Studying the Labor Market with the Job Openings and Labor Turnover Survey

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Abstract:

The Job Openings and Labor Turnover Survey (JOLTS) is a new data source of the Bureau of Labor Statistics that estimates monthly vacancies, hires, and separations. It has quickly become a useful tool for studying the labor market. This chapter summarizes its aggregate and micro-level evidence, including the relations of vacancies and worker flows to unemployment and other measures of labor market conditions. The chapter also discusses the implications of this evidence and the potential of the data for future research.

The views expressed are solely those of the author and do not necessarily reflect the official positions or policies of the U.S. Bureau of Labor Statistics or the views of other staff members.

1. Introduction

In recent years, the Bureau of Labor Statistics (BLS) has released several new data products that describe the dynamics of the labor market. One of these is the Job Openings and Labor Turnover Survey (JOLTS). The survey is the only existing data source to measure vacancies, hires, and separations at the establishment level at a regular (monthly) frequency. This relatively new survey already adds to the understanding of the role firm behavior plays in job posting and worker turnover.

This chapter details the characteristics of the JOLTS data and provides descriptive evidence at both the aggregate and micro levels. The discussion is primarily for researchers wishing to use the data for their own studies. As such, it characterizes the data scope, composition, measurement and estimation, and the research potential these data have. The chapter also presents some basic evidence on the aggregate and micro-level relations of vacancy postings to unemployment and worker flows to labor market conditions.

The survey is an evolution of earlier data series (notably the BLS Worker Turnover Survey[1]), as well as research on vacancies, job turnover, and unemployment done by Abraham (1987) and Blanchard and Diamond (1989, 1990) and theories of labor market search developed by Mortensen and Pissarides (1994). This work, and the wide literature that followed, underscores the importance of understanding the matching process between workers and firms and highlights the rich heterogeneity surrounding the matching process. As such, the BLS designed JOLTS to capture these facets of this

[1] The Worker Turnover Survey measured vacancies, ascensions, and separations for the manufacturing industry; the BLS discontinued the survey in 1982. See Davis and Haltiwanger (1998) and Clark and Hyson (2001) for more on this survey.

literature. The result is a high-frequency, timely survey with several major advantages over previous data. The first is its reporting of hires and separations directly by the firm. Other sources (e.g., administrative wage records) forced researchers to infer these flows from observed changes in the employer of a worker. The second is its reporting of job openings, or vacancies, which are reported directly by the firm. Previously, researchers had to rely on indexes (such has the Help Wanted Index) for a measure of vacancies. These indexes, in addition to potential selection and measurement issues, did not lend themselves to studying vacancy postings at the micro level. This is particularly important since theories of labor market search and matching often model behavior at the level of workers and firms, not at the aggregate level. The final advantage is its distinction between quits and layoffs. The two types of separations have differing cyclical patterns, and separately measure voluntary and involuntary severances, respectively.

Existing research using JOLTS is sparse. Clark (2004) summarizes the aggregate evidence since the survey's inception. Hall (2004) and Shimer (2005) use the JOLTS data to support theories of wage rigidities in labor market search. Besides this chapter, Davis, Faberman, and Haltiwanger (2005a, 2005b) are the first to present analyses of the micro-level JOLTS data. The data have also become popular with the press and various industry and policy groups. Research into the theory and evidence of labor dynamics has ballooned in recent years, and the estimates JOLTS provides are related to several facets of this research. In addition to the studies already mentioned, the data relates closely to work done by Anderson and Meyer (1994), and Burgess, Lane, and Stevens (2000). The data also relates to work on job reallocation and firm dynamics done by Dunne, Roberts, and Samuelson (1989a, 1989b), Davis, and Haltiwanger (1990, 1992), Foote (1998), and

others.[2] Future research with the JOLTS survey will only build on these studies, and complement existing data sources of similar and related measures.[3]

The following section defines the concepts and terminology used throughout the paper. The next section describes the data sample, measurement, and estimation, presents some basic aggregate evidence, and highlights the survey's research strengths and limitations. The following section explores the relation between vacancies and unemployment at both the aggregate and micro levels. An exploration of the relations between worker flows and aggregate and local labor market conditions comes next. The final section concludes and discusses potential avenues of future research.

2. Concepts and Definitions

This section provides an overview of important concepts and definitions used in this paper. More precise definitions are in the description of the data. The primary unit of observation for the JOLTS survey is the *establishment*, which covers the operations of a firm at a single physical location. *Firms* can have one or more establishments. *Employment* measures how many individuals are employed and receiving earnings at a particular establishment. JOLTS uses the standard BLS measure of employment, which counts the number of employed persons as of the pay period that includes the 12th of the month. The JOLTS data are establishment-based and cover nonfarm payrolls, which imply that employment estimates generally exclude self-employed individuals and non-profit organizations not covered under a state unemployment insurance program.

[2] For a complete review of the theoretical and empirical literature related to labor market search and worker and job flows see Davis and Haltiwanger (1999) and Mortensen and Pissarides (1999), respectively.
[3] See Manser (1998), Davis and Haltiwanger (1998), Abowd and Kramarz (1999), and Abowd, Haltiwanger, and Lane (2004) for summaries of these other data sources.

Worker flows measure changes in the match of a worker to an establishment. *Hires* are new additions to the workforce of an establishment, while *separations* are removals from its workforce. These removals may be voluntary (e.g., *quits*) or involuntary (e.g., *layoffs* and *discharges*). Note that other separations, such as retirements, also exist. Given these definitions, an individual who stops working at an establishment may not count as part of employment, but also may not count as a separation. Examples of this occurrence include teachers on summer break and unassigned workers at a temporary help agency. I discuss the implications of this nuance in the data section below. In general (and abstracting from this nuance), the *net* employment growth of an establishment is simply the difference between hires and separations. If hires are greater, the establishment is *expanding*. If separations are greater, the establishment is *contracting*.

The JOLTS data also measure *job openings*, also known as *vacancies*. These are unfilled employment positions posted by an establishment. As such, vacancies are usually thought of as a measure of unmet labor demand. Vacancies are often discussed with respect to their relation to unemployment. This relation is known as the *Beveridge Curve*, which implies an inverse relation between the two. In other words, when unemployment rises over time, vacancies should decline.

3. Data

3.A. Source Data and Measurement

The JOLTS program publishes monthly estimates of vacancies, hires, and separations for all nonfarm establishments. The program also reports separations broken out into quits, layoffs and discharges, and other separations (e.g., retirements). The data

start in December 2000 and are updated monthly, with the latest estimates available within two months of a period's end.[4] The current time series spans nearly four years. The aggregates estimates are available nationally and for four major regions by 2-digit North American Industry Classification System (NAICS) sector.[5] The BLS reports JOLTS estimates in levels and as rates.

The JOLTS data are a sample of roughly 16,000 establishments surveyed each month. The survey is made up of overlapping panels that remain in the sample for 18 months. The sample is weighted so that its employment estimates match those of the Current Employment Statistics (CES) survey.[6] The survey form has four major data elements: employment, hires, separations, and vacancies. Establishments report their employment for the pay period that includes the 12th of the month, its hires and separations between the first and end of the month, and the number of vacancies it has at the end of the month. Respondents also categorize their separations into quits, layoffs and discharges, and other separations. Note that there are three different reference periods for the data collected. The employment reference period is standard for all federal statistical surveys and allows the data to be benchmarked to the CES estimates. The reference period for hires, separations, and vacancies are chosen to maximize reporting accuracy. The survey also has each respondent's state and industry codes, plus an identifier that

[4] Currently, only certain statistics are available seasonally adjusted, since the current time series is too short to allow a complete seasonal adjustment of the data. Aggregate estimates of layoffs and discharges and other separations are the notable series not yet available seasonally adjusted.

[5] The NAICS replaces the older Standard Industrial Classification (SIC) system. The most notable change in NAICS is its classification of the service sector into several separate sectors, such as information, professional and business services, education and health, and travel and hospitality. JOLTS industry estimates are for two-digit NAICS sectors. In general, these sectors correspond to major SIC industry sectors (e.g., manufacturing, services. etc.)

[6] Consequently, if one wanted to replicate the JOLTS worker flow and vacancy rate estimates, they would use the appropriate CES employment estimate in the denominator.

allows a match to the same establishment's record in the BLS Quarterly Census of Employment and Wages (QCEW, also known as ES-202) data.

Hires, separations, and vacancies have precise definitions. These definitions refer to specific occurrences so that BLS can measure changes in the worker-firm match as well as possible and so respondent's confusion in reporting is minimized. The BLS asks survey respondents to report their worker flows and vacancies based on the following definitions.

- *Hires* include new hires, re-hires, seasonal and short-term hires, recalls after a layoff, and transfers from other worksites.
- *Separations* include quits, layoffs lasting more than 7 days, firings and other discharges, terminations of short-term and seasonal workers, retirements, and transfers to other worksites.
- *Vacancies* are all unfilled, posted positions available on the last day of the month. The vacancy must be for a specific position that could start within 30 days, and an active recruiting process must be underway for the position.

JOLTS estimates (in the publicly available data and throughout this chapter) are expressed in *rates*. For the worker flows, these rates are simply the flow's share of employment. For vacancies, the rate is vacancies divided by the sum of vacancies and employment. This measure follows the definition of vacancies as unmet labor demand, so that the denominator of its rate is the sum of both unmet and filled labor demand. This also makes the vacancy rate analogous to the unemployment rate, which uses the labor force as its denominator (i.e., the sum of employed and unemployed labor supply).

3.B. Aggregate Evidence

The publicly available JOLTS estimates present a wealth of new evidence for the aggregate labor market. While the times series is short, it spans a recession and slow labor market recovery, allowing researchers a glimpse of the cyclical behavior of worker flows and vacancies. Figures 1 and 2 illustrate their patterns between December 2000 and October 2004. The National Bureau of Economic Research (NBER) dates the recession as starting in March and ending in November of 2001. Figure 1 shows the hires and separations rates over the period. Hires decline during the recession and remain low through mid-2003. The hiring rate then begins a gradual, steady increase though the end of the sample period. Separations are high throughout most of 2001. They decrease rather abruptly, however, in early 2002. The separations rate reaches a low in mid-2003. Separations then increase gradually through the end of the sample period, even though net growth is strong during this time. Figure 2 charts the movements of the unemployment and vacancy rates.[7] The unemployment rate estimates come from the Current Population Survey (CPS). Generally speaking, the two move in opposite directions. In 2001, unemployment rises and vacancies fall. Unemployment rates hover around 6 percent and vacancy rates remain near 2 percent for most of 2002 and 2003. Beginning in mid-2003, the unemployment rate begins to fall and the vacancy rate starts to rise; these patterns continue into late 2004. Overall, the JOLTS evidence is consistent with other labor market measures. CES estimates show employment growth recovering in mid-2003, the same time that hiring and vacancies increase. Also, the patterns of hires

[7] Note that the vacancy rate is considerably smaller in magnitude than the unemployment rate. Several factors, such as the JOLTS definitional requirements that vacancy postings must be for work to start within 30 days, that an active recruitment process be underway, and that the vacancy is for an unfilled position. Thus, the definition would not capture informal recruiting methods and job openings that occur considerably earlier than the start of work.

and separations closely follow the patterns of gross job gains and gross job losses estimates, respectively, from the Business Employment Dynamics (BED) program.[8]

The aggregate estimates also illustrate the more basic evidence on the magnitude and volatility of these variables. Table 1 presents the aggregate means, standard deviations, and correlations with relevant labor market variables. The hires rate averages 3.3 percent while the separations rate averages 3.2 percent. These rates correspond to about 4 million hires and separations each per month. The vacancy rate averages 2.4 percent, which is less than half the average unemployment rate over this time. These rates exhibit relatively little time-series volatility, but this may be a consequence of the brief time series. Similarly, one should interpret the magnitudes of the time-series correlations with caution (though their signs are likely more robust). Vacancies and the two worker flows are all negatively correlated with unemployment. One might expect separations to have a positive relation, but it is evident that quits (which make up 54 percent of separations, on average) drive the negative relation. The correlations of vacancies, hires, and separations with net employment growth are closer to what one might expect.

Table 2 lists the summary statistics for vacancies, hires, and separations by industry and region for December 2000 through January 2004. Consistent with the evidence of Anderson and Meyer (1994), and Burgess, Lane, and Stevens (2000), worker flow rates vary widely by industry. Worker flow rates are highest in seasonal industries, such as construction and leisure and hospitality, and low in other industries, such as manufacturing and government. Note that high turnover industries are not necessarily the ones with the highest vacancy rates. Instead, industries that expand over this period, such as professional and business services, and education and health services, have the highest

[8] For further evidence, see Spletzer et al. (2004) and Clark (2004).

vacancy rates. Education and health has the highest vacancy rate despite also having one of the lowest rates of worker turnover. Manufacturing, which underwent a large employment decline over this period, has one of the lowest vacancy rates (along with construction and resources). To a lesser extent, vacancy and worker flow rates vary by region. In general, the South and West, which have relatively high employment growth, have higher rates of vacancies, hires, and separations (which occur primarily though more quits.) This suggestive evidence is consistent with the geographic patterns of employment dynamics found by Eberts and Montgomery (1995) and Faberman (2003).

3.C. Some Notes on Research with the JOLTS Data

The available JOLTS data already provide interesting evidence about the labor market, yet it remains a relatively new and evolving survey. The passage of time will lengthen the time series, making the survey even more useful in understanding the cyclical behavior of vacancies and worker flows. Researchers should be aware that the JOLTS sample is only representative nationwide, by major industry, and by region. With a sample size of 16,000 establishments, exploiting the data at finer industrial or geographic detail will likely face issues of precision and selection. The multiple reference periods for different data elements can complicate some research studies. The survey does not have data on wages or other establishment characteristics, though the possibility exists for linking JOLTS data to other microdata sources (like the BED) to obtain this information.

A significant issue for JOLTS (discussed in Wohlford et al., 2003) is the measurement of hires and separations. The BLS continuously researches its estimation of these statistics to both understand and improve their measurement. An important finding

of this research is that the measurement of hires and separations is not as simple as theory would dictate. As noted earlier, the relation between hires, separations and the level of employment is complicated by the fact that employed workers can exist empirically in one of *two* states: employed and working, or employed but not working (where "working" is defined as on the payroll.) Educators on summer break, temporary help workers retained but not assigned to a particular job (i.e., "on call"), and temporary layoffs are common examples of the latter category. Other complications also exist—for instance, hires may occur months prior to the start of work.[9] These nuances make measuring hires and separations more difficult to measure than employment, which most federal statistical surveys (including JOLTS) measures as a point-in-time count of individuals on the payroll.

Figure 3 illustrates the possible transitions a worker can undertake and the relative difficulty of measuring each, based on internal analysis by JOLTS program staff. As one might expect, the easiest flows to measure are those where an employed and working individual is either hired or separated. Flows that deal with employed individuals not currently working are where measurement difficulties arise, with the greatest difficulties occurring where an individual separates from a job match during a period of non-work. Wohlford et al. (2003) find that separations are disproportionately harder to measure, creating an asymmetry between the measurement issues of hires and separations. This asymmetry in turn results in a disparity between the CES employment trend and the cumulative difference between JOLTS hires and separations.

[9] The JOLTS defines a hire when the work is actually started, and asks respondents to not to count a hire until that time.

The BLS constantly researches these issues, and has taken steps (such as the creation of separate survey forms for schools and temporary help firms) to improve worker flow measurement. Further research on these measurement issues is obviously important for improving data quality, but it can also prove useful in understanding firms' reporting of (and economists' ability to measure) how job matches are created, maintained, and severed.

3.D. Research Sample

This chapter presents micro-level evidence of vacancies and worker flows. For my analyses, I use a sample of JOLTS establishments pooled over the December 2000 – January 2004 period that have positive employment reported in two consecutive months. Restricting the sample to continuous units minimizes potential spurious effects of outliers and inconsistent data reporters. My sample is further restricted to those where I can match the microdata used to estimate the aggregate statistics to their state. This allows me to study vacancies and worker flow relations to state labor market conditions. My resulting sample contains 282,205 (or 91.2 percent) of the establishment-month observations used to create the public statistics over this period.[10] This implies that the average month in this sample has just over 7,600 observations. Results in my analyses are all sample-weighted, and often (where noted) also employment-weighted. Unless otherwise noted, estimates are not seasonally adjusted.

[10] Even with the noted restrictions, aggregate estimates from my research sample very closely match the estimates from the full sample.

4. Vacancies and the Beveridge Curve

4.A. Aggregate Relations

An important relation in the theory of worker search and matching is the Beveridge curve, which relates the cyclical movements of vacancies to those of unemployment. This section explores the JOLTS evidence of this relation at both the aggregate and micro levels. Figure 4 begins with a plot of the aggregate vacancy rate versus the unemployment rate. The solid line represents the quadratic trend of the monthly vacancy-unemployment relation from December 2000 through October 2004. The dotted line charts the path of the vacancy-unemployment relation. Vacancies fall as unemployment rises, leading to a movement downward along the trend line. This pattern continues until mid-2003, when the unemployment rate reaches a peak of 6.3 percent and the vacancy rate reaches a trough of 2.0 percent. At this point, the relation "loops" around and moves back up along the trend line. Given the economic downturn and recovery during this period, the evidence is consistent with previous findings for the Beveridge Curve (e.g., Blanchard and Diamond, 1989).

Figure 5 illustrates the aggregate vacancy-unemployment relation in terms of labor market "tightness", defined as the ratio of vacancies to unemployment. The ratio begins the period relatively high, but declines dramatically (from 0.85 to 0.38) throughout 2001. The ratio remains low until the beginning of 2004, when it begins a gradual, steady rise. This evidence is consistent with expectations, given the cyclical climate—following the high employment growth of 2000, the labor market is very tight. Labor market slack increases during the recession, and as employment growth remains

stagnant, this slack persists. Once employment growth resumes, labor market tightness increases.

4.B. Vacancy Postings and the Local Labor Market

The JOLTS data are especially powerful in allowing a micro-level study of vacancies and their relation to the labor market. Most theories of labor market search (see Mortensen and Pissarides, 1999) model the relation of vacancies to unemployment as a firm-level decision whether to post a vacancy in response to current labor market conditions. Theory dictates that, controlling for outside factors, the negative aggregate relation should also hold at the micro level. Consequently, I estimate the relation of establishment vacancy rates to local (i.e., state) unemployment rates.[11] This approach identifies the establishment response to local labor market conditions, illustrates whether a micro-level Beveridge Curve exists, and if it does, what shape the curve takes.

It is useful to begin with the basic statistical properties of local unemployment and establishment-level vacancies, particularly since there is little empirical evidence on the latter. Table 3 lists these properties for the pooled estimates of unemployment rates in state j at month t (U_{jt}), and vacancy rates for establishment i in state j at month t (V_{ijt}). I report separate vacancy rate statistics for all observations and the subsample of those with positive vacancies. I weight all statistics by employment. State unemployment rates come from the BLS Local Area Unemployment Statistics (LAUS) data, which use CPS and other data sources to produce estimates. State unemployment rates are similar to the national rates, on average, though they exhibit greater variation. Vacancy rates are less

[11] Note that there is a timing difference in the reporting of vacancies and unemployment for a given month. Reported vacancies are those posted at the end of the month, while the unemployed are those who actively looked for work in the four weeks prior to the week of the 19th. This is true for both national and state-level unemployment. Thus, the vacancy rates used in this study will lead unemployment rates by about two weeks, on average.

than half of unemployment rates, on average, but closer inspection suggests that much of this stems from establishments who post no vacancies in a given month. Only 12 percent of establishment-month observations (representing 53 percent of employment, however) have a vacancy posted at the end of the month. This statistic is somewhat misleading, however, since many establishments (79 percent) have no net change employment (and hence likely do not need a vacancy posting) at the monthly frequency. Nevertheless, conditional on changing employment levels, only 34 percent of establishment-month observations (representing 68 percent of employment) have a vacancy posting at the end of the month. It may be that the JOLTS vacancy definition does not capture long-term vacancy postings or vacancies that are posted and filled within the month, or it may be that establishments use less formal hiring practices more frequently.[12] The finding merits further research. When one conditions on having positive vacancies, the average vacancy rate nearly doubles.

Table 3 also shows that state and month effects explain much of the unemployment variation, but little of the vacancy variation. Much of this result stems from the fact that the former are state-level data while the latter are establishment data. State fixed effects explain more than half the variation in unemployment rates, while month fixed effects account for one-third of the variation. These effects account for just over 1 percent of the establishment vacancy variation. Establishment effects account for 42 percent of the variation of all vacancies and two-thirds of the variation conditional on the posting of at least one vacancy.

[12] To see why JOLTS may not capture these occurrences, please see the formal definition of JOLTS vacancies described earlier, as well as the caveats in Note 7.

I explore the relation between establishment vacancy postings and state unemployment by using my pooled sample to regress establishment vacancy rates on state unemployment rates. I expect the relation to be nonlinear, and use a fourth-order polynomial of unemployment as a result. Nonparametric analyses of the data (not reported here) suggest that a polynomial of this order fits the data well.[13] I weight the regressions by employment and run separate regressions that include state and establishment fixed effects.

I plot the predicted relations of vacancies to unemployment from these regressions in Figure 6. There are separate predicted trends for the unconditional relation, the relation with state effects removed, and the relation with establishment effects removed. As expected, vacancy postings are inversely related to the local unemployment rate. The polynomial coefficients for each regression are all jointly significant at the 5 percent level. The relation is steeper once I control for state or establishment effects. This is likely due to the large variation in trend unemployment across states.[14] Controlling for state or establishment effects, however, makes little difference for the results. This suggests that much of the between-establishment variation is between states, and not necessarily between establishments within states. Overall, the results suggest that a Beveridge Curve relation in fact exists at both the micro and aggregate levels.

[13] These nonparametric tests include measures of average vacancies along the unemployment rate distribution, and local regression estimation of the same distribution. Both approaches give similar, albeit less smooth, trends in the data.

[14] Note that state fixed effects are a subset of establishment fixed effects, in the sense that establishments cannot change their location in the data. Consequently, establishment effects will identify both state trend variations and between-establishment variations within a state.

5. Worker Flows and the Labor Market

5.A. Aggregate Movements

The JOLTS microdata also allow a richer analysis of worker flows. The basic aggregate evidence illustrated that, even with its short time series, JOLTS can shed new light on the behavior of labor dynamics.

Both hires and separations exhibit considerable cyclical variation. Other evidence, however (e.g., Dunne, Roberts, and Samuelson, 1989a, 1989b; Davis, Haltiwanger, and Schuh, 1996), suggests that there is also a large amount of job reallocation that underlies these worker flows. Each period, many firms simultaneously expand, contract, start up, and shut down. An important question resulting from this work asks what the relations are between this reallocation and worker flows. Namely, what do worker look like at job-creating versus job-destroying firms? To answer this question, I split my sample into three groups: those that added workers, those that lost workers, and those that kept employment constant. For the sake of consistency, I use an establishment's difference between hires and separations to define whether it expanded ($H > S$), contracted ($H < S$), or remained stable ($H = S$). I then calculate the aggregate estimates of hires and separations for each group by month.[15] My results for hires and separations are in Figures 7 and 8, respectively.

The figures show analogous pictures. Expanding establishments have high hires rates, while contracting establishments have high separations rates. Both groups have rates averaging over 6.3 percent. These rates are also considerably more volatile than the other worker flow series, with standard deviations that are between 1.5 and 3.6 times

[15] I also seasonally adjust these estimates using the same seasonal factors used for hires and separations for the public aggregate data.

greater than those for the other series. Interestingly enough, separation rates at expanding establishments and hiring rates at contracting establishments are both higher than the worker flow rates at stable establishments. The former rates average 2.1 and 1.7 percent, respectively while the rates at stable establishments average 1.1 percent. Stable establishments also have the least volatile worker flows, suggesting that both their employment levels and their within-establishment churning are relatively steady. Overall, the evidence suggests that a large portion of hires occur at expanding establishments while a large portion of separations occur at contracting establishments. It also suggests that the relation of hires and separations to net growth is likely nonlinear at the establishment level—contracting establishments have more hires than those with no net growth and expanding establishments have more separations than those with no net growth. This latter result is a puzzling finding, and warrants further research.

5.B. Worker Flow Relations to the Local Labor Market

A noted advantage of the JOLTS data is its ability to distinguish between quits and layoffs and discharges. Preliminary evidence from the aggregate data suggest that quits are generally procyclical while layoffs and discharges are generally countercyclical. The microdata, when matched to measures of local labor market conditions, allow me to explore the behavior of these flows at a very fine level. By doing so, I can examine whether establishment-level relations to local labor market conditions are consistent with the aggregate evidence.

In Table 4, I report the basic relations of pooled establishment-month observations of hires (H_{ijt}), quits (Q_{ijt}), and layoffs and discharges (L_{ijt}) to state labor market statistics. These statistics are pooled state-month observations of the

unemployment rate, its change from the previous month (ΔU_{jt}), and the employment growth rate (N_{jt}). The last statistic uses estimates from the CES. Note that the reported correlations seem very weak, yet all are significant at the 5 percent level. This is a consequence of using pooled establishment observations, which tend to have large idiosyncratic components to their variation regardless of the variable examined. Note that even establishment fixed effects only explain between 21 and 30 percent of the variations of these flows (state-month effects explain 1 to 2 percent). The most relevant characteristics of these correlations are their sign and their magnitudes relative to each other. The signs of the correlations of the three flows with the state labor market variables suggest a procyclical pattern for establishment hires and quits and a countercyclical pattern for layoffs—higher growth, lower unemployment, and decreases in unemployment are related to greater hires and quits rates and lower layoff rates. In addition, hires have a stronger relation to state labor market conditions than the other flows. The notable exception is quit rates and their relatively strong negative relation to state unemployment. The pooled state-month correlations are significant, much larger in magnitude. Employment growth and unemployment are negatively related, and unemployment tends to exhibit mean reversion.

Finally, I estimate the micro-level relations of these flows to the change in the state unemployment rate. I focus on this variable rather than net growth or the unemployment rate itself since a) it does not exhibit a high level of within-state persistence, and b) it measures a change over the month, just as the worker flows do. I regress the flow rate of each establishment-month observation on a fourth-order polynomial of ΔU_{jt}, weighting the regressions by employment. As with the regressions of

the previous section, the fourth-order polynomial is consistent with similar nonparametric fits of the data.[16] As before, I perform separate regressions for the unconditional relation, and the relations with state and establishment effects removed.

Figures 9, 10 and 11 plot the relations of hires, quits, and layoffs, respectively to the change in the local unemployment rate. Figure 9 shows that establishments hire less when the local unemployment rate is rising. The relation is nonlinear, with hires more responsive to decreases rather than increases in unemployment. Figure 10 shows that quits decreases as unemployment rises, and that this relationship is close to linear. In Figure 11, layoffs increase with increases in local unemployment. Again, there is a nonlinear relationship with layoffs somewhat more responsive to unemployment decreases than unemployment increases. This micro evidence parallels the patterns in the aggregate evidence. Surprisingly, removing neither the state nor the establishment fixed effects alter these results.

6. Conclusions and Further Research Potential

The JOLTS data provide a wealth of labor market information at both the aggregate and micro levels. The data are the most comprehensive data source for vacancies in the US, and have the timeliest, most frequent, and most direct measure of worker flows. While the time series is short, the aggregate JOLTS estimates already present rich new evidence on the cyclical and secular behavior of vacancies and worker flows. Vacancies, hires, and quits all exhibit procyclical patterns between 2001 and 2004, while layoffs exhibit a countercyclical pattern. Vacancies also exhibit a cyclical relation to unemployment consistent with the Beveridge Curve. The micro-level estimates provide several new insights into the behavior of vacancies and worker flows.

[16] The nonparametric exercises are the same as in note 7.

Establishment-level vacancy postings are negatively related to local unemployment rates, suggesting the Beveridge Curve relation holds even at the micro level. This result holds even though many establishments (even the ones who change employment levels) often do not post vacancies. Expanding establishments account for a large portion of hires and contracting establishments account for a large portion of separations. Stable establishments, while exhibiting a steady pattern of worker churning, have the lowest rates of either worker flow, suggesting that the relations of hires and separations to establishment growth are nonlinear and nonmonotonic. Finally, the evidence suggests that hires are strongly related to changes in local unemployment rates, falling nonlinearly with increases in unemployment. Quits also fall with increases in the local unemployment rate, while layoffs rise with these increases.

These findings barely scratch the surface of what the JOLTS data can say about the labor market. There are three areas where the aggregate estimates and microdata can aid research. The first is vacancy postings. Earlier works, such as Abraham (1987) and Blanchard and Diamond (1989, 1990), study vacancies and their relation to unemployment using estimates from the Help Wanted Index. The JOLTS vacancy data has a major advantage over this index (and others like it) in that it is reported directly by firms. This provides a representative, tangible measure of job openings and allows micro-level studies of firm vacancy posting behavior similar to previous work by Holzer (1994), including current work by Davis, Faberman, and Haltiwanger (2005a). Evidence in this chapter already suggests that the micro-patterns of firms post vacancies may differ from existing theories of their behavior.

The second area of potential research deals with separations. The JOLTS data can aid in understanding them since it differentiates between quits and layoffs. This is important for macroeconomic analyses of worker flows, since quits are procyclical, while layoffs are countercyclical. In addition, JOLTS can help in the understanding of the worker-firm interaction with respect to separations, since quits are voluntary and layoffs are involuntary. Models such as those in Akerlof, Rose and Yellen (1988) and McLaughlin (1991) highlight the importance of this distinction.

The final area of potential research deals with worker flows more broadly. The aggregate national, regional, and industry estimates already present many new findings. Future work with these and the micro-level estimates can build on the earlier work of Anderson and Meyer (1994) and Burgess, Lane, and Stevens (2000). The existence of vacancy, employment, and worker flow data reported by each establishment allows a micro-level study of their interactions that was previously impossible, but essential for understanding labor market search and the matching of workers to firms. Research on the relation between worker flows and firm behavior also relates naturally to research on the relation between worker turnover and the patterns of job reallocation studied by Dunne, Roberts, and Samuelson (1989), Davis, Haltiwanger, and Schuh (1996), Foote (1998) and others. Overall, the JOLTS data provide many opportunities to increase our understanding of labor market dynamics.

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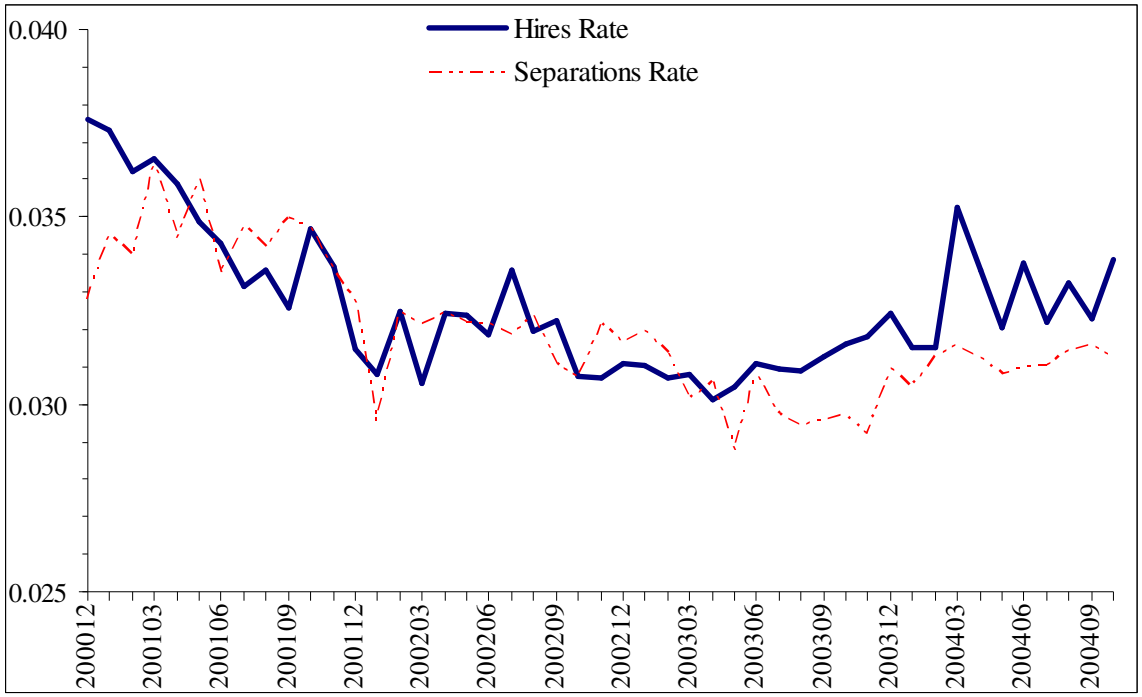
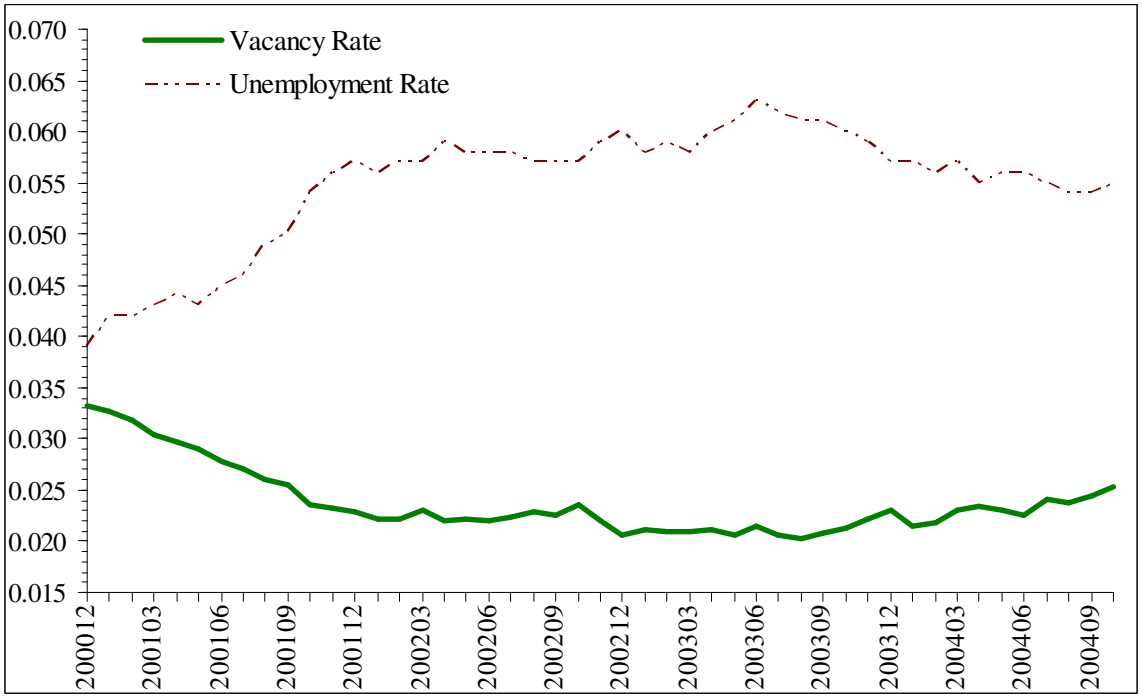
Figure 1.
Hires and Separations Rates, December 2000 – October 2004



Source: Public JOLTS nonfarm estimates, seasonally adjusted.

Figure 2.
Vacancy and Unemployment Rates, December 2000 – October 2004



Source: Vacancies are from public JOLTS nonfarm estimates and unemployment is from the CPS. Both are seasonally adjusted.

Figure 3.
Measurement Issues with Worker Flows and Employment

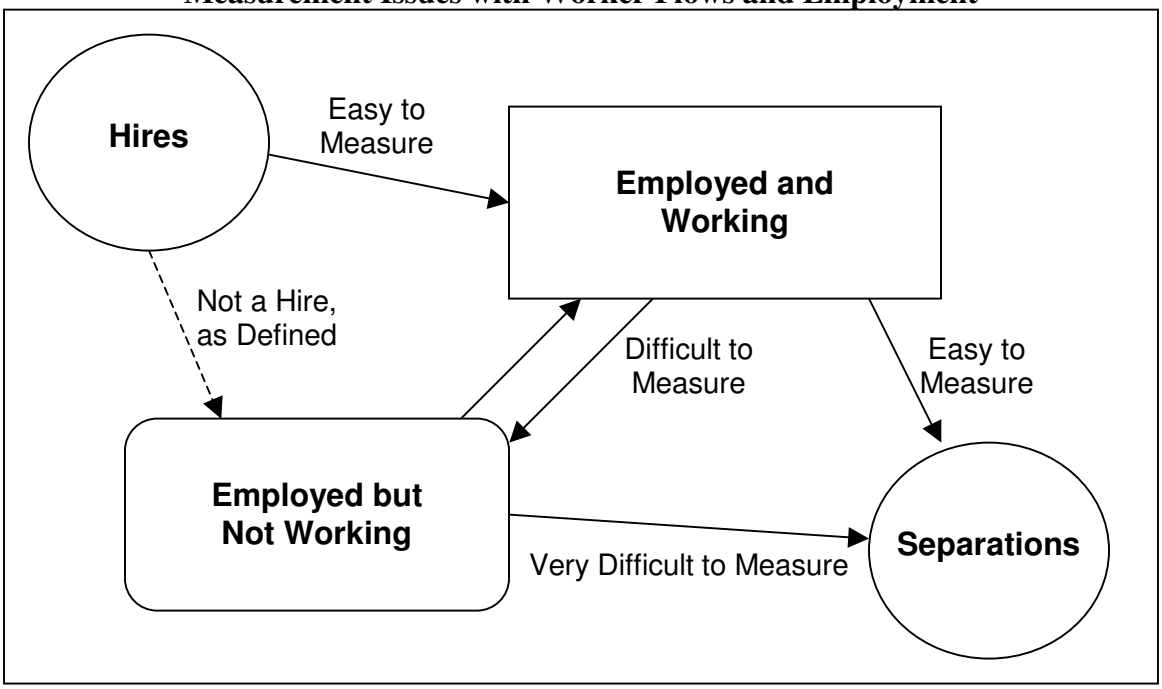
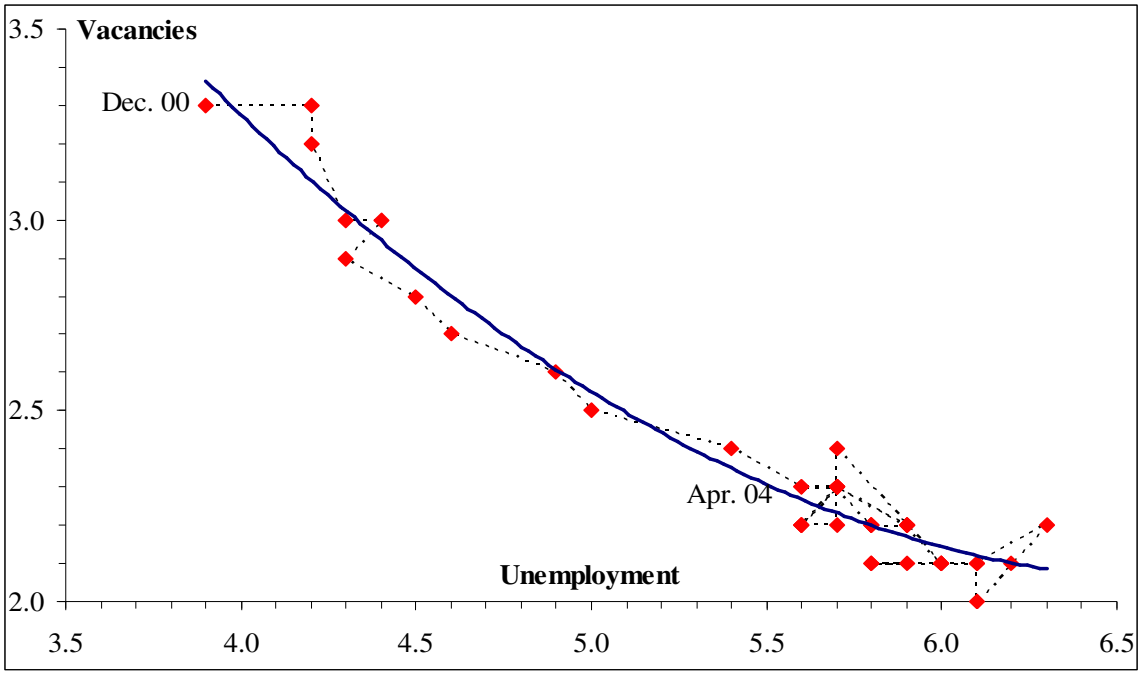
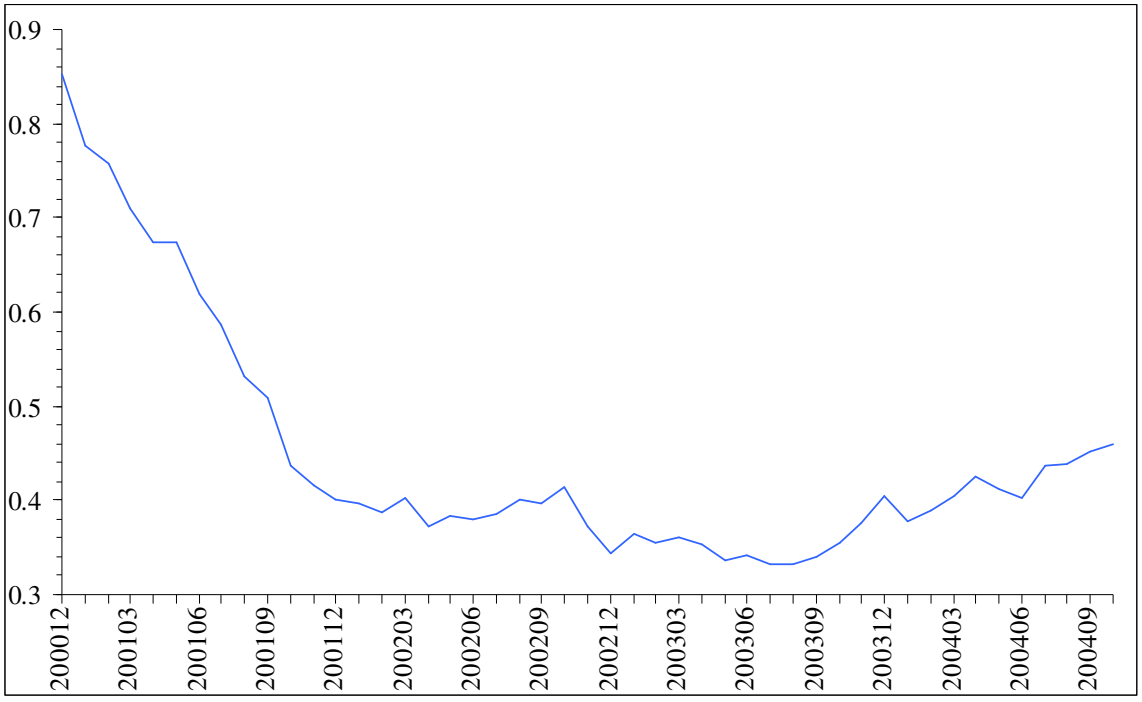


Figure 4.
Vacancy vs. Unemployment Rates (Beveridge Curve), Dec. 2000 – Oct. 2004



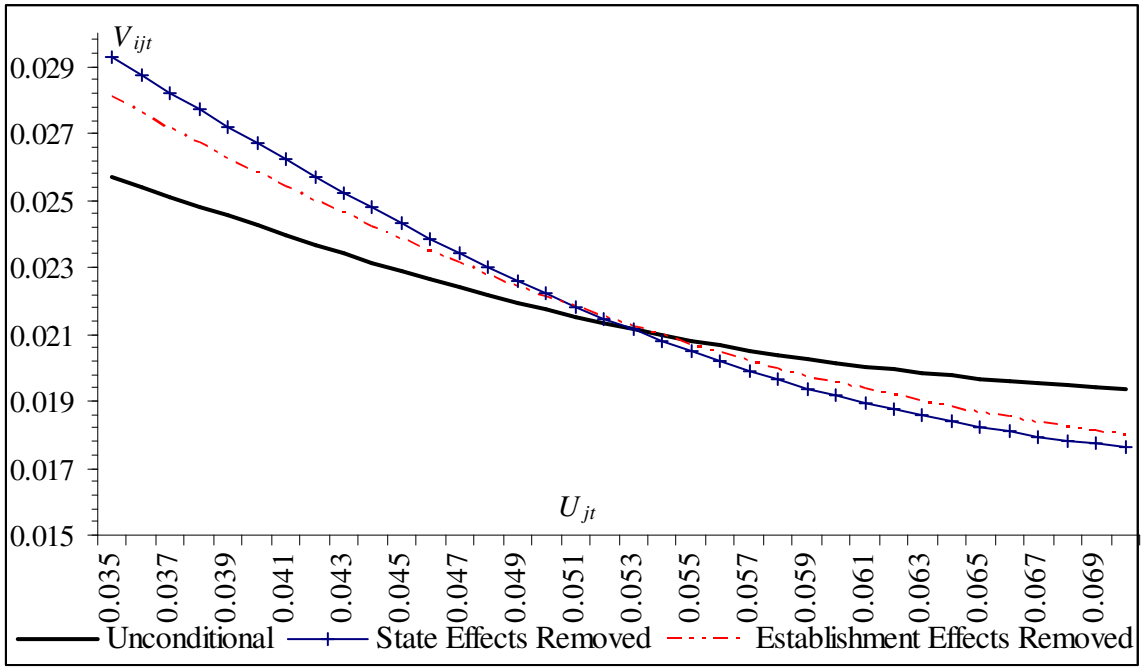
Source: Vacancies are from public JOLTS nonfarm estimates and unemployment is from the CPS. Both are seasonally adjusted. The dotted line represents the time-series path of the unemployment-vacancies relation, while the solid line represents the quadratic trend of the relation.

Figure 5.
Labor Market Tightness (V_t/U_t), December 2000 - October 2004



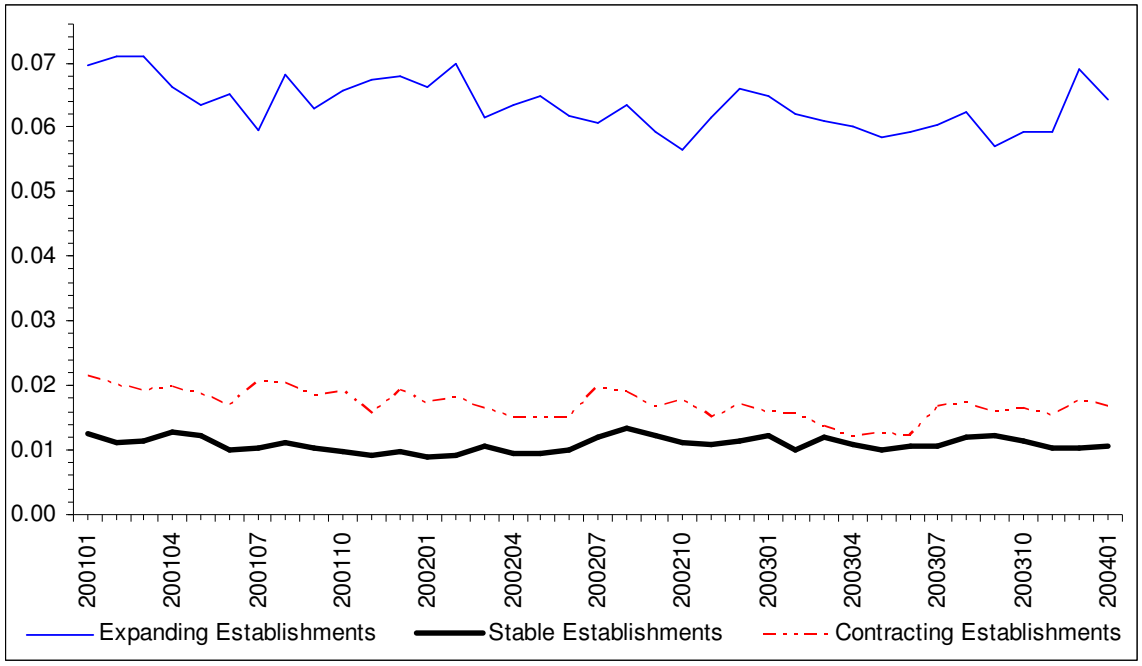
Source: Authors tabulations from public JOLTS nonfarm vacancy estimates and CPS unemployment estimates. Both are seasonally adjusted.

Figure 6.
Establishment Vacancies and Their Relation to the Local Unemployment



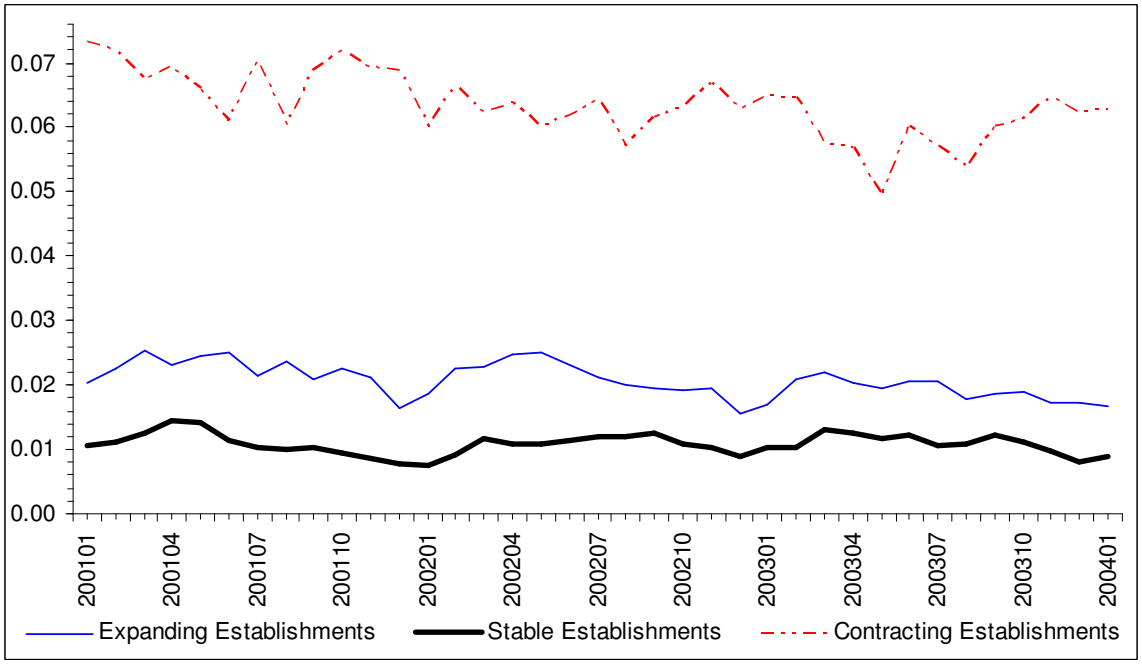
Source: Author's estimation of establishment vacancy rates on a fourth order polynomial of the state unemployment rate using JOLTS establishment microdata and LAUS unemployment estimates. State and establishment fixed effects are used where noted. See text for details.

Figure 7.
Hiring Rates by Type of Establishment-Level Employment Change



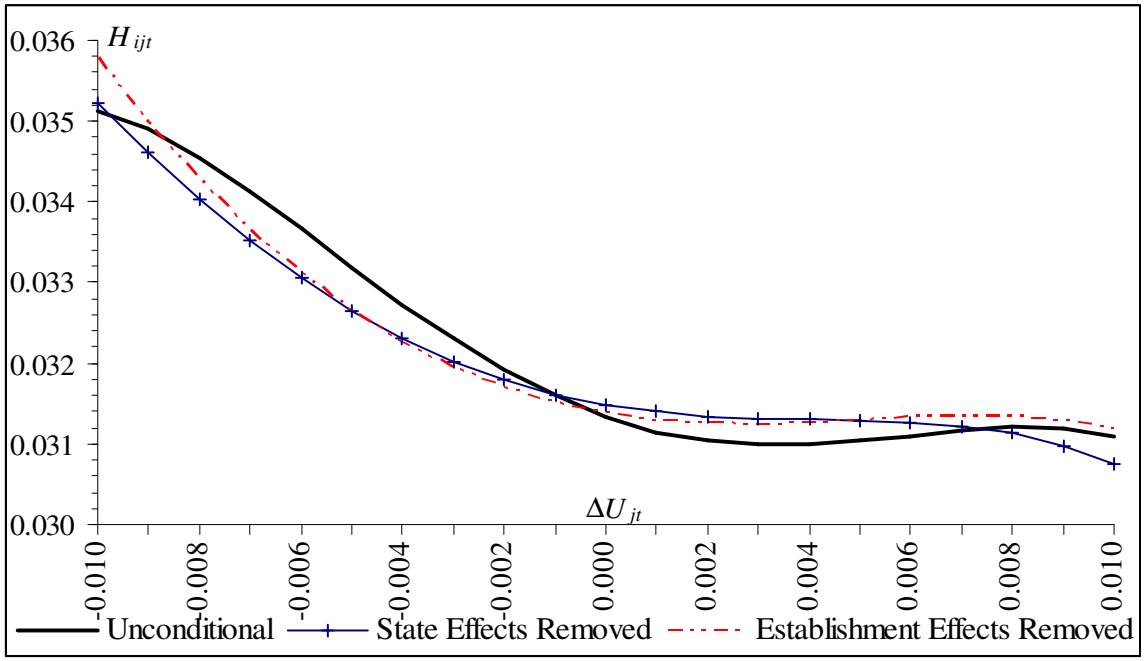
Source: Author's tabulations of JOLTS microdata. Estimates are seasonally adjusted using factors from the aggregate public estimates.

Figure 8.
Separation Rates by Type of Establishment-Level Employment Change



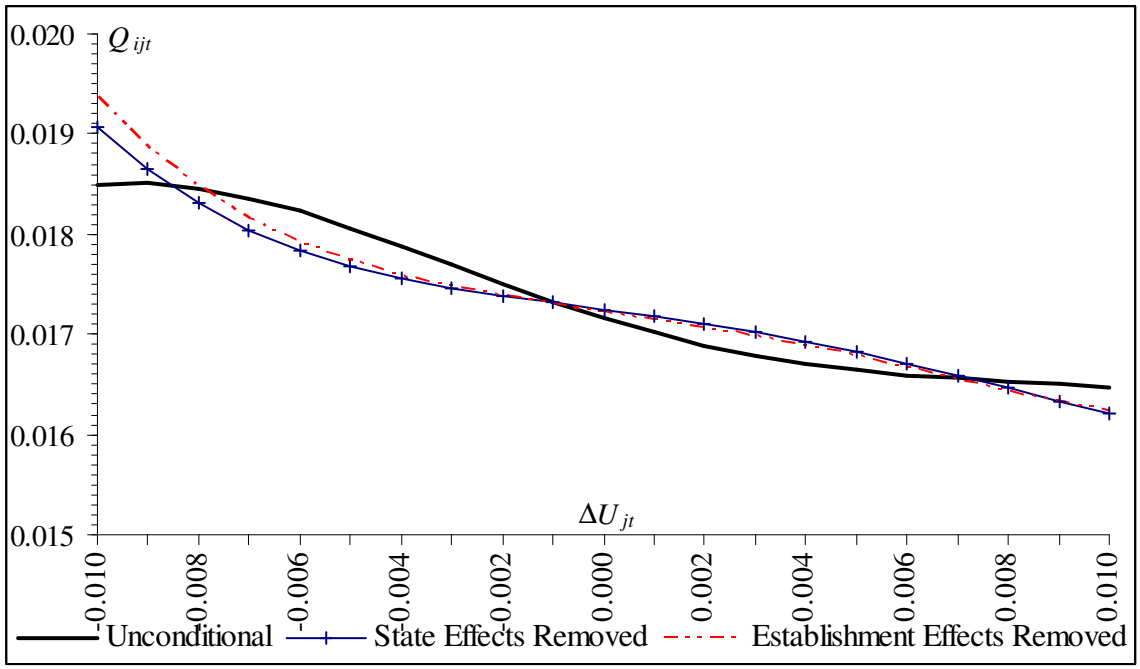
Source: Author's tabulations of JOLTS microdata. Estimates are seasonally adjusted using factors from the aggregate public estimates.

Figure 9.
Establishment Hirings and Their Relation to Changes in Local Unemployment



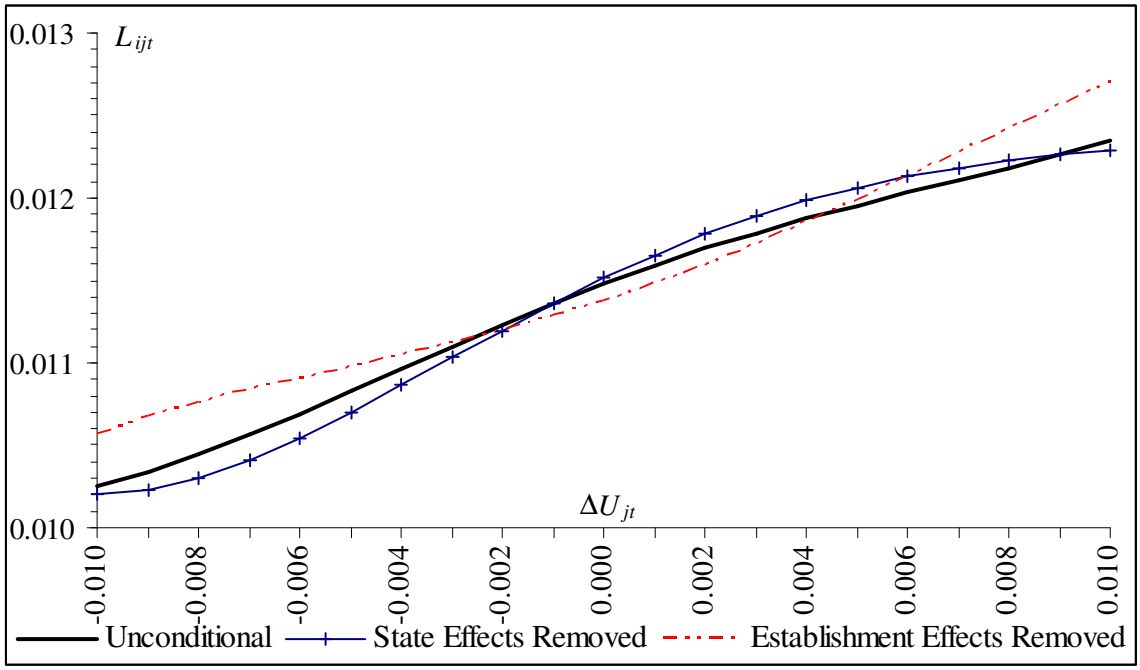
Source: Author's estimation of establishment vacancy rates on a fourth order polynomial of the state unemployment rate using JOLTS establishment microdata and LAUS unemployment estimates. State and establishment fixed effects are used where noted. See text for details.

Figure 10.
Establishment Quits and Their Relation to Changes in Local Unemployment



Source: Author's estimation of establishment vacancy rates on a fourth order polynomial of the state unemployment rate using JOLTS establishment microdata and LAUS unemployment estimates. State and establishment fixed effects are used where noted. See text for details.

Figure 11.
Establishment Layoffs and Their Relation to Changes in Local Unemployment



Source: Author's estimation of establishment vacancy rates on a fourth order polynomial of the state unemployment rate using JOLTS establishment microdata and LAUS unemployment estimates. State and establishment fixed effects are used where noted. See text for details.

Table 1.
Vacancy and Worker Flow Aggregate Summary Statistics

	Vacancies (V_t)	*Hires* (H_t)	*Separations* (S_t)	*Quits* (Q_t)
Mean	0.024	0.033	0.032	0.032
(Standard Deviation)	(0.003)	(0.002)	(0.002)	(0.002)
Correlation with...				
Unemployment (U_t)	-0.97*	-0.84*	-0.77*	-0.94*
Net Growth (N_t)	0.22	0.44*	-0.35*	-0.01
Vacancies (V_t)	1.00	0.87*	0.72*	0.92*
Hires (H_t)		1.00	0.68*	0.85*

Source: Author's calculations based on public JOLTS and CPS aggregate data (seasonally adjusted). Net growth rates are the difference between the hires and separations rates. Statistics are based on data from December 2000 through October 2004. Asterisks (*) denote significance at the 5 percent level.

Table 2.
Vacancy and Worker Flow Summary Statistics by Industry and Region

	Vacancies (V_j)	*Hires* (H_j)	*Separations* (S_j)
Major Industry			
Resources	0.010	0.030	0.031
	(0.003)	(0.009)	(0.007)
Construction	0.014	0.055	0.057
	(0.004)	(0.013)	(0.007)
Manufacturing	0.014	0.022	0.027
	(0.003)	(0.003)	(0.003)
Trade, Transportation, Utilities	0.017	0.035	0.036
	(0.003)	(0.006)	(0.005)
Information	0.019	0.020	0.023
	(0.005)	(0.004)	(0.005)
Financial Activities	0.020	0.022	0.021
	(0.002)	(0.004)	(0.003)
Prof. & Business Services	0.028	0.040	0.036
	(0.005)	(0.005)	(0.006)
Education & Health	0.035	0.027	0.024
	(0.005)	(0.005)	(0.004)
Leisure & Hospitality	0.029	0.063	0.060
	(0.007)	(0.004)	(0.011)
Other Services	0.019	0.030	0.031
	(0.004)	(0.007)	(0.009)
Government	0.018	0.015	0.012
	(0.003)	(0.005)	(0.004)
Region			
Northeast	0.020	0.032	0.031
	(0.004)	(0.007)	(0.005)
Midwest	0.021	0.027	0.027
	(0.004)	(0.006)	(0.005)
South	0.023	0.034	0.033
	(0.003)	(0.005)	(0.004)
West	0.023	0.033	0.032
	(0.004)	(0.004)	(0.003)
Across-Industry Correlations with...			
Net Growth (N_j)	0.75*	0.23	0.02
Vacancies (V_j)	1.00	0.20	0.05
Hires (H_j)		1.00	1.00

Source: Author's tabulations from JOLTS data. Net growth rates are the difference between the hires and separations rates. Means are reported, with standard deviations in parentheses. Statistics are based on data from December 2000 through January 2004. Asterisks (*) denote significance at the 5 percent level.

Table 3.
Local Unemployment and Establishment Vacancy Summary Statistics

	Unemployment (U_{jt})	*All Vacancies* (V_{ijt})	*Positive Vacancies* ($V_{ijt} > 0$)
Mean	0.055	0.021	0.041
Standard Deviation	0.011	0.039	0.046
Median	0.055	0.003	0.027
10^{th}, 90^{th} Percentiles	0.041, 0.069	0.000, 0.063	0.005, 0.090
Number of Observations	1,887	282,260	129,089
Share of Employment [Estabs.] with $V_{ijt} > 0$	NA	0.525 [0.119]	NA
Share of Empl. [Estabs.] with $V_{ijt} > 0 \mid Net \neq 0$	NA	0.679 [0.338]	NA
Percent of Variation Explained by...			
Month Effects	33.9	0.5	0.7
State Effects	51.9	0.7	1.0
Establishment Effects	NA	41.9	66.7

Source: Author's tabulations from pooled JOLTS microdata (vacancies) and pooled LAUS state data (unemployment). Estimates are based on data from December 2000 through January 2004. Estimates (except the share of establishments with positive vacancies) are weighted by employment.

Table 4.
Establishment Worker Flow Variation and Local Labor Market Conditions

	Hiring Rate (H_{ijt})	*Quits Rate* (Q_{ijt})	*Layoffs Rate* (L_{ijt})
Pooled Correlation with…			
Net Growth Rate (N_{jt})	0.023	0.007	-0.009
Unemployment (U_{jt})	-0.023	-0.036	0.004
Unemployment Change (ΔU_{jt})	-0.013	-0.012	0.009
Percent of Variation Explained by…			
Establishment Effects	28.5	30.0	21.4
State × Month Effects	1.8	2.2	1.1
State Correlations			
$\rho(U_{jt}, N_{jt}) =$ -0.123		$\rho(U_{jt-1}, \Delta U_{jt}) =$ -0.261	

Source: Author's tabulations from pooled JOLTS microdata (worker flows), pooled LAUS state data (unemployment), and pooled CES state data (net growth). Estimates are based on data from December 2000 through January 2004. All estimates are weighted by employment. All correlations are significant at the 5 percent level or higher. The variations explained are from the regression of each worker flow estimate on either 14,573 establishment effects or 1,887 state × month effects.