vacancy that ended during the same week as their search spell. The hypothesis is that, since the jobseeker was one of the last people to apply to the vacancy, and since the vacancy was one of the last positions the jobseeker applied to before ending their search spell, these individuals are the most likely to have exited their search spell because they found a job on a website. We find that 22 percent of all jobseekers in our sample satisfy this criterion, and 25 percent of jobseekers who searched for at least two weeks satisfy the criterion. In comparison, Stevenson (2008) finds that 22 percent of all jobseekers

in 2002 found employment by searching on the internet. Figure 6 shows that there is clearly information on a potential match in this selection criterion. The figure plots the average fraction of a jobseeker's applications that are to a vacancy that ends each week for jobseekers grouped by their total spell length. We scale the horizontal axis so that it plots the remaining weeks of a jobseeker's search spell. Week zero represents the last week of the spell. On average, 17 percent of all applications are to a vacancy that happens to end the same week that a jobseeker applies to it. The fraction, however, increases sharply as jobseekers reach the end of their search spell, with a substantial spike in the last week of search. The spike is considerably larger for jobseekers with long search spells. Thus, we conclude that our selection criterion provides useful information on whether there is a potential match between a jobseeker and a vacancy.

Figure 7 plots the applications per week for the subset of individuals that we identify as apply to at least one expiring vacancy in their last week of search. Referring back to Figure 6, these are the individuals with at least one such application in Week zero. As one can see, the main patterns from Figure 4 are also present in Figure 7. Thus, we conclude that long-duration jobseekers in fact send the most applications, on average. It is not a function of intermittent search behavior, and likely holds for jobseekers who end their search spell because of a job match.

The other striking pattern that emerges from Figure 4 (and is also present in Figures 5 and 7) is that the differences in application behavior by completed spell length are essentially a level effect. Conditional on spell tenure, applications per week decline steeply after the first week, then continue to decline throughout in subsequent weeks. Figure 8 reinforces this finding parametrically. It depicts our baseline model from Figure 1 and compares it to a model where we add to the baseline model all the jobseeker characteristics from the model in Figure 3, and a set of fixed effects to control for spell length. Figure 8 illustrates that, once we control for completed spell length, the declining relationship between

applications and the duration of search steepens. It still exhibits a steep decline after the first week, from 2.9 to 0.8 applications per week, on average, but then continues to decline thereafter, to an average of just 0.1 application per week after 6 months of search.

We can also control for all fixed jobseeker characteristics, both observable and unobservable, through the use of jobseeker fixed effects. By construction, jobseekers active for only one week contribute nothing to the identification in this case. We observe a nearly identical decline in the number of applications per week as we do controlling for only spell length. This implies that completed spell length is a sufficient statistic for all fixed, unobservable jobseeker characteristics relevant for the jobseeker's application behavior

Finally, we can replicate our regression analysis for the subsample of jobseekers with a potential match on the website. Figure 9 shows the estimates from our baseline model and the baseline model extended to include controls for demographics and spell tenure. We report the estimates from using the subsample of jobseekers with a potential match as well as the full sample of jobseekers for comparison. The figure shows that the subsample yields qualitatively similar results. Quantitatively, the subsample of jobseekers with a potential match has a somewhat smaller effect of including spell tenure, but controlling for spell tenure using this subsample still produces a monotonically declining relationship between applications per week and search duration.

There are a variety of unobserved characteristics that may be captured by completed spell length. One may be a jobseeker's reservation wage, or more broadly, the reservation value of a job. Long-duration jobseekers may be more "choosy" in that they have a relatively higher reservation value (though the preceding evidence on their application behavior runs counter to this hypothesis). Completed spell length may also reflect differences in the actual time spent searching, in addition to applying to vacancies, jobseekers put into search. This could include time spent perusing job postings

not applied to as well as time spent searching for work outside of the website. We use information on the amount of applications per webpage view and the average time spent searching on the website per week as proxies for the reservation value and physical search effort (on the website), respectively. Unfortunately, we only have measures of these statistics for a jobseeker's total tenure on the website, and therefore cannot observe how these measures vary over the duration of search. Nevertheless, the measures, when compared to the results in Figure 8, can provide some instruction on the source of the variation captured by completed spell length.

Figure 10 shows how applications per webpage view (left panel) and time spent searching (right panel) vary with completed spell length. As mentioned before, these are averages over the full spell and differences by spell length could reflect differences in behavior within the search spell. The figure shows that applications per webpage view is increasing in completed spell length. Jobseekers that search for up to a month send an application for every 15.8 webpages viewed, on average, while those who search for 6 months send an application for every 13.8 webpages viewed, on average. We interpret this as evidence that long-duration jobseekers are less "choosy" in the vacancies that they apply to. This further cuts against an interpretation of a higher reservation value of a job for these individuals. Furthermore, for the result to be driven purely by differences among individuals within their search spell, it would have to be the case that applications per webpage view increases with search duration. Both cases cut against the view that long-duration jobseekers search longer because of high reservation job values, whether it be due to fixed preferences or preferences that vary with duration.

The right panel of Figure 10 shows that time spent searching per week declines sharply with completed spell length then remains relatively stable for most individuals with longer search spells. Individuals with spells less than a month in length spend over 50 minutes per week on the website, while those with completed spells of 6 weeks or longer spend just over 25 minutes per week on the

website. Again, we cannot differentiate whether long-duration jobseekers spend less time searching regardless of spell length or whether time spent searching declines with duration. Either way, variations across either the completed spell length margin or the duration margin seem to only matter within the first 6 weeks of search. Time spent searching per week is relatively constant thereafter.

We conclude this section by noting that our results hold qualitatively under additional robustness checks. First, we examine the effect our inactivity criterion has on our results by replicating our regression analysis using different cutoffs of inactivity to define the length of a spell. Using a stricter, 2-week cutoff or a looser, 13-week cutoff for weeks of inactivity to define a spell produces qualitatively similar results to the 5-week cutoff used in the main analysis. Second, we examine whether the second and subsequent spells identified using the 5-week cutoff exhibit qualitatively similar application behavior. The later spells all have declining applications per week over their duration. We report the results of these exercises in the appendix.

5. The Role of Local Labor Demand

Finally, we examine the role labor demand plays in accounting for the relationship between jobseeker application behavior and search duration. Applications may decline over time simply because the pool of relevant vacancies shrinks over the duration of search. In stock-flow models of labor market search (Coles and Smith, 1998; Ebrahimi and Shimer, 2010), workers search over the full pool of available vacancies when they begin their search (i.e., the “stock”). If jobseekers remain unemployed, they subsequently search only over newly-posted vacancies as they arrive (i.e., the “flow”). Consequently, these models predict that applications per week should drop precipitously after the first week of search, and remain roughly constant thereafter (assuming a roughly constant arrival rate of new vacancies). This is broadly consistent with the application pattern we observe in the online job search data. Since we have detailed data on the timing of applications to all vacancies on the website, we can

construct measures of the stocks of total and newly-posted vacancies within each metropolitan area during each calendar week of the sample. These measures allow us to estimate the effect that any stock-flow process of job search may have on the relation between application behavior and search duration.

We estimate our baseline model from Figure 1, but add to it a flexible formulation of new and incumbent vacancies as in the following model:

$$(1) \quad A_{ij\tau}(t) = d(t) + \alpha_j + \gamma_\tau + \eta_T(t) + \beta_0 \ln v_j^n(t) + \beta_1 \ln v_j^e(t) + \beta_2 d(1) \cdot \ln v_j^e(t) + \varepsilon_{ij\tau}(t).$$

For individual i in metropolitan area j during duration week t , the model regresses total applications during the week, $A_{ij\tau}(t)$, on a set of dummy variables for the week of search, $d(t)$. It includes fixed effects for metropolitan area j and spell start week τ , as well as the control for whether the week represents the last week of the spell, from the baseline model. It also includes the (log) number of vacancies posted during the week, $v_j^n(t)$, the (log) number of incumbent vacancies that existed prior to the week and remain active, $v_j^e(t)$, and the (log) number of incumbent vacancies interacted with an indicator for the first week of search. A stock-flow model would imply that $\hat{\beta}_1 = 0$, while a model where the full stock of vacancies is sampled each period would imply that $\hat{\beta}_2 = 0$.

Our estimates from this model are in Figure 11. We also include the original baseline model for comparison. Controlling for both the number of active local vacancies does little to alter the baseline relationship between applications per week and search duration. If anything, there is a slightly larger rise with duration in the later weeks of search. We then examine the relationship between application behavior and search duration after controlling for both individual effects and local labor demand. Figure 12 presents the baseline model as well as estimates from two additional models. The first takes the model that controls for observable individual characteristics and the length of the completed search

spell and adds the vacancy variables as in (1). The second takes the model that controls for jobseeker fixed effects and adds the vacancy variables as in (1). In both of these alternative models, applications decline continuously over the duration of job search. The predicted number of applications per week is slightly higher when controlling for jobseeker fixed effects rather than observable jobseeker characteristics and spell length fixed effects, but the basic pattern holds—search effort, as measured by applications per week, falls with the duration of job search.

Given the evidence in Figure 2, it is not surprising that controlling for the stock of new and existing vacancies does little to affect the relationship between application behavior and search duration. The majority of a jobseeker's applications continue to be to existing rather than new observations months after the search spell begins. Even though the fraction of applications that are to new vacancies rises with duration, consistent with a stock-flow search process, it never rises to a level that is quantitatively large enough to affect the strong, declining relationship between applications and search duration.

6. Conclusions

This paper examines the relationship between search behavior and duration of search for jobseekers using an online job search website. We focus on the number of applications jobseekers send to vacancies posted on the website as our measure of search effort. We find that the amount of applications jobseekers send declines with search duration. Without additional controls for the composition of jobseekers or the local stock of active vacancies, much of the decline in application behavior occurs within the first few weeks of search. Thereafter, the number of applications sent per week is flat to slightly rising with respect to duration. When we control for the composition of jobseekers by using the length of their completed search spell, we find a steeper relationship between applications per week and search duration. This occurs because long-duration jobseekers send more

applications per week, on average, than shorter-duration jobseekers. The finding is robust to analyses that account for various measurement issues, including infrequent job search and unknown reasons for the end of a search spell. We then control for the number of active vacancies in a jobseeker's metropolitan area, differentiating between pre-existing and newly posted vacancies. We find that it has little effect on the application-duration relationship. This is because most applications are to pre-existing vacancies, and there is little change in the stock in these vacancies over the duration of search. Consequently, when we control for both composition and the number of active local vacancies, we find that our main result holds. Thus, controlling for both the composition of jobseekers and local labor demand produces a strongly declining relationship between applications per week and search duration. In other words, search effort declines over time.

A corollary to this result is that the effects of jobseeker composition due to unobserved heterogeneity dominate differences in search effort in explaining why some jobseekers have long search spells. Specifically, we find that long-duration jobseekers exert the most effort throughout the duration of their job search. This runs counter to the notion implied by theory that jobseekers have longer search spells because they exert lower effort than those who exit search earlier. Unobserved heterogeneity in the ability of jobseekers to land a job is the more likely cause of long spells of job search. This heterogeneity may reflect the fact that long-duration jobseekers are simply among the least employable in the view of employers, or it may reflect the fact that they are the least efficient in targeting their search towards vacancies for which they are well-suited.

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Table 1. Website Search Behavior by Demographic Group

	Share of Jobseekers	Applications per Week	Total Weeks Spent Searching	Applications per Webpage View	Search Time per Week (mins)
Full Sample	100.0	1.71	2.13	0.067	47.0
Male	43.1	1.67	2.13	0.071	44.1
Female	56.9	1.74	2.12	0.065	49.2
18-24 Years Old	52.8	1.88	1.97	0.066	48.0
25-39 Years Old	26.9	1.66	2.06	0.073	43.4
40-54 Years Old	15.2	1.44	2.49	0.064	47.8
55+ Years Old	5.1	1.33	2.94	0.058	53.6
High School Deg.	62.5	1.74	2.04	0.068	46.8
Certification	10.1	1.62	2.27	0.068	48.0
Associates Deg.	12.0	1.70	2.39	0.065	48.7
Bachelors Deg.	13.5	1.69	2.21	0.066	46.5
Graduate Deg.	1.9	1.48	2.03	0.072	40.2
White	50.3	1.65	2.09	0.067	44.0
Black	25.4	1.78	2.20	0.068	50.6
Hispanic	14.6	1.76	2.06	0.066	49.4
Other	9.7	1.72	2.13	0.067	48.4

Notes: Summary statistics are mean values across the 4,765,043 jobseekers in our sample. Applications per week and total weeks spent searching are for the first identified search spell only. Applications per webpage view and search time per week are for the jobseeker's full tenure on the website.

Table 2. Characteristics of Vacancies Applied to by Demographic Group

	Pct. to Same CBSA	Pct. to Modal Industry	Pct. to Newly-Posted Vacancy
Full Sample	94.7	75.8	13.7
Male	94.5	74.7	14.5
Female	94.9	76.6	13.0
18-24 Years Old	95.6	75.9	10.8
25-39 Years Old	93.9	75.5	15.7
40-54 Years Old	93.5	75.7	18.2
55+ Years Old	93.6	76.6	19.3
High School Deg.	95.6	76.4	12.1
Certification	93.8	74.5	16.4
Associates Deg.	94.2	73.8	15.2
Bachelors Deg.	92.5	75.4	16.1
Graduate Deg.	89.7	79.2	22.4
White	93.6	76.3	14.0
Black	96.0	74.5	12.6
Hispanic	96.4	76.5	13.5
Other	95.0	76.2	15.2

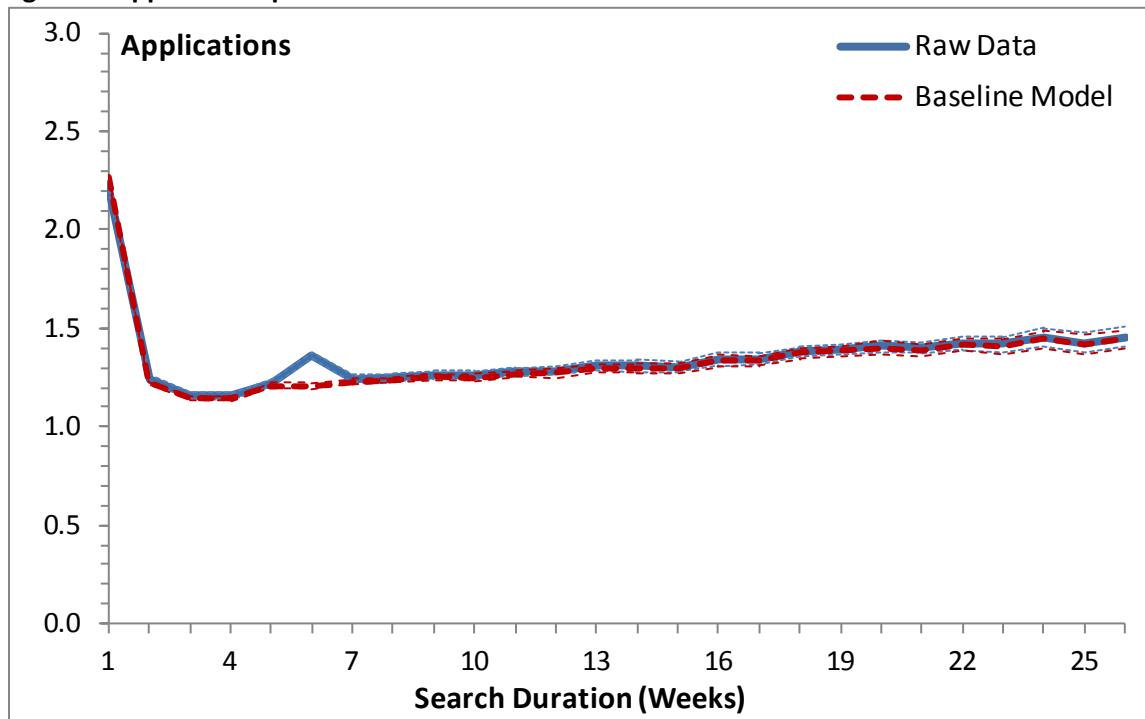
Notes: Summary statistics are mean values across all applications made by the 4,765,043 jobseekers in our sample during their first identified search spell. Mean web tenure refers to the average total time vacancies applied to were active on the website. “Total applications received” refers to the mean number of applications vacancies applied to received during their tenure on the website. Both measures condition out calendar week means.

Table 3. Characteristics of Vacancies by Industry

	Share of Vacancies	Mean Total Applicants	Mean Web Tenure	Applicants per Week Active
Full Sample	100.0	31.1	6.5	4.8
Personal Care	2.0	75.5	8.3	9.1
Other Services	0.8	57.8	13.8	4.2
Hotel & Hospitality	2.2	43.9	5.4	8.2
Food & Restaurant	16.2	38.5	9.6	4.0
Education	0.7	35.8	23.2	1.5
Retail	44.6	34.5	5.8	5.9
Automotive	2.6	33.1	17.6	1.9
Transportation	1.3	32.2	4.3	7.6
Warehousing	2.8	29.2	3.1	9.5
Administrative & Office	1.4	27.1	2.9	9.4
Construction	2.0	22.0	6.7	3.3
Professional & Technical	4.7	17.8	2.5	7.1
Management	2.0	16.4	14.1	1.2
Sales & Marketing	3.3	15.7	4.2	3.8
Health & Wellness	4.7	13.3	5.1	2.6
Customer Service	8.8	12.4	2.6	4.8

Notes: Summary statistics are mean values for the 1,419,029 vacancies applied to by jobseekers during their first search spell in our sample. “Total applications received” refers to the mean number of applications vacancies applied to received during their tenure on the website. Mean web tenure refers to the average total time vacancies applied to were active on the website. Both measures condition out calendar week means.

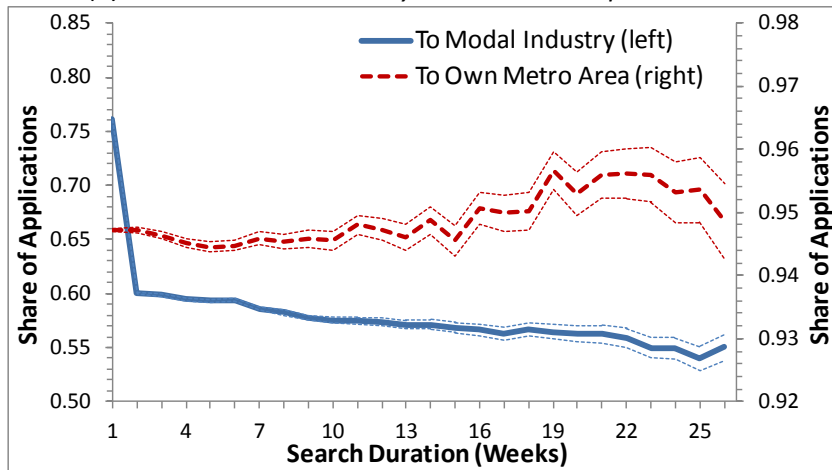
Figure 1. Applications per Week of Search



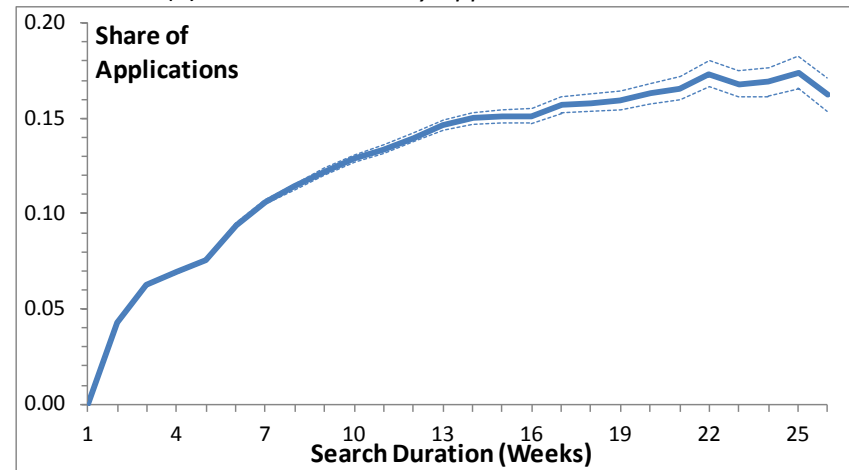
Notes: Figure depicts mean applications per jobseeker per week of search, unconditionally and conditional on the jobseeker's metropolitan area, and controls for the start and end of the jobseeker's spell. Thin dashed lines represent 95 percent confidence intervals, with standard errors clustered by metropolitan area. Note that the spike at 6 weeks is an artifact of our search spell identification methodology. See text for details.

Figure 2. Application Characteristics by Search Duration

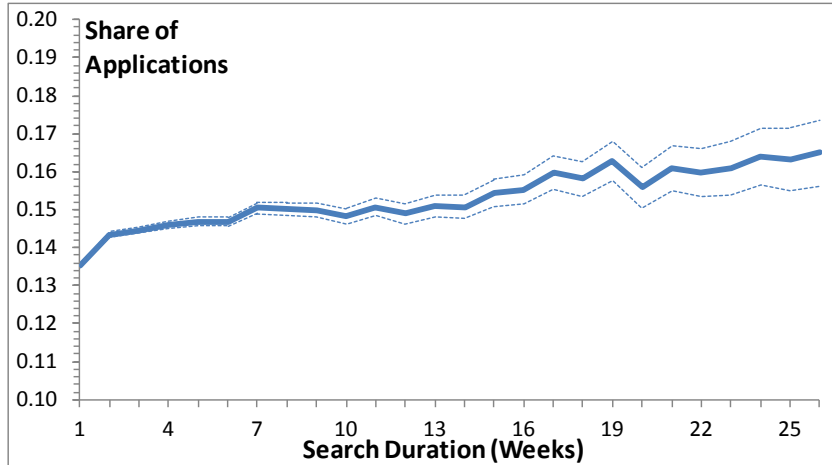
(a) Share to Modal Industry and Own Metropolitan Area



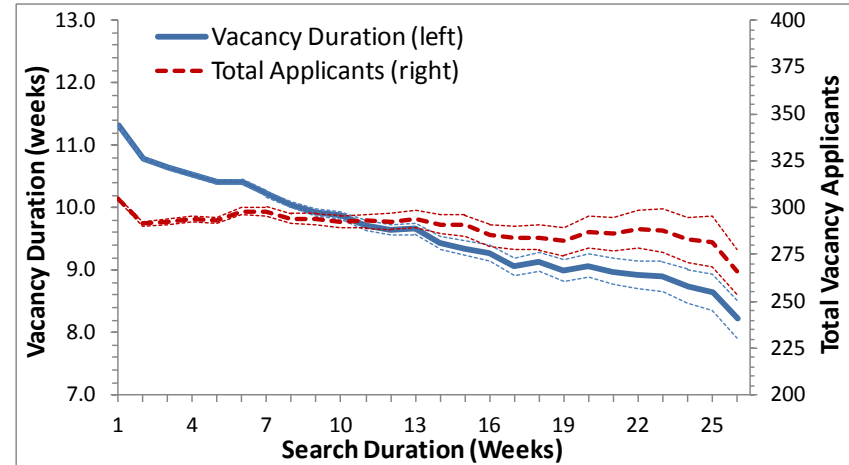
(b) Share to Previously Applied-To Vacancies



(c) Share to Newly-Posted Vacancies

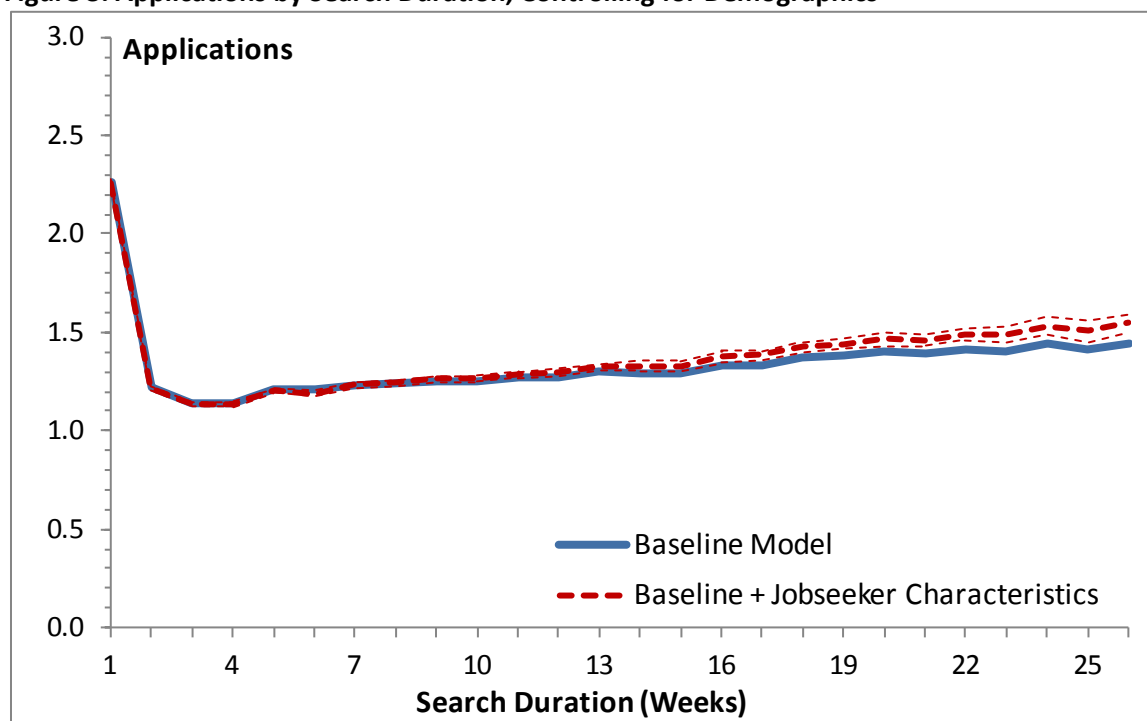


(d) Mean Duration and Total Applicants of Vacancies Applied To



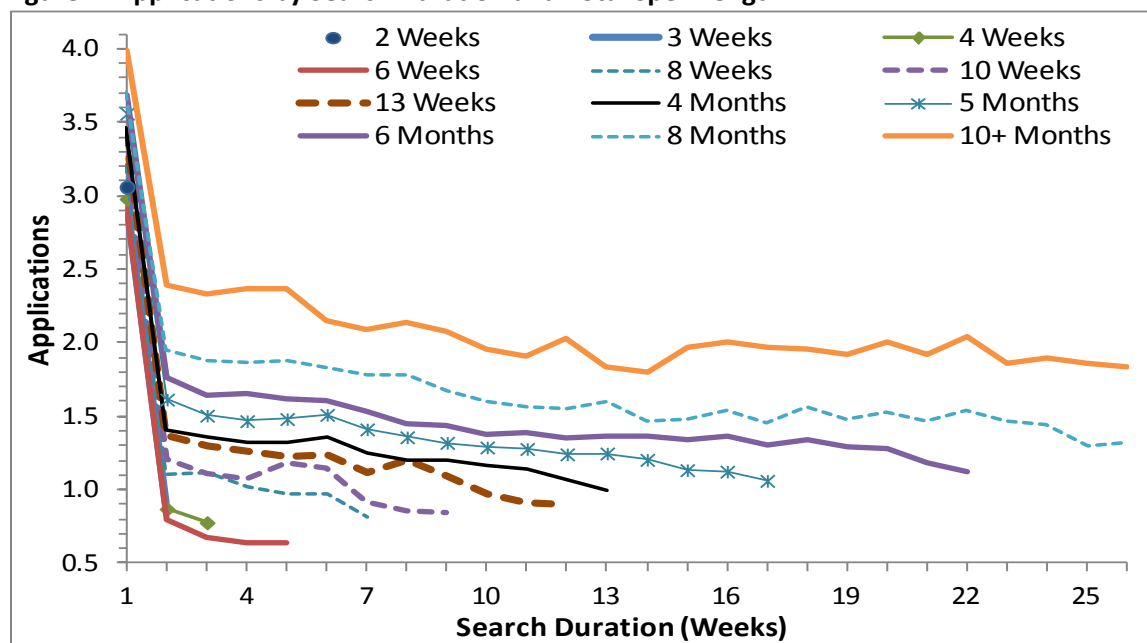
Notes: Panels depict the (unconditional) fraction of applications to the jobseeker's modal industry or metropolitan area, to a newly-posted vacancy, to a previously applied-to vacancy, and the mean vacancy duration (in weeks) and mean applications received by vacancies applied to, respectively. Mean vacancy duration and total applications condition out calendar week means. Thin dashed lines represent 95 percent confidence intervals.

Figure 3. Applications by Search Duration, Controlling for Demographics



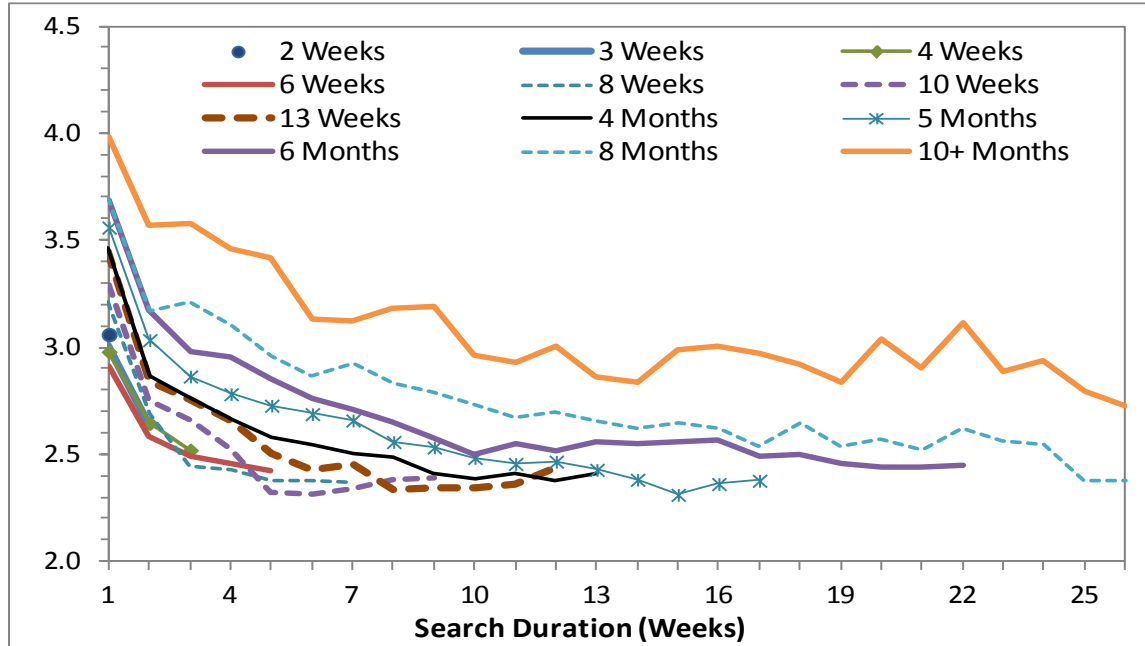
Notes: Figure shows estimated relation between applications per week and duration of search in our baseline model and additionally controlling for demographic characteristics (age, age squared, gender, education, and race). Dashed lines represent 95 percent confidence intervals (with standard errors clustered on jobseeker's metropolitan area).

Figure 4. Applications by Search Duration and Total Spell Length



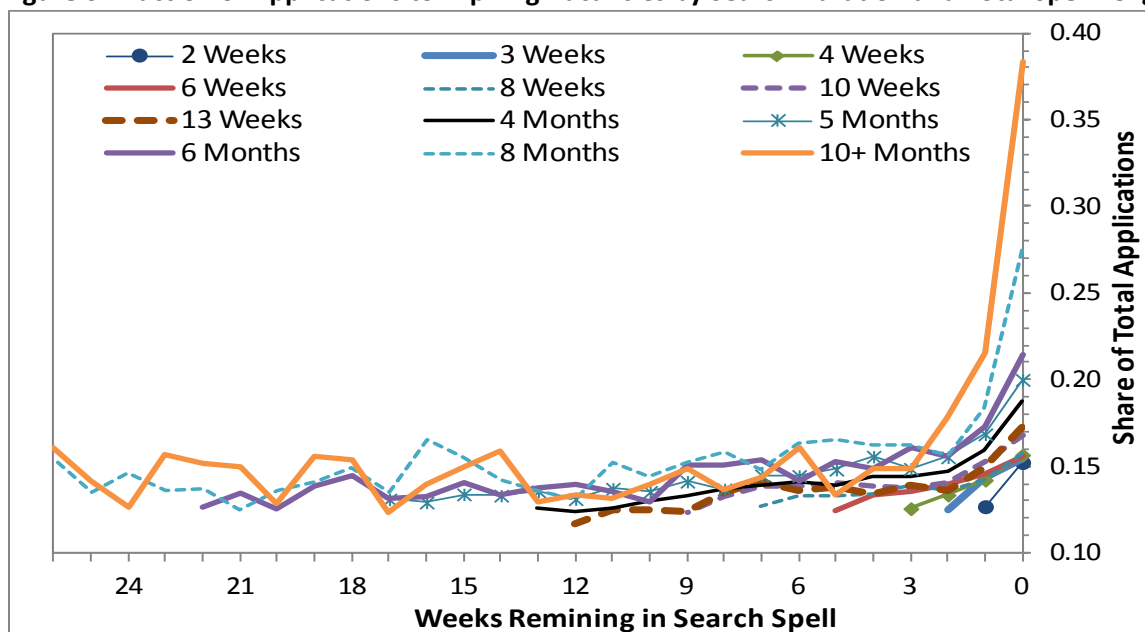
Notes: Figure shows the estimated (unconditional) relationship between applications per week and duration of search separately for jobseekers based on the total length of their search spell. Only selected spell lengths are reported.

Figure 5. Applications by Search Duration and Total Spell Length, Conditional on Sending at Least One Application



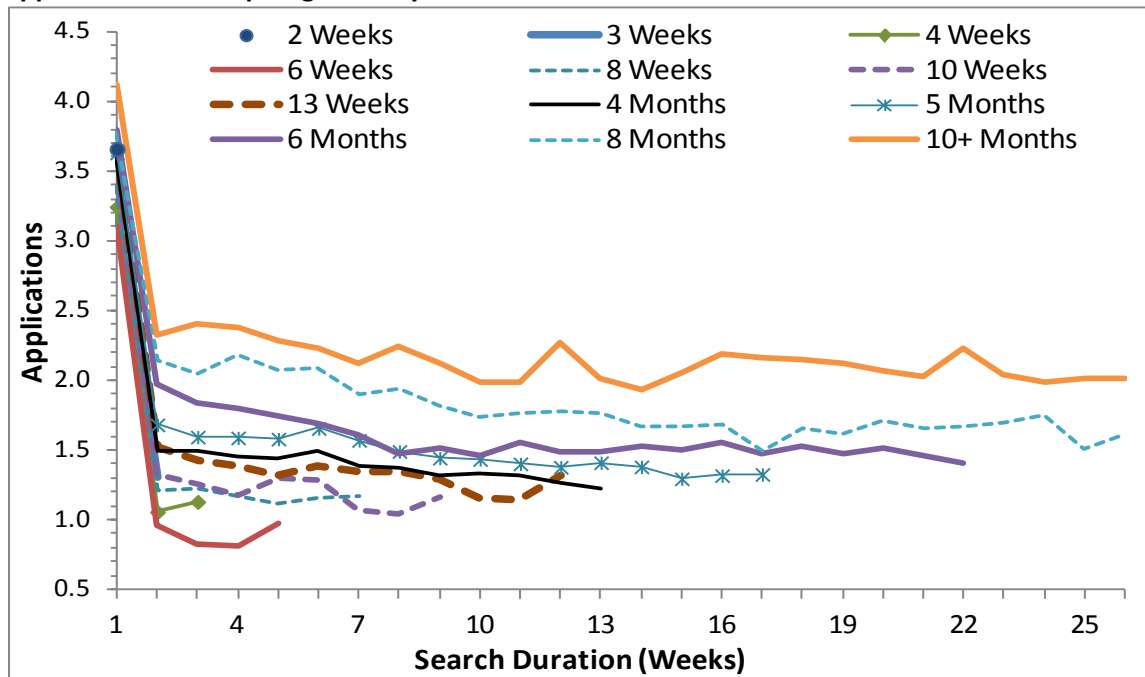
Notes: Figure shows the estimated (unconditional) relationship between applications per week and duration of search separately for jobseekers based on the total length of their search spell. Mean applications are only calculated for individuals who sent at least one application in a given week. Only selected spell lengths are reported.

Figure 6. Fraction of Applications to Expiring Vacancies by Search Duration and Total Spell Length



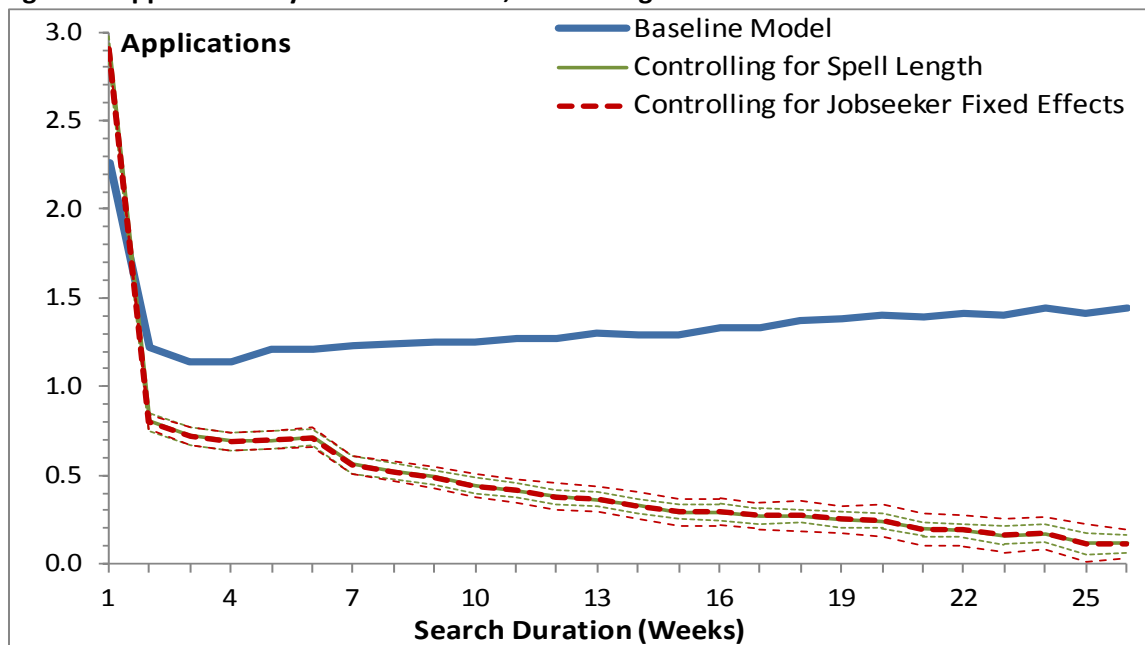
Notes: Figure shows the estimated (unconditional) fraction of applications each week that are to an expiring vacancy (defined as a vacancy that receives its last application during the same week) by the number of weeks remaining in the search spell, separately by the total spell length of the jobseeker. Only selected spell lengths are reported.

Figure 7. Applications by Search Duration and Total Spell Length, Conditional on Ending Search with an Application to an Expiring Vacancy



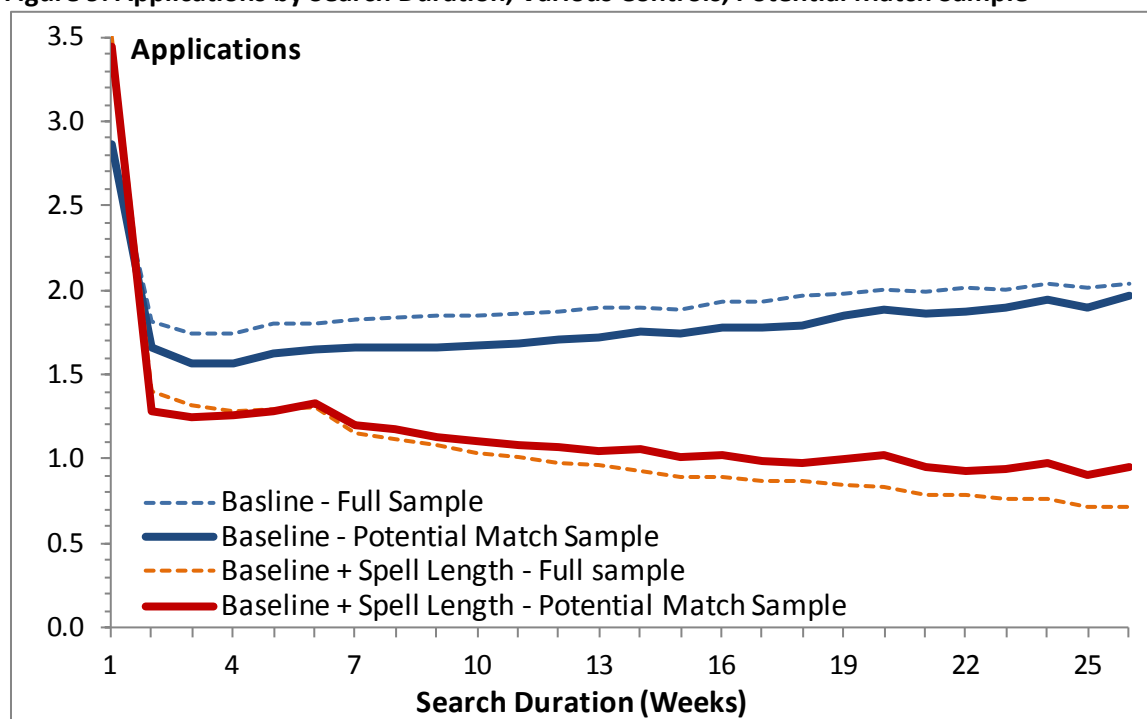
Notes: Figure shows the estimated (unconditional) relationship between applications per week and duration of search separately for jobseekers based on the total length of their search spell. Mean applications are only calculated for individuals who sent at least one application to a vacancy that expired (defined as receiving its last application) during their last week of search. Only selected spell lengths are reported.

Figure 8. Applications by Search Duration, Controlling for Fixed Jobseeker Characteristics



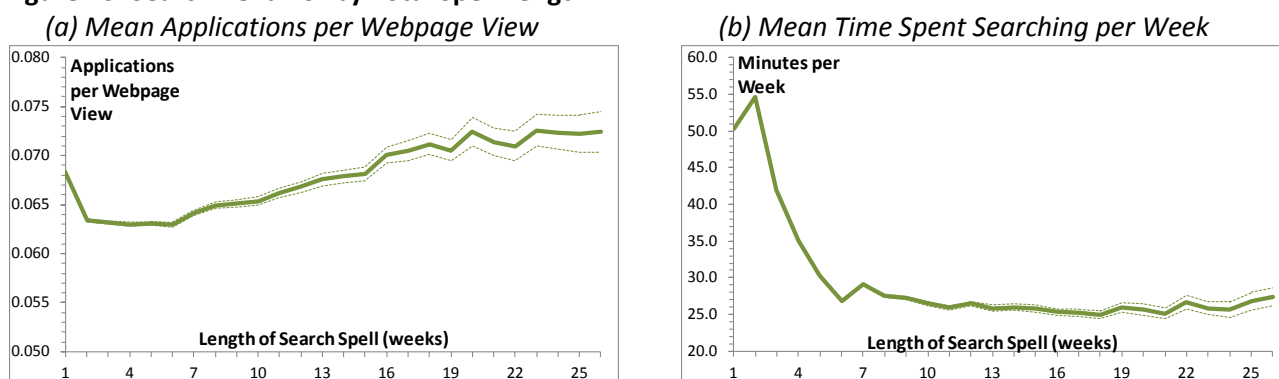
Notes: Figure shows the estimated relationship between applications per week and the duration of search for our baseline model, a model that additionally controls for total spell length, and a model that includes person fixed effects.

Figure 9. Applications by Search Duration, Various Controls, Potential Match Sample



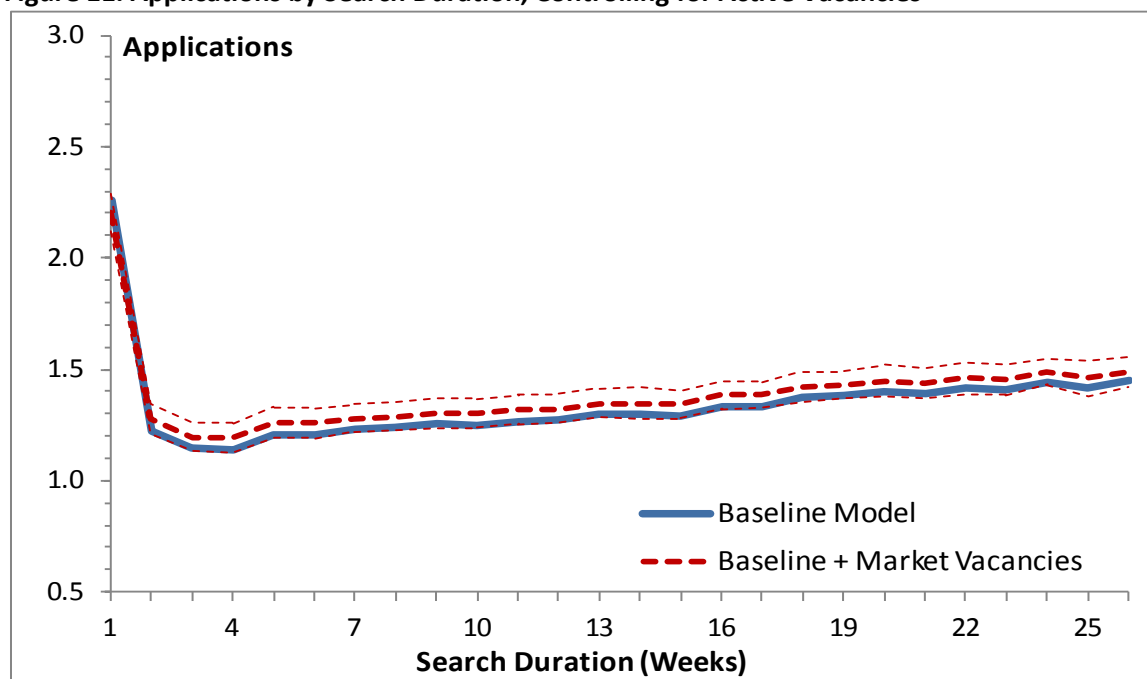
Notes: Figure shows the estimated relationship between applications per week and the duration of search for our baseline model and a model that additionally controls for total spell length using the full sample of jobseekers and a subsample that are identified as potentially matching with an expiring vacancy.

Figure 10. Search Behavior by Total Spell Length



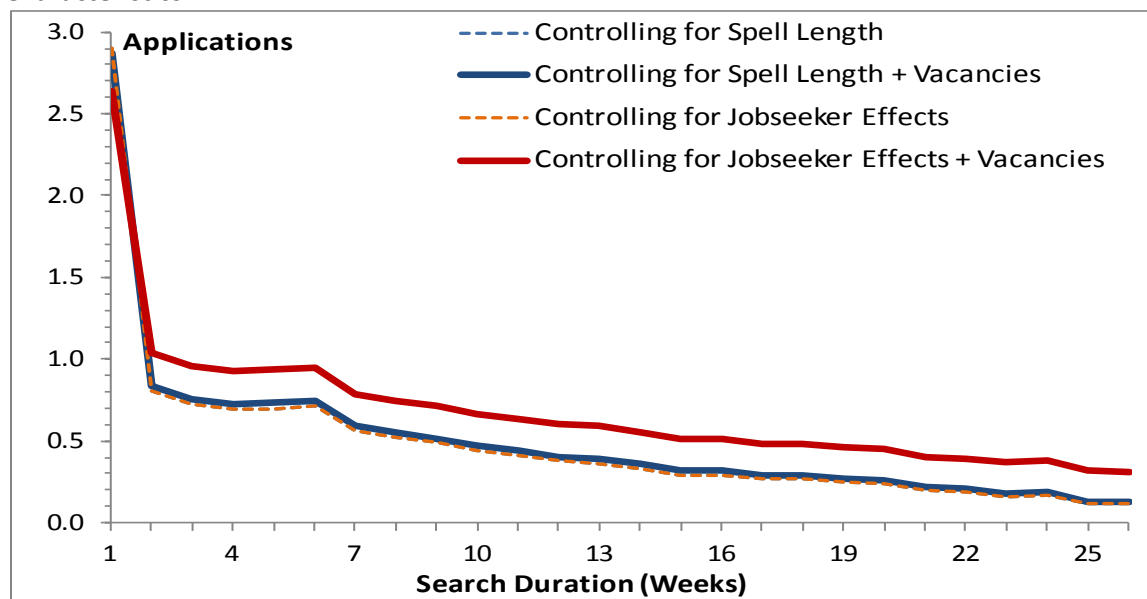
Notes: Panels depict the distribution of jobseekers, the (unconditional) mean number of applications, the mean number of applications per webpage view, and the mean time spent searching the website (in minutes). Dashed lines represent 95 percent confidence intervals.

Figure 11. Applications by Search Duration, Controlling for Active Vacancies



Notes: Figure shows the estimated relationship between applications per week and the duration of search for our baseline model and three models that additionally control the number of new vacancies, both total and newly-posted vacancies within a jobseekers metropolitan area. The first measure controls for the number of incumbent and newly-posted vacancies each week. The second and third measures control for total vacancies in the first week and newly-posted vacancies only from the second week forward.

Figure 12. Applications by Search Duration, Controlling for Active Vacancies and Fixed Jobseeker Characteristics



Notes: Figure shows the estimated relationship between applications per week and the duration of search for our baseline model, a model that additionally controls for the number of active vacancies, and a model that controls for active vacancies and fixed jobseeker characteristics. The latter are controlled for by either fixed effects for spell length and demographic controls or jobseeker fixed effects.

Appendix (not intended for publication)

Appendix A. Estimates without Spell Length Identification

Identifying when jobseekers are actually searching, rather than idle, on the website is an important part of our analysis. Many jobseekers send applications over a short period of time, and return later, sometimes many weeks later, so send applications again. We use a strategy of counting more than 5 weeks of inactivity as the end of one search spell and the start of a new spell. In the absence of this identification, results tend to be dominated by the fraction of jobseekers who send zero applications, as the following figures show.

Figure A.1. Applications per Week, Counting Total Web Tenure as a Single Spell

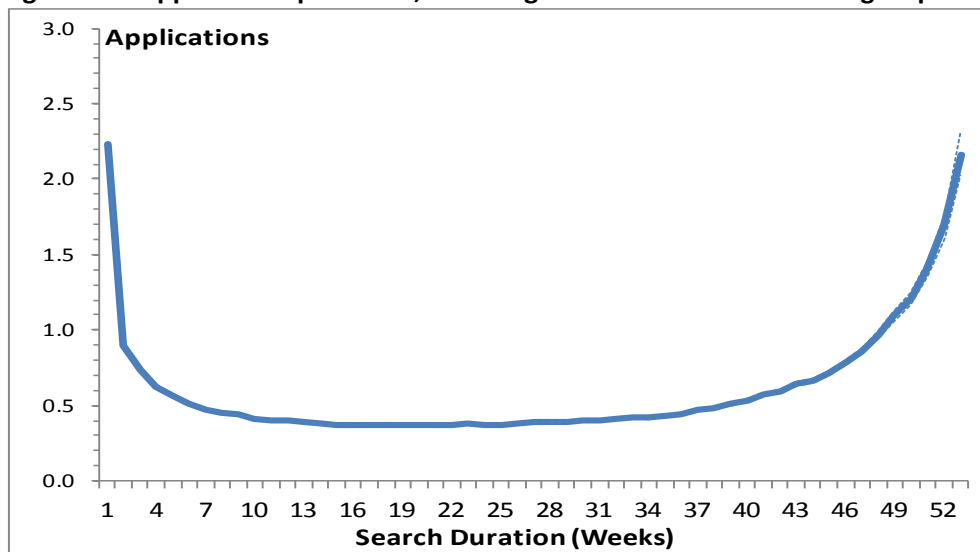


Figure A.2. Fraction of Observations with Zero Applications, Counting Total Web Tenure as a Single Spell

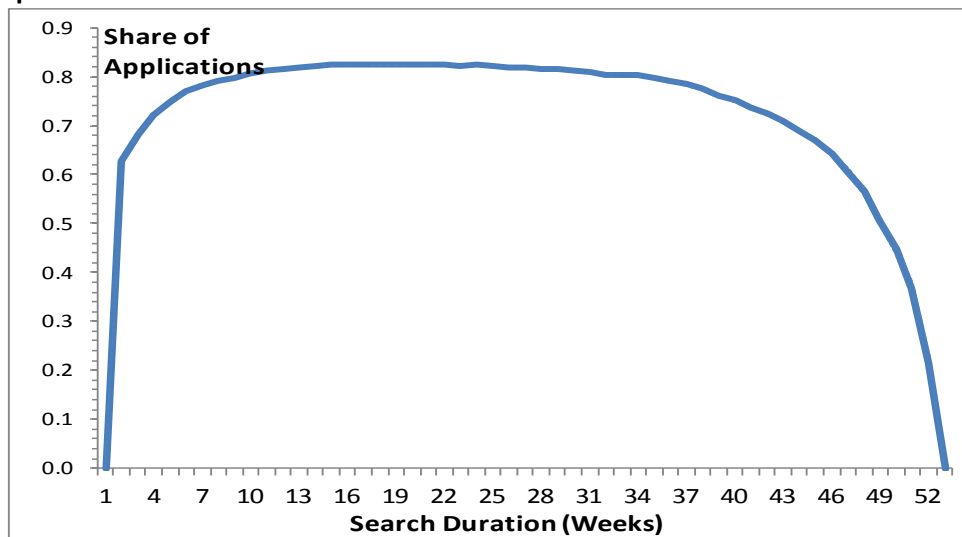
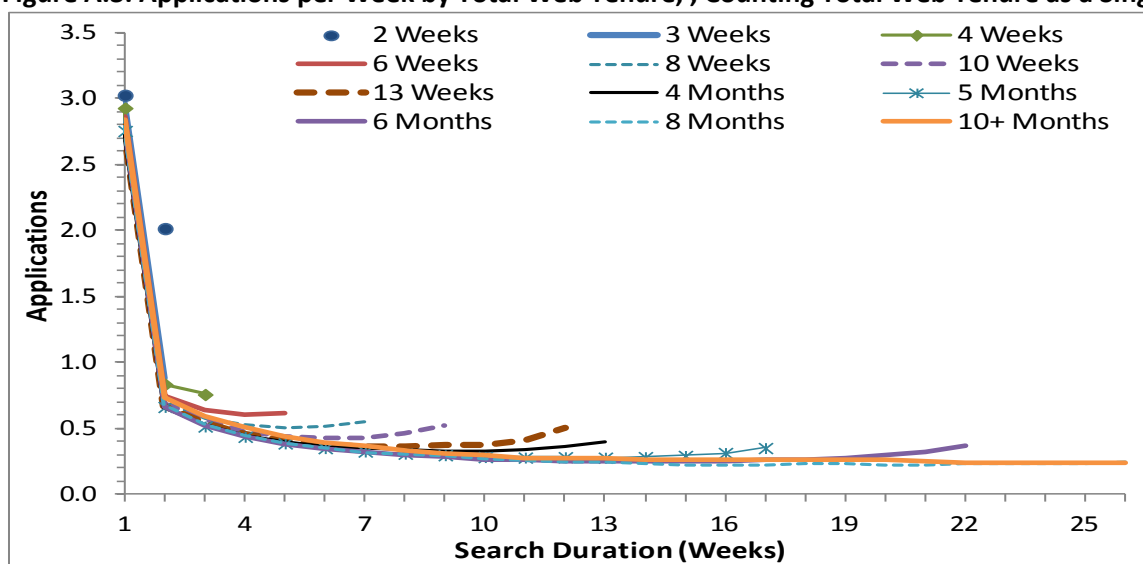


Figure A.3. Applications per Week by Total Web Tenure, , Counting Total Web Tenure as a Single Spell



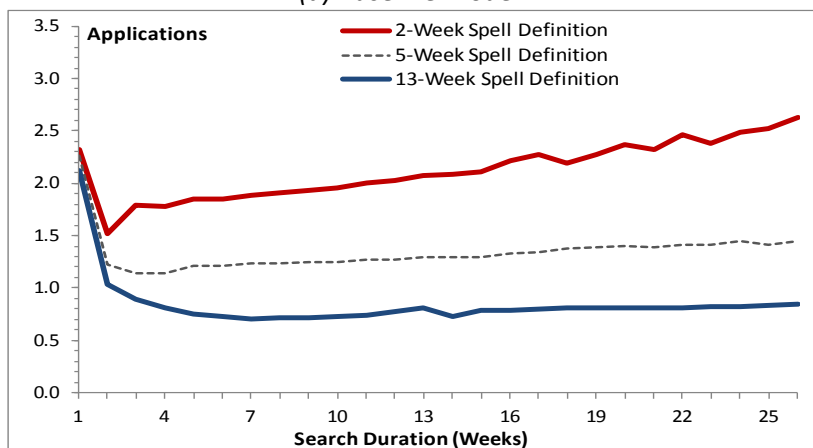
Appendix B. Estimates Using Differing Spell Length Criteria

We check the robustness of our cutoff of 5 weeks of inactivity by replicating our main results using a 2-week and 13-week cutoff instead. The following figure replicates the baseline regression model of the analysis in the text, as well as the models that control for demographics and spell length, local vacancies, and the “full specification” of local vacancies and jobseeker fixed effects. Each panel of the figure shows the estimated relationship between applications and search duration using the 2-week, 5-week, and 13-week cutoff rules.

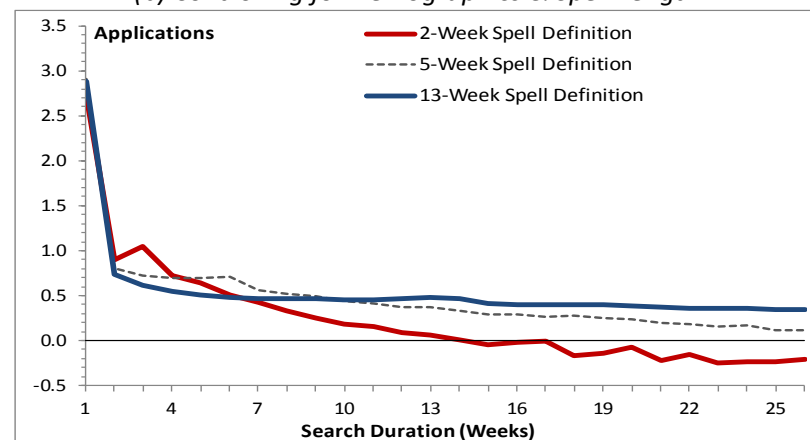
The figures show clear quantitative differences in the estimated relationship between applications per week and search duration, especially in the specifications that do not include fixed effects for completed spell length or fixed jobseeker characteristics. Qualitatively, however, the key result of our analysis holds regardless of spell length identification criteria. That is, applications decline with the length of search, especially after controlling for jobseeker characteristics.

Figure B.1. Estimated Relation between Applications and Search Duration under Alternate Spell Length Identification Criteria

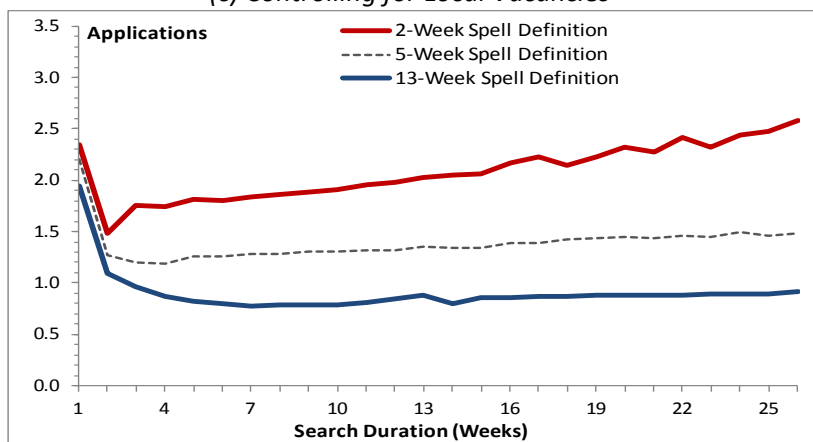
(a) Baseline Model



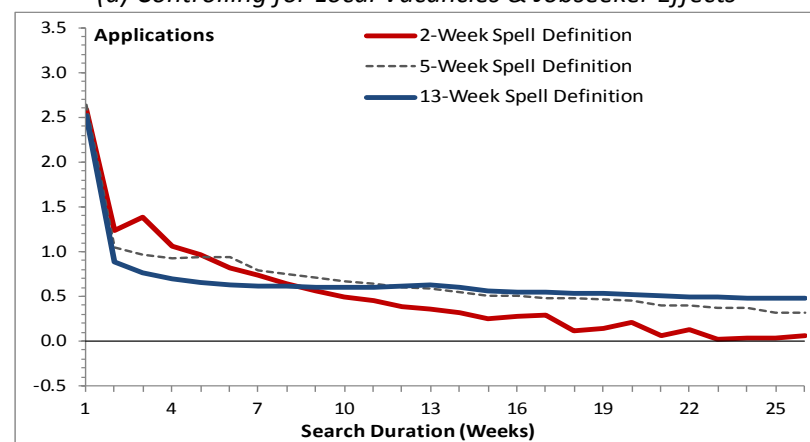
(b) Controlling for Demographics & Spell Length



(c) Controlling for Local Vacancies



(d) Controlling for Local Vacancies & Jobseeker Effects



Notes: Panels depict the estimated relationship between applications sent per week and search duration under the four different regression specifications used in the analysis of the main text, using three different cutoff criteria to identify the end of a search spell: 2 weeks, 5 weeks, and 13 weeks of inactivity on the website.

Appendix C. Additional Results by Completed Spell Length

Identifying when jobseekers are actually searching, rather than idle, on the website is an important part of our analysis. Many jobseekers send applications over a short period of time, and return later,

Figure C.1. Mean Applications per Week by Total Spell Length

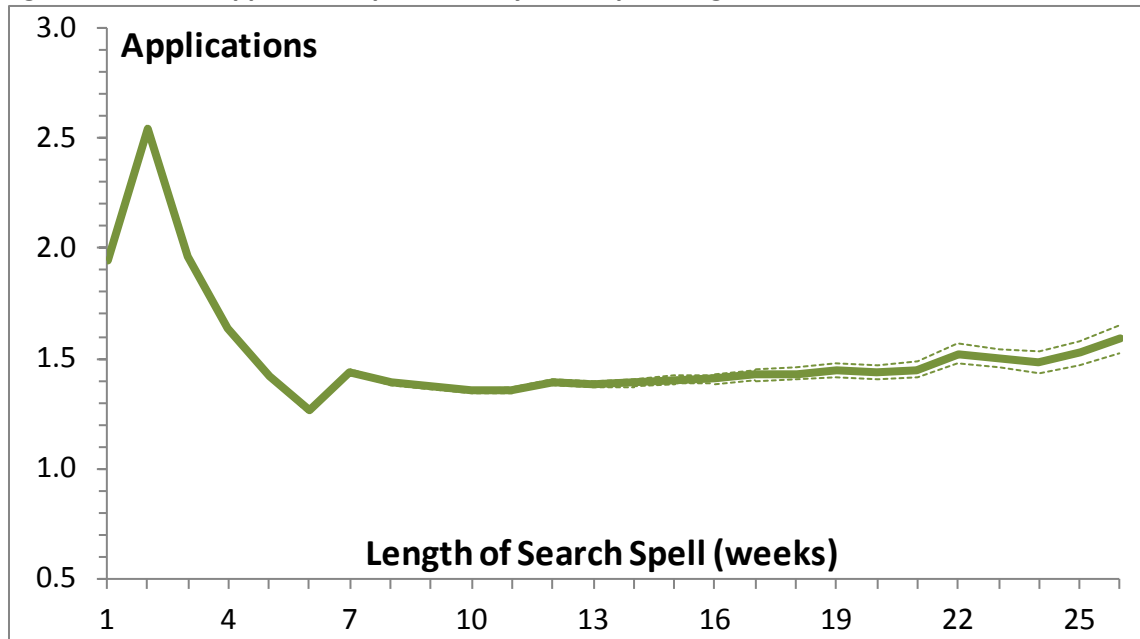


Figure C.2. Distribution of Jobseekers by Total Spell Length

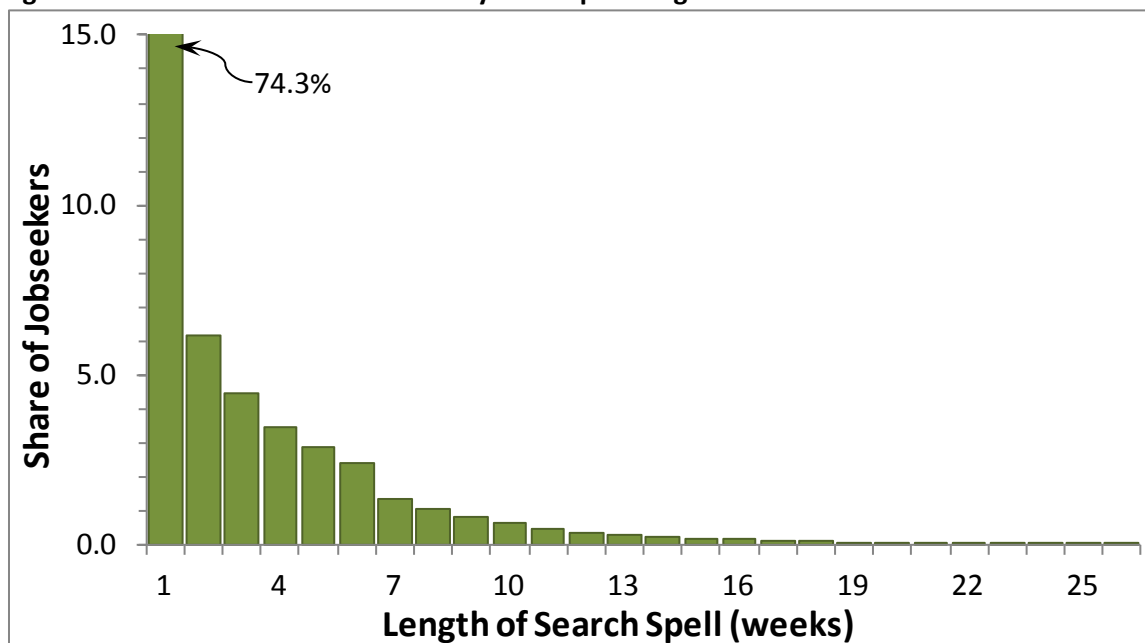
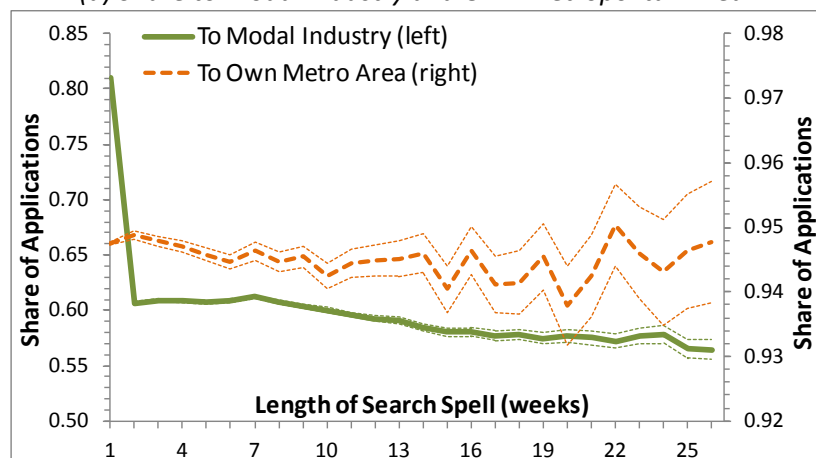
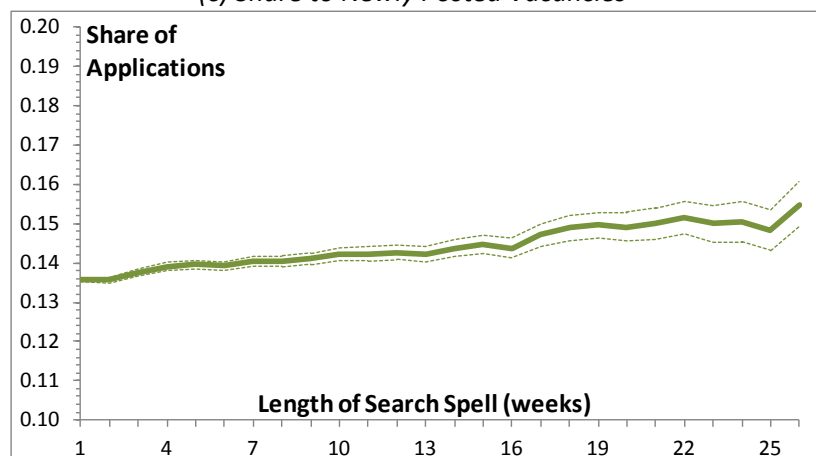


Figure C.2. Application Characteristics by Total Spell Length

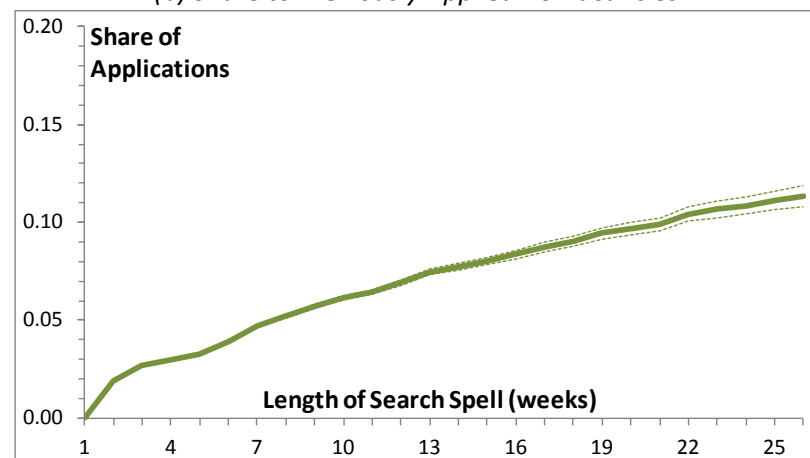
(a) Share to Modal Industry and Own Metropolitan Area



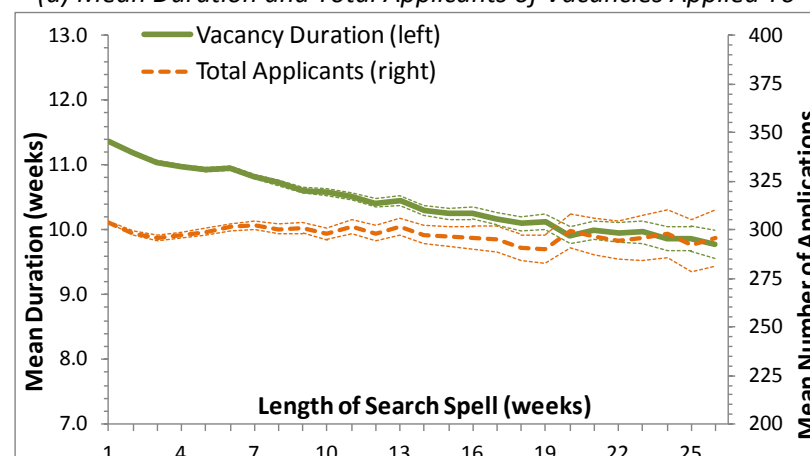
(c) Share to Newly Posted Vacancies



(b) Share to Previously Applied-To Vacancies

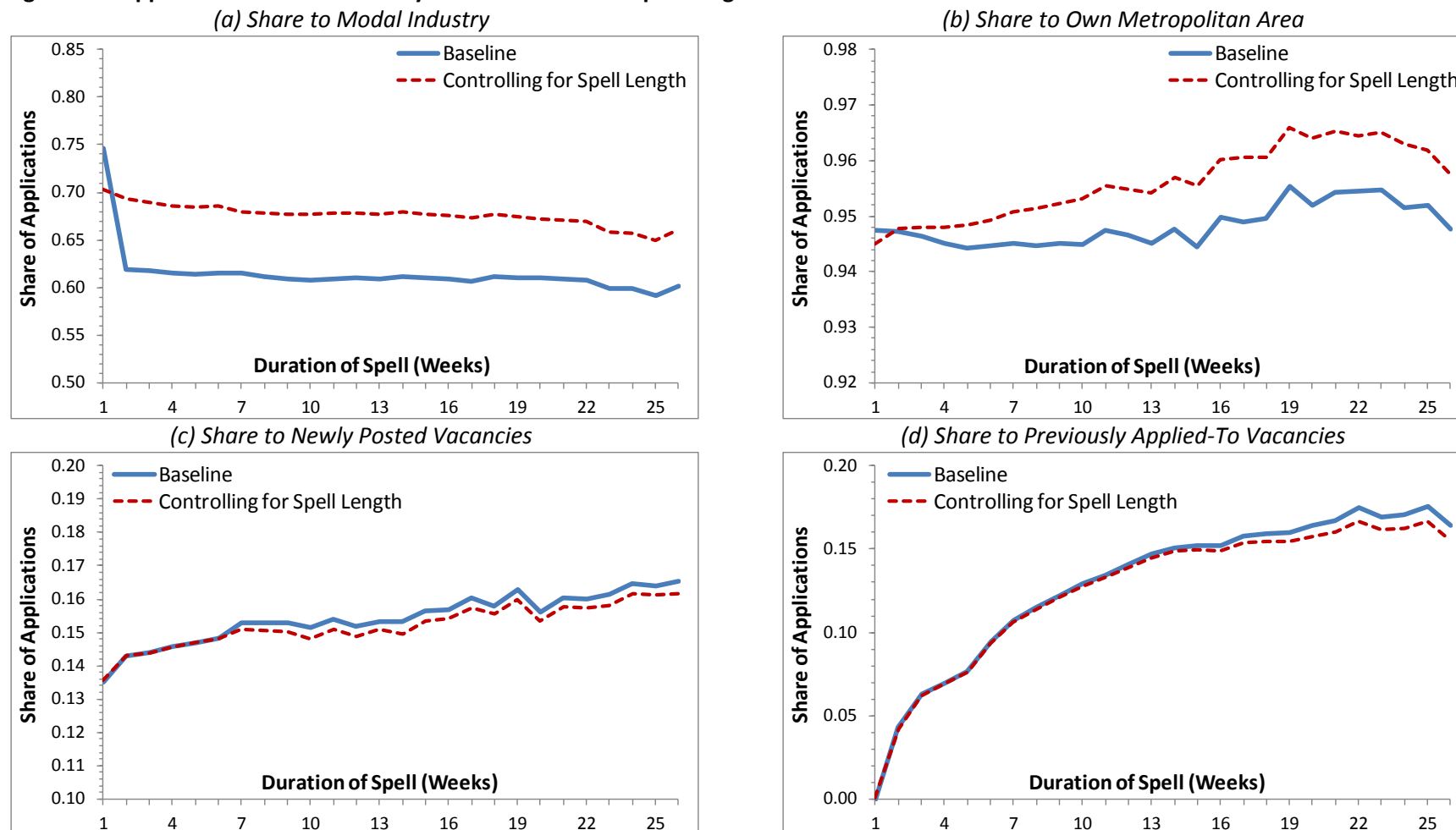


(d) Mean Duration and Total Applicants of Vacancies Applied To



Notes: Panels depict the (unconditional) fraction of applications to a jobseeker's modal industry, to the jobseeker's metropolitan area, the mean number of applications per webpage view, and the mean time spent searching the website (in minutes). Dashed lines represent 95 percent confidence intervals.

Figure C.3. Application Characteristics by Duration and Total Spell Length



Notes: Panels depict the (unconditional) fraction of applications to a jobseeker's modal industry, to the jobseeker's metropolitan area, to newly-posted vacancies, and to previously applied-to vacancies by search duration, separately by the total spell length of jobseekers.

Appendix D. Estimates for all Identified Spells

We also estimate the regression models of our main analysis for all identified search spells. The estimation approach is similar to that in the main text, except that we now include a set of dummy variables for the second, third, and fourth or higher search spell, as well as interactions between these dummy variables and the dummy variables for the week of search duration. Using the full specification listed in Section 5 of the main text as an example, the estimated model is

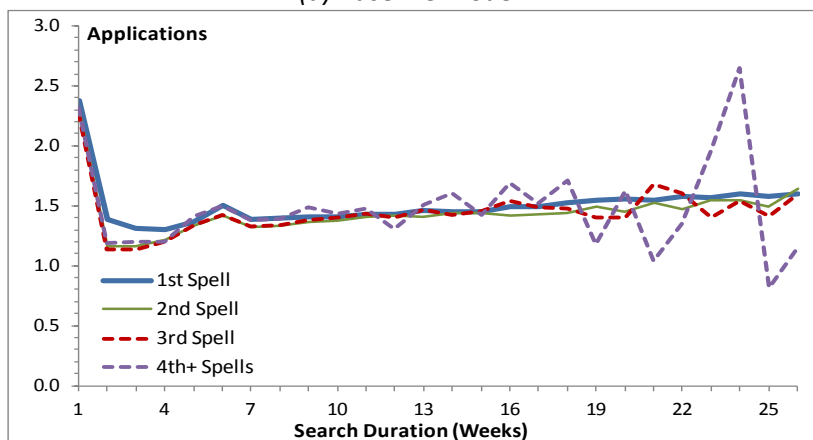
$$A_{ijn\tau}(t) = d(t) + \theta_n + \sum_{n=2}^{4+} \mu_n(t) + \alpha_j + \gamma_\tau + \eta_T(t) + \beta_0 \ln v_j^n(t) + \beta_1 \ln v_j^e(t) \\ + \beta_2 d(1) \cdot \ln v_j^e(t) + \varepsilon_{ijn\tau}(t),$$

where θ_n represents a set of dummy variables for identifying each distinct spell (with the fourth and higher spells grouped together) and $\sum_{n=2}^{4+} \mu_n(t)$ represents the set of interaction terms between these dummy variables and the dummy variables for spell duration, $d(t)$. The estimated conditional mean number of applications sent during week t of search spell n is $\hat{d}(t) + \hat{\theta}_n + \hat{\mu}_n(t)$. We present the estimated coefficients derived from the above specification as well as the analogous intermediate regression specifications for each spell (or spell group, for the fourth and later spells) in the figure below.

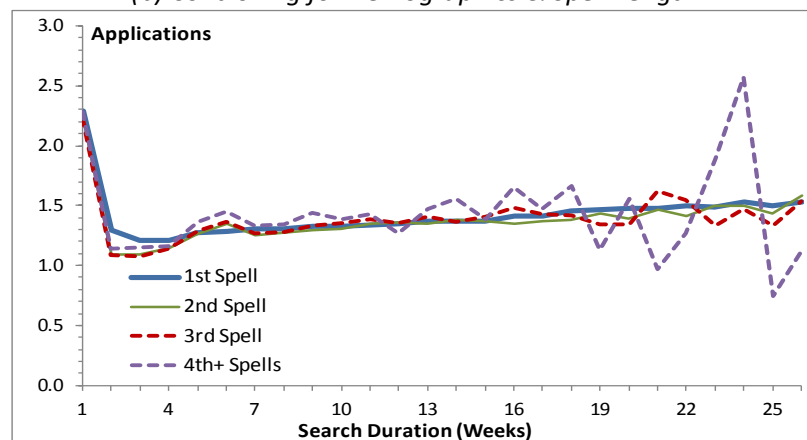
In short, the figures show very similar patterns across all search spells. Once controls for jobseeker characteristics are added, the second and subsequent spells have a somewhat larger decline in applications per week over the duration of search, but otherwise the key finding of a strongly negative relationship between applications and search duration holds within each job search spell.

Figure D.1. Estimated Relation between Applications and Search Duration across All Identified Search Spells

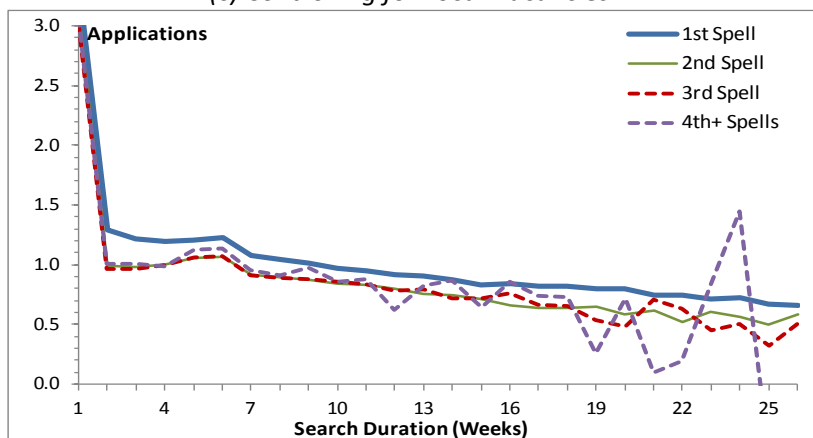
(a) Baseline Model



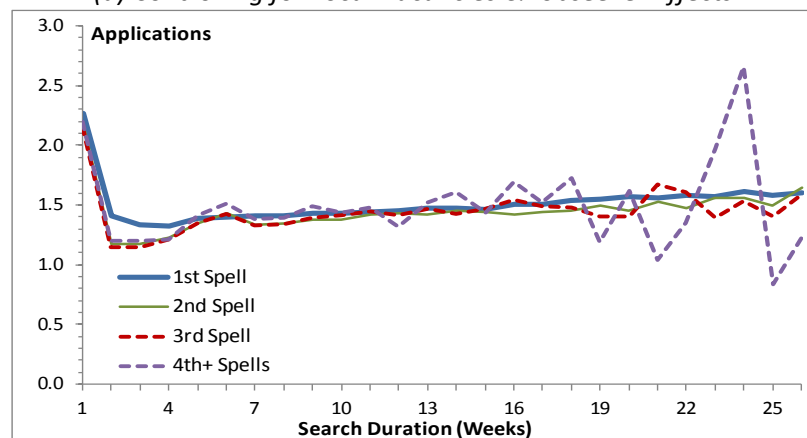
(b) Controlling for Demographics & Spell Length



(c) Controlling for Local Vacancies



(d) Controlling for Local Vacancies & Jobseeker Effects



Notes: Panels depict the estimated relationship between applications sent per week and search duration under four different regression specifications used in the analysis of the main text. The specifications are for a sample of all identified search spells. They estimate the application-duration relationship parametrically using dummy variables for each spell, independently and interacted with spell duration dummy variables.