The Effect of Quits on Worker Recruitment: Theory and Evidence*

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Abstract

Recruitment effort by a firm can signify one of two things: a desire to expand or a need to replace workers who have quit profitable positions. Standard matching models with on-the-job search treat these two recruitment activities as the same. Yet, we provide empirical evidence that suggests these two activities differ in the sense that, all else equal, an establishment is much more likely to post a vacancy and hire a worker if a worker has quit a position at the firm. Our evidence is robust to a variety of controls, including establishment fixed effects. One natural explanation for this is that workers who quit leave behind firm-specific physical and organizational capital, thereby making replacement hiring less costly than the creation of a new position. To this end, we develop a matching model with on-the-job search and multi-worker firms that differentiates between the cost of creating a new position and the cost of adverting for an existing opening. The model naturally creates a distinction between worker and job flows and, through endogenously-determined thresholds for separations, worker replacement and position creation, produces rich firm-level employment dynamics that are broadly consistent with our empirical evidence.

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1 Introduction

Workers often quit their jobs to take a better offer. There is now evidence (e.g., Topel and Ward (1992)) that job-to-job transitions are an important part of wage gains over an individual's life cycle. There is also evidence (Fallick and Fleischman (2004), Nagypál (2005b)) that these job-to-job transitions are an important part of aggregate employment dynamics. To date, however, the literature has little to say about the job that a quitting worker leaves behind. In this paper, we aim to fill this gap.

In standard matching models with on-the-job search (e.g., Pissarides (1994), Mortensen (1994), or, more recently, Nagypál (2005a)), there is no distinction made between a vacancy that is created due to a worker quit and one that is newly created. If existing positions entail some firm-specific organizational or physical capital that a quitting worker leaves behind, however, then the decision to replace a quitting worker is different from that to create a new position. Given the capital of the remaining position, one would expect that the firm would be more likely to recruit following a quit, considering that the cost is relatively cheaper. In this paper, we explore whether this holds both empirically and theoretically.

The relationship between quits and recruitment is, of course, confounded by the fact that quit decisions, like hiring decisions, are endogenous events, influenced by the business climate of the firm. Firms with grim prospects are more likely to experience a quit, less likely to replace those quits and may even lay off additional workers. Firms with bright prospects generally experience fewer quits, are more likely to replace those who do quit, and may even hire additional workers.

We start by examining the impact of quits on worker recruiting behavior at the micro level. In doing so, we appeal to the Job Openings and Labor Turnover Survey (JOLTS) recently developed by the Bureau of Labor Statistics (BLS). The data are ideal for our purposes because they are a survey of establishments that directly report vacancies, hires and most importantly, separations identified as either quits, layoffs, or other separations. We find evidence that quits may in fact lead to considerable recruitment and hiring. First, quits comprise the majority (54 percent) of separations. Second, establishments with a quit account for a disproportionate share of subsequent hires and vacancies. They make up 58 percent of employment, but account for 66 percent of all hires and 74 percent of all vacancies. Third, we replicate previous research (Faberman (2005); Davis, Faberman, and Haltiwanger (2006a)) in finding a negative relation between quits and establishment-level employment growth and a positive relation between hires and growth. Nevertheless, we find direct, *positive* relationships between the incidence of a quit and subsequent hiring and vacancy posting. These relationships hold after differentiating between expanding, contracting, and stable establishments and after controlling for both growth and establishment-specific effects.

We next formalize our notion of a quit replacement decision within a labor-market search and matching framework. We build upon the standard model of Mortensen and Pissarides (1994)) and allow for on-the job search as in Nagypál (2006). On-the job search, along with the existence of multi-worker firms, are two key features of our model. The key innovation of the model is its differentiation between the cost of advertising a vacancy and the cost of creating a new position. This feature allows us to distinguish between a hire to replace a quit and a hire for a new position. In the model, unemployed workers randomly contact open positions created by firms whose idiosyncratic productivity, ε, changes over time. An adverse shock to firm productivity can result in an endogenously-determined separation of workers from the firm, if ε falls below some threshold. A favorable shock can result in firm expansion, which requires the costly creation of new positions and the recruitment of new workers. Within this framework, employed workers randomly make contact with open positions at other firms. If a new offer dominates the worker's current job, the worker quits and takes the new job, leaving the original employer with a decision to either replace the worker (incurring only the cost of advertising the vacancy) or contract its employment (and losing the sunk cost incurred when the position was created). The model predicts a rich pattern of job creation and job destruction wherein a firm makes its quit replacement decision. In particular, the firm will chose to repost a vacancy to replace a quit only if its productivity is above some endogenously-determined threshold, $\hat{\varepsilon}$. Otherwise, the job is destroyed and the firm contracts. This process of on-the-job search and replacement is closely related to the concept of vacancy chains described by Akerlof, Rose, and Yellen (1988). In addition, firms whose productivity is above an endogenously-determined third threshold, $\breve{\varepsilon} \geq \hat{\varepsilon}$, open vacancies for new positions in addition to replacing quitting workers.

These dynamics identify a continuum of decision rules as a function of ε, where firms go from choosing to contract through layoffs, to choosing to contract through attrition, to remaining stable by replacing their turnover, to expanding through job creation. Through this continuum, the model implies that new vacancy openings increase with firm productivity, quits and layoffs decline with firm productivity, and the probability that a worker accepts a new job offer increases with the productivity of that job, all of which are consistent with our empirical evidence.

After documenting the many qualitative predictions of the model using numerical examples, we test the predictions of the model using a Simulated Method of Moments approach to match the model-generated moments to key features of the data. We simulate our model on a weekly basis and aggregate the simulated data to monthly observations, thereby addressing the issue of time aggregation that is so prevalent in the fast-moving U.S. labor market even with monthly observations.

2 Evidence on worker replacement and recruitment

2.1 Data

For our empirical analysis, we use microdata from the Job Openings and Labor Turnover Survey (JOLTS), produced by the BLS. The JOLTS data are a sample of roughly 16,000 establishments. Respondents belong to either a certainty sample or a rotating sample. Those in the latter group are sampled randomly and rotate out after 18 months. The data include monthly observations on the establishments' employment, hires, separations, and vacancies (job openings). The data are ideal for our purposes because they break out separations into quits, layoffs and discharges, and other separations (e.g., retirements), are reported directly by establishments, and are representative of the U.S. economy. We use data pooled over the December 2000 to January 2005 period and restrict our sample to establishments with observations in at least two consecutive months to avoid issues with establishment entry and exit. Our final sample contains about 372,000 establishment-month observations.

Even with all of its advantages, using the JOLTS data still leaves us with several empirical challenges to address. The first is endogeneity. Theoretically, worker turnover and recruitment are jointly determined by the prospects an establishment faces. Our theoretical model allows us to explicitly address this issue. For the empirical analysis, we use the growth rate of the firm as a proxy to differentiate establishments with different prospects. We define this growth rate using the symmetric growth measure of Davis, Haltiwanger, and Schuh (1996) as defined using the JOLTS data by Davis, Faberman, and Haltiwanger (2006a). Growth at establishment i in month t, g_{it}, is

$$g_{it} = \frac{H_{it} - S_{it}}{\frac{1}{2}\left(N_{it} + \tilde{N}_{i,t-1}\right)}, \tag{1}$$

where H_{it} is the number of hires, S_{it} is the number of separations, N_{it} is employment and $\tilde{N}_{i,t-1} = N_{it} - H_{it} + S_{it}$. (We use the revised measure of employment in $t-1$ based on the JOLTS timing differences described in Faberman (2005)). Thus, an establishment's growth rate is its net employment change divided by the average of the current and previous months' employment. We measure hiring, quit, layoff, and vacancy rates using the same denominator.

Our next challenge is observability. Ideally, we would like information relating hires and vacancies to quits at the position-level, but our data are at the establishment level. Our model and its estimation again can explicitly account for this. In our empirical analysis, the best we can do is to analyze the establishment-level data with particular attention paid to the frequency and timing of quits, vacancies and hires. This leads us to our next challenge: timing. JOLTS measures hires and separations as flows over the month, and vacancies as a stock at the end of the month. This difference is important to note for our study, since it means that vacancies opened during the month may not appear in our sample, resulting in a time aggregation problem we need to address in the simulation of our structural model.[1]

[1]Burdett and Cunningham (1998) report that, in the 1982 Employment Opportunity Pilot Project, 44 percent of vacancies ended within 7 days and 72 percent of vacancies ended within two weeks.

It also gives us guidance on the appropriate sequencing of quits, vacancies, and hires for our analysis. Namely, if a worker quits in month t, we expect to be most likely to observe a vacancy at the end of month t and then a hire during month $t + 1$. This, of course, assumes that the vacancy was not posted and filled the same month the quit occurred. Below, we focus our analysis on the sequencing as described, but also present results relating contemporaneous quits and hires.

Our final challenges relate to the size and fixed characteristics of establishments. Smaller establishments tend to have lumpy employment changes. Their growth rates are often zero, and, conditional on being nonzero, they tend to be relatively large in absolute value by construction. In addition, some establishments tend to be high-turnover establishments (perhaps because of their industry, demand structure, labor-force composition, etc.) and others do not. Consequently, we report our main results by establishment size class and industry, and, where appropriate, we control for the presence of establishment fixed effects. With these caveats in mind, we proceed to the empirical analysis.

2.2 Quits, recruitment, and establishment growth

Quits comprise a large fraction of worker turnover, accounting for 54 percent of all separations in the JOLTS data. An important part of understanding the effect of quits on recruitment behavior is understanding how they relate to establishment growth. In relating theory to the evidence, one can think of employment growth (particularly the high-frequency changes we observe in our data) as being determined by idiosyncratic shocks to firm profitability (i.e., productivity or demand), a relationship we make explicit in our structural model. Moreover, matching models with on-the-job search, such as the one we present below, imply that the likelihood that a worker quits decreases with a firm's profitability, since the probability of receiving a more attractive outside offer decreases as the fortune of the current employer improves. At the same time, adverse shocks to profitability increase the likelihood of a layoff and decrease the payoff from opening new vacancies. Thus, the theory suggests rather complex relationships between, worker flows, vacancies, and establishment growth that are intermingled with the quit-recruitment relationship.

Davis, Faberman, and Haltiwanger (2006a) and Davis, Faberman, and Haltiwanger (2006b) illustrate that these relationships are indeed quite complicated. We replicate their findings in Figures 1 through 3 using our pooled establishment-month observations.[2] Figure 1 shows the quit and layoff rates as functions of the (contemporaneous) establishment employment growth rate. The figure shows that both quits and layoffs increase with the size of an employment contraction, are low and essentially constant in expanding establishments, and are lowest for establishments with very little or no employment change. Among stable and expanding establishments, quits outpace layoffs, while among contracting establishments, layoffs increase sharply and almost linearly with the size of a contraction. Quits, however, increase rapidly with smaller contractions, but then level off at around 10 percent of employment. Thus, quits are relatively more important than layoffs for small contractions, but layoffs account for an increasing share of separations as contractions get larger. When interpreting these figures, note that over 90 percent of employment is at establishments with absolute growth rates less than 10 percent. Figure 2 depicts hiring and vacancy rates as

[2]Davis et al. estimate these relationships by calculating the weighted mean values of the noted variables for fine growth rate intervals using the same JOLTS sample as our own. In a semi-parametric estimation, they show these results are robust to the inclusion of establishment fixed effects.

functions of the establishment employment growth rate for the same month. The figure illustrates a small, but positive amount of hiring among shrinking establishments. Stable establishments have the lowest hiring rate, while the hiring rate increases almost linearly with establishment growth rate for expanding establishments (in some sense, the latter has to occur by construction). Figure 2 also illustrates that vacancy rates also increase with the establishment growth rate, but do so less rapidly than hires. Finally, Figure 3 shows that the vacancy yield (the number of hires in month t per vacancies open at the end of month $t-1$) as a function of the establishment employment growth rate in month t. Due to the timing difference, this is not simply a ratio of the two lines in Figure 2. Nonetheless, the vacancy yield is rapidly increasing with the establishment growth rate, particularly among expanding establishments.

2.3 The micro behavior of recruitment and quits

As explained earlier, we are most interested in how the incidence of a quit relates to subsequent establishment recruiting behavior. Consequently, we relate quits in one month to vacancies posted at the end of the same month and hires in the subsequent month. Given the timing and observability issues discussed above, this provides an imperfect measure of the response to a quit. We attempt to address this in our regression analysis below. For now, the results we present here give an informative (and, as it turns out, robust) first glance at the issue at hand.

We report basic summary statistics in Table 1. The table shows worker turnover and vacancy rates for the full sample and the sample broken down by whether a quit occurred in the previous month. Quits account for 1.7 percent of all employment, and 3.0 percent of employment among establishments with at least one quit. Layoffs and discharges, the other major type of worker separation, make up 1.1 percent of all employment, with a slightly higher rate (1.3 percent) at establishments without a quit. Hires make up 3.2 percent of employment, with a notably higher rate at establishments with a quit in the previous month (3.6 versus 2.7 percent). The average vacancy rate is 2.2 percent, with a large disparity between establishments who did and did not have a prior quit. Those with no quits have an average vacancy rate of 1.2 percent, while those with at least one quit have an average vacancy rate of 2.8 percent, more than double the previous rate. Thus, hiring and vacancy posting occur at considerably higher rates at establishments with at least one prior quit. The bottom half of Table 1 shows that only 14 percent of all establishments have at least one quit in a month, but these establishments make up nearly 58 percent of employment, implying that most quits occur at larger establishments. These establishments also make up 64 percent of hires and 74 percent of vacancies, implying that the incidence of a quit leads to a disproportionate occurrence of vacancies and hiring.

Table 2 illustrates the probabilities of having a vacancy and a hire by the prior incidence of a quit. We report results for all establishments, by industry and by establishment size. Given our earlier discussion of establishment size and turnover issues, we have to address the facts that establishments will have fixed characteristics (such as their industry) that affect their rates of turnover and recruitment and that the probability of experiencing at least one quit is strongly influenced by establishment size. For all establishments, our evidence suggests that the incidence of a quit substantially increases the probability of a subsequent vacancy or hire. The likelihood of each increases on the order of 50 percentage points. Across industries, there is considerable variation in these probabilities. For example industries such as Retail and Construction, industries that Davis, Faberman, and Haltiwanger (2006b) show most likely use less-formal hiring practices, have lower probabilities of vacancies and hires given a prior quit. Nevertheless, the qualitative result that establishments with a quit are more likely to post a vacancy or have a hire still holds across *all* industries. This is also true across establishment size classes, where the probabilities of having a vacancy or a hire increase with size, but it remains the case that these probabilities are always higher when there was a preceding quit.

Figure 4 depicts the establishment-level hiring rate (upper panel) and vacancy rate (lower panel) as functions of the previous month's quit rate.[3] We disaggregate the relations by expanding, contracting and stable establishments to crudely account for the endogeneity issue discussed above. Both hiring and vacancy rates increase with the quit rate. Both relationships, especially for vacancies, exhibit concavity. Among vacancies, the greatest increase occurs between quit rates of 0.1 and 1.2 percent. Figure 4 also shows that the distinction by growth rate only has a quantitative impact on the relationships of hiring and vacancies to the prior months quit rate. In all cases, the relationships have qualitatively similar increases with quits. As expected, expanding establishments have the highest hiring and vacancy rates. The increase for hires is not tautological, since quits are for the prior month. Note that there is a spike in the hiring and vacancy rates for establishments with no quits that drops then increases gradually for positive quit rates. Hiring and vacancy rates are lower for contracting and stable establishments, but still increase with the quit rate.

[3]We estimate these rates as means calculated within fine quit rate intervals that increase with the quit rate. We use the variable interval length because of large drop-off in the number of observations as the quit rate increases.

2.4 Regression analysis

Thus far, despite measurement challenges related to timing, observability, endogeneity, and establishment characteristics, our evidence has consistently suggested a positive relation between the incidence of a quit and subsequent vacancies and hiring. This relation occurs despite the fact that quit rates decline with establishment growth and vacancy and hiring rates increase with establishment growth. For our final analysis, we study the quit-recruitment relation within a regression framework, where we can control for the effects of establishment characteristics and growth.

Table 3 lists the regression results of hires (both in the subsequent and current months) and vacancies on the quit rate, controlling for various characteristics. For each dependent variable we run (1) the unconditional OLS regression of the variable on the quit rate, (2), the same regression controlling for establishment fixed effects, (3) the regression controlling for establishment fixed effects and the employment growth rate, and (4) the regression controlling for establishment fixed effects and the growth rate differentiated into positive and negative changes. For the regressions of contemporaneous hires on the quit rate, we face an endogeneity issue when we include the growth rate in the latter two specifications. To account for this, we use an instrumental variables approach using the prior months growth rate as the instrument.

To summarize, Table 3 shows that the positive relations of leading hires, contemporaneous hires, and vacancies to quits are robust to controlling for establishment fixed effects and establishment growth. Contemporaneous hires actually have a stronger relation to the quit rate than hires in the subsequent month. Of course, contemporaneous hires could occur before a quit, confounding the relation we wish to identify. Nevertheless, even when controlling for and instrumenting for the growth rate, the relationship between these hires and the quit rate still holds.

Finally, we replicate the regressions in columns (1), (2), and (3) substituting the continuous quit rate variable with dummy variables for fine quit rate intervals.[4] We then plot the quit coefficients graphically (with the means added back for the specifications including fixed effects and/or growth). We again use an IV estimate when including the growth rate in the regression of contemporaneous hires. Our results are in Figure 5. Note that the unconditional regression specifications (column (1) in Table 3) produce estimates identical to those in Figure 4 when hiring and vacancy rates are not differentiated by type of establishment growth. Consequently, we observe the same increasing relationships of hiring and vacancies to quits that we saw in the previous figure. What is important to note, however, is that when we control for establishment fixed effects and establishment growth, the slope of the relationships become flatter (particularly for leading hires), but the positive relations remain in all cases.

To summarize our empirical analysis, we find that establishments with a quit account for a disproportionately large fraction of subsequent vacancies and hiring. Furthermore, across a broad set of metrics, we find a positive relationship between the incidence of a quit and subsequent vacancies and hiring. This relation holds up even after controlling for endogeneity issues related to establishment growth, timing and observability issues that come from studying establishment rather than position-specific data, and fixed establishment characteristics, including industry and size. Thus, it is likely that quits generate a considerable amount

[4]These intervals are identical to those used to generate the relations observed in Figure 4.

of vacancies and hires and that this process accounts for a large fraction of high-frequency labor-market dynamics.

3 Model

We next seek to characterize the above findings within a theoretical framework. To do so, we consider a matching model with search frictions and endogenous separations, in the spirit of Mortensen and Pissarides (1994). We also allow for on-the-job search, as in Nagypál (2006). Our main innovation, and the features that allow us to identify dynamics related to quits, are the introduction of multi-worker firms and recruiting costs differentiated between a sunk job creation cost and a flow cost of advertising a position.

3.1 Model setup

Consider an economy populated by workers and firms who are both risk-neutral and discount future incomes at a rate r. There is a unit measure of workers. Workers have a flow utility of b while unemployed. There is a measure α of firms who each employ one or more workers. A firm's idiosyncratic productivity is ε, which is distributed according to $F(\varepsilon) : [0, \bar{\varepsilon}] \rightarrow [0, 1]$. At rate γ_ε, each firm draws a new productivity realization from the distribution $F(\cdot)$.

The output of a particular position at a firm with productivity ε is $\varepsilon\nu$, where ν is an indicator variable that determines whether or not the position is productive. All positions are initially productive when created. Subsequently, a new value of the position-specific ν is drawn at rate γ_ν, where ν takes on the value of 0 with probability $\frac{\delta(\varepsilon)}{\gamma_\nu}$ and the value of 1 with probability $1 - \frac{\delta(\varepsilon)}{\gamma_\nu}$, where $\delta(\varepsilon)$ is a decreasing function. Once a position becomes unproductive (because $\nu = 0$), it remains so forever. In addition, workers leave the firm for exogenous reasons at a rate δ_0.

Firms hire workers by either creating or having positions come available then posting vacancies to fill those positions. Vacancies at a firm are filled independently of one another. The upfront cost of creating v positions is equal to $C(v)$, where $C(\cdot)$ is a strictly increasing and strictly convex function with $C(0) = 0$ and $C'(0) \geq 0$. The flow cost of keeping a vacant position open is c. If a vacant position closed without being filled, the position ceases to exist. If a worker quits the firm or leaves for exogenous reasons, the firm can repost the vacated position at flow cost c. In this case, the firm incurs no fixed cost of position creation, making it less costly to recruit for an existing position than for a newly created position, a crucial feature of the model. If a firm does not search to replace a departing worker at the time of the worker's departure, the position ceases to exist. In addition, the firm can terminate workers and positions at any time.

Workers can search while unemployed and employed. Given that jobs at different firms differ in their productivity, workers have an incentive to search on-the-job. To keep the model simple, the search intensity of employed workers is fixed at $s \in (0, 1]$, while that of unemployed workers is normalized at 1.

Wages in the model are determined by surplus sharing. The outside option of the firm is the reposting of the vacant position while the outside option of the worker is unemployment. Notice that once a match is created, there is no interaction between the workers in a firm. Hence, the surplus of a match is independent of the number of workers a firm employs. In other words, the concept of a firm embedded in the model is that of a multi-worker entity experiencing a common productivity process.

Contacts between vacancies and searching workers is generated by a matching function with the standard properties, implying that workers contact a firm at rate $\lambda(\theta)$ per unit of search effort, and firms contact workers at rate $\eta(\theta)$, where $\theta = \frac{v}{u+s(1-u)}$ defines labor market tightness in the model.

3.2 Characterization of the stationary equilibrium

Let us next introduce some notation. Let the rate at which workers quit to take another job be $\mu(\varepsilon)$. Let the probability that a firm of type ε succeeds in filling a vacant position upon contacting a worker be $\xi(\varepsilon)$. Let the unnormalized distribution of firm productivity across vacancies be $H(\varepsilon)$, so that $H(\bar{\varepsilon}) = v$. Then, denote the normalized distribution of productivity across vacancies by $\hat{H}(\varepsilon) = \frac{H(\varepsilon)}{v}$. Finally, let the unnormalized distribution of productivity across filled positions be $K(\varepsilon)$, so that $K(\bar{\varepsilon}) = 1 - u$.

Next, we derive the Bellman equations characterizing the value of employment and unemployment for workers and the value of a filled and unfilled position for a firm. Notice that due to the linearity of the production function and the fact that the positions of a firm are filled independently of one another, the only state variable that affects the value of a position, and thereby wages, is firm productivity.

The value of a productive job for a worker is

$$\begin{aligned} rW(\varepsilon) = {} & w(\varepsilon) + s\lambda(\theta) \int I\left(W(\varepsilon') > W(\varepsilon)\right)\left(W(\varepsilon') - W(\varepsilon)\right) d\hat{H}(\varepsilon') + \\ + \quad & \gamma_\varepsilon \int \left[\max\left[W(\varepsilon') - U, 0\right] + U - W(\varepsilon)\right] dF(\varepsilon') - \left(\delta(\varepsilon) + \delta_0\right)\left(W(\varepsilon) - U\right), \end{aligned} \tag{2}$$

where U is the value of unemployment for the worker. The first term is the flow wage received by the worker. The second term reflects the gain due to a quit, which takes place if the job offer the worker encounters has a higher value to the worker than its current job. The third term reflects the change in value associated with a new draw of firm productivity. The last term reflects the loss of value associated with the job becoming unproductive or the worker leaving the firm for exogenous reasons. The value of unemployment can be expressed as

$$rU = b + \lambda(\theta) \int \max\left[W(\varepsilon') - U, 0\right] d\hat{H}(\varepsilon'), \tag{3}$$

where the first term is the flow payoff received by an unemployed worker and the second term reflects the gain from meeting a vacant position.

Similarly, the value of a filled position at a firm with productivity ε is

$$\begin{aligned} rJ(\varepsilon) &= \varepsilon - w(\varepsilon) - s\lambda(\theta) \int I\left(W(\varepsilon') > W(\varepsilon)\right)\left(J(\varepsilon) - R(\varepsilon)\right) d\hat{H}(\varepsilon') + \\ &+ \gamma_\varepsilon \int \left[\max\left[J(\varepsilon') - R(\varepsilon'), 0\right] + R(\varepsilon') - J(\varepsilon)\right] dF(\varepsilon') - \delta(\varepsilon) J(\varepsilon) - \delta_0 \left(J(\varepsilon) - R(\varepsilon)\right), \end{aligned} \tag{4}$$

where $R(\varepsilon)$ is the expected value of having a vacant position. Here, the second term reflects the loss of value associated with a worker quit, which occurs as described above. The value of a vacant position is determined by

$$rR(\varepsilon) = \max\left[0, -c + \eta(\theta)\xi(\varepsilon)\left(J(\varepsilon) - R(\varepsilon)\right) + \gamma_\varepsilon \int \left[R(\varepsilon') - R(\varepsilon)\right] dF(\varepsilon') - \delta(\varepsilon) R(\varepsilon)\right]. \tag{5}$$

To ensure that it is never optimal for a firm to keep a vacant position open while that position cannot be profitably operated at current productivity, we make the following assumption:

Assumption 1. *The cost of vacancy posting is large enough so that* $\gamma_\varepsilon \int R(\varepsilon') dF(\varepsilon') \leq c$.

To eliminate wages from the above expressions, let us define total match surplus as $S(\varepsilon) = J(\varepsilon) + W(\varepsilon) - R(\varepsilon) - U$. Given surplus sharing, with the worker's share denoted as β, worker surplus will be $W(\varepsilon) - U = \beta S(\varepsilon)$ and firm surplus will be $J(\varepsilon) - R(\varepsilon) = (1-\beta) S(\varepsilon)$. Summing Equations (2) and (4), and using that $I(W(\varepsilon') > W(\varepsilon)) = I(S(\varepsilon') > S(\varepsilon))$ we get that

$$
\begin{aligned}
r(S(\varepsilon) + R(\varepsilon) + U) &= \varepsilon + s\lambda(\theta) \int I(S(\varepsilon') > S(\varepsilon)) (\beta S(\varepsilon') - S(\varepsilon)) \, d\hat{H}(\varepsilon') + \\
&+ \gamma_\varepsilon \int [\max[S(\varepsilon'), 0] + R(\varepsilon') - R(\varepsilon) - S(\varepsilon)] \, dF(\varepsilon') - \delta(\varepsilon)[S(\varepsilon) + R(\varepsilon)] - \delta_0 S(\varepsilon).
\end{aligned}
\tag{6}
$$

Using the definition of the surplus function, we can rewrite the asset equation for the value of a vacant position as

$$
(r + \gamma_\varepsilon + \delta(\varepsilon)) R(\varepsilon) = \max\left[0, -c + \eta(\theta)\xi(\varepsilon)(1-\beta)S(\varepsilon) + \gamma_\varepsilon \int R(\varepsilon') dF(\varepsilon')\right]. \tag{7}
$$

Clearly, the functional equations for $S(\cdot)$ and $R(\cdot)$ jointly define a contraction which maps increasing functions into increasing functions, hence the Contraction Mapping Theorem implies that $S(\cdot)$ and $R(\cdot)$ are increasing, hence $W(\cdot)$ is also increasing.

Given monotonicity, workers will accept all jobs that have a firm productivity higher than that of their current firm. Thus,

$$
\mu(\varepsilon) = s\lambda(\theta)\left(1 - \hat{H}(\varepsilon)\right), \tag{8}
$$

and

$$\xi(\varepsilon) = \frac{u + s(1-u)\frac{K(\varepsilon)}{K(\bar{\varepsilon})}}{u + s(1-u)} = \frac{u + sK(\varepsilon)}{u + s(1-u)}, \tag{9}$$

while the surplus function can be written as

$$\begin{aligned} rS(\varepsilon) = {} & \varepsilon - rU + s\lambda(\theta)\int_{\varepsilon} \beta S(\varepsilon')d\hat{H}(\varepsilon') - (\mu(\varepsilon) + \delta(\varepsilon) + \delta_0) S(\varepsilon) + \\ + \ & \gamma_{\varepsilon} \int [\max[S(\varepsilon'), 0] + R(\varepsilon') - R(\varepsilon) - S(\varepsilon)]\, dF(\varepsilon') - [r + \delta(\varepsilon)]\, R(\varepsilon). \end{aligned} \tag{10}$$

Let $\tilde{\varepsilon}$ be where $S(\tilde{\varepsilon}) = 0$. Notice that a firm will close all the positions it operates once ε falls below $\tilde{\varepsilon}$. We will maintain that $\tilde{\varepsilon} > 0$, to induce sufficiently unproductive firms to shut down.

Given Assumption 1, $R(\tilde{\varepsilon}) = 0$, and using that $S(\tilde{\varepsilon}) = 0$, we get, after substituting in for the value of unemployment, that $\tilde{\varepsilon}$ is implicitly defined by

$$b = \tilde{\varepsilon} - (1-s)\,\lambda(\theta)\int_{\tilde{\varepsilon}} \beta S(\varepsilon')d\hat{H}(\varepsilon') + \gamma_{\varepsilon}\int [\max[S(\varepsilon'), 0] + R(\varepsilon')]\, dF(\varepsilon'). \tag{11}$$

The difference between b and $\tilde{\varepsilon}$ comes from two sources: the higher option value of search while unemployed (due to higher search intensity while unemployed), reflected by the second term on the right-hand side, and the option value of changing productivity, reflected by the third term on the right-hand side.

Next, let the lowest productivity for which it is worthwhile to repost a vacancy be $\hat{\varepsilon} \geq \tilde{\varepsilon}$. Firms with productivity $\varepsilon \in (\tilde{\varepsilon}, \hat{\varepsilon})$ find it profitable to continue existing relationships, but they do not find it profitable to replace lost workers due to separations into unemployment (at rate $\delta(\varepsilon) + \delta_0$) or due to quits (at rate $\mu(\varepsilon)$). Therefore, while these firms do not shut down, they will contract by attrition. Clearly, $R(\hat{\varepsilon}) = 0$, and for any $\varepsilon > \hat{\varepsilon}$, $R(\varepsilon) > 0$, so $\hat{\varepsilon}$ is implicitly defined by

$$c = \eta(\theta)\xi\left(\hat{\varepsilon}\right)(1-\beta)S\left(\hat{\varepsilon}\right) + \gamma_{\varepsilon}\int R(\varepsilon')dF\left(\varepsilon'\right). \tag{12}$$

Given the upfront cost of creating new positions, a firm with productivity ε opens $v(\varepsilon)$ new positions where

$$C'\left(v(\varepsilon)\right) \geq R(\varepsilon) \tag{13}$$

with complementary slackness $v\left(\varepsilon\right) \geq 0$. Given the assumption that $C'(0) \geq 0$, new positions will be created by firms with productivity above $\check{\varepsilon} \geq \hat{\varepsilon}$, where

$$C'\left(0\right) = R\left(\check{\varepsilon}\right). \tag{14}$$

Moreover, given the properties of $C\left(\cdot\right)$ and $R\left(\cdot\right)$, $v\left(\cdot\right)$ is increasing in ε. Thus, $\check{\varepsilon}$ defines a third productivity threshold. Firms with productivity $\varepsilon \in (\hat{\varepsilon}, \check{\varepsilon})$ find it profitable to replace workers who have left, but do not find it profitable to open new positions because of their upfront cost. Such firms will be either stable (if $\delta(\varepsilon) = 0$) or shrinking over time (if $\delta(\varepsilon) > 0$), since they still face the loss of unproductive positions. Finally, firms with productivity above $\check{\varepsilon}$ not only replace workers who have left, but also create new positions, allowing them to expand.

Finally, one can derive the distribution of productivity across vacancies and jobs in a stationary equilibrium from the appropriate balance equations. In particular, equating the flow into $H(\varepsilon)$ (made up of new vacancies, reposted vacancies, and vacancies that had a change in their productivity) and the flow out of $H(\varepsilon)$ (made up destroyed vacancies, filled vacancies, and vacancies that had a change in their productivity) gives

$$\begin{aligned}\alpha \int_{\hat{\varepsilon}}^{\varepsilon} v(\varepsilon')dF(\varepsilon') + \int_{\hat{\varepsilon}}^{\varepsilon} (\mu(\varepsilon') + \delta_0)\, dK(\varepsilon') \quad &+ \quad \gamma_\varepsilon H(\overline{\varepsilon})\left[F(\varepsilon) - F(\hat{\varepsilon})\right] = \\ &= \quad \int_{\hat{\varepsilon}}^{\varepsilon} \left[\delta(\varepsilon') + \eta(\theta)\xi(\varepsilon')\right] dH(\varepsilon') + \gamma_\varepsilon H(\varepsilon).\end{aligned} \tag{15}$$

Similarly, equating the flow into $K(\varepsilon)$ (made up of filled vacancies, and jobs that had a change in their productivity) and the flow out of $K(\varepsilon)$ (made up destroyed jobs, jobs that become vacant due to a quit or exogenous separation, and jobs that had a change in their productivity) gives

$$\int_{\tilde{\varepsilon}}^{\varepsilon} \eta(\theta)\xi(\varepsilon')dH(\varepsilon') + \gamma_\varepsilon K(\overline{\varepsilon})\left[F(\varepsilon) - F(\tilde{\varepsilon})\right] = \int_{\tilde{\varepsilon}}^{\varepsilon} \left(\delta(\varepsilon') + \mu(\varepsilon') + \delta_0\right) dK(\varepsilon') + \gamma_\varepsilon K(\varepsilon). \tag{16}$$

3.3 Solving for the stationary equilibrium

To solve for the equilibrium objects $S(\varepsilon)$, $R(\varepsilon)$, $H(\varepsilon)$, and $K(\varepsilon)$, it is useful to derive differential equations characterizing these functions together with the appropriate boundary conditions.

Differentiating Equation (7) with respect to ε gives for $\varepsilon \in [\hat{\varepsilon}, \overline{\varepsilon}]$

$$R'(\varepsilon)\left(r + \gamma_\varepsilon + \delta(\varepsilon)\right) + R(\varepsilon)\,\delta'(\varepsilon) = (1-\beta)\eta(\theta)\left[\xi'(\varepsilon)S(\varepsilon) + \xi(\varepsilon)S'(\varepsilon)\right]. \tag{17}$$

Differentiating Equation (10) with respect to ε, using $\mu'(\varepsilon) = -s\lambda(\theta)\hat{h}(\varepsilon)$, then substituting in from Equation (17) for $\varepsilon \in [\hat{\varepsilon}, \overline{\varepsilon}]$ and recognizing that $R(\varepsilon) = 0$ for $\varepsilon \in [\tilde{\varepsilon}, \hat{\varepsilon})$, gives for $\varepsilon \in [\tilde{\varepsilon}, \overline{\varepsilon}]$

$$\begin{aligned}(r + \delta(\varepsilon) + \mu(\varepsilon) &+ \delta_0 + \gamma_\varepsilon + I(\varepsilon \geq \hat{\varepsilon})(1-\beta)\eta(\theta)\xi(\varepsilon))\, S'(\varepsilon) = \\ &= 1 + \left[(1-\beta)\left(s\lambda(\theta)\hat{h}(\varepsilon) - I(\varepsilon \geq \hat{\varepsilon})\,\eta(\theta)\xi'(\varepsilon)\right) - \delta'(\varepsilon)\right] S(\varepsilon)\,.\end{aligned} \tag{18}$$

Differentiating Equation (15) with respect to ε for $\varepsilon \in [\hat{\varepsilon}, \overline{\varepsilon}]$ and differentiating Equation (16) with respect to ε for $\varepsilon \in [\tilde{\varepsilon}, \overline{\varepsilon}]$ and combining these results give for $\varepsilon \in [\tilde{\varepsilon}, \hat{\varepsilon})$

$$k(\varepsilon) = \frac{\gamma_\varepsilon (1-u) f(\varepsilon)}{\delta(\varepsilon) + \mu(\varepsilon) + \delta_0 + \gamma_\varepsilon} \tag{19}$$

and for $\varepsilon \in [\hat{\varepsilon}, \overline{\varepsilon}]$

$$h(\varepsilon) = \frac{\alpha v(\varepsilon) + (\mu(\varepsilon) + \delta_0)\frac{\alpha v(\varepsilon) + \gamma_\varepsilon (v+1-u)}{\delta(\varepsilon)+\gamma_\varepsilon} + \gamma_\varepsilon v}{\delta(\varepsilon) + \eta(\theta)\xi(\varepsilon) + \gamma_\varepsilon + \mu(\varepsilon) + \delta_0} f(\varepsilon) \tag{20}$$

and

$$k(\varepsilon) = \frac{\alpha v(\varepsilon) + \gamma_\varepsilon (v+1-u)}{\delta(\varepsilon) + \gamma_\varepsilon} f(\varepsilon) - h(\varepsilon). \tag{21}$$

Then one can solve for the stationary equilibrium objects $S(\varepsilon)$, $R(\varepsilon)$, $H(\varepsilon)$, $K(\varepsilon)$, $\mu(\varepsilon)$, $\xi(\varepsilon)$, $v(\varepsilon)$, $\tilde{\varepsilon}$, $\hat{\varepsilon}$, $\breve{\varepsilon}$ from Equation (18) together with boundary condition $S(\tilde{\varepsilon}) = 0$, Equation (17) together with boundary condition $R(\hat{\varepsilon}) = 0$, Equation (20) together with boundary condition $H(\hat{\varepsilon}) = 0$, equations (19) and (21) together with boundary condition $K(\tilde{\varepsilon}) = 0$, and equations (8), (9), (13), (11), (12), and (14). These solutions then determine $u = 1 - K(\bar{\varepsilon})$, $v = H(\bar{\varepsilon})$, and $\theta = \frac{v}{u+s(1-u)}$.

4 Model implications

Our model has a rich set of implications that we highlight in our simulated estimation below. Here, we detail the implications qualitatively. First, firms with different productivities have different growth patterns and correspondingly have different relationships between quits and vacancy postings. In particular, we can distinguish four regions of productivity depicted in Figure 6. In Region 1, productivity has fallen below the separation threshold and the firm shuts down, destroying all of its jobs. In Region 2, firms are between the separation threshold and the replacement threshold. Here, they do not post any vacancies, and thereby contract their employment through attrition. In Region 3, firms are between the replacement threshold and the job creation threshold. These firms post vacancies to replace workers who have left, but do not create additional jobs. Finally, firms in Region 4 are above the job creation threshold and therefore have the highest productivity levels and recruit to both replace workers who have left and hire for new positions. Of course, firms move across these regions due to productivity shocks, giving rise to rich employment dynamics.

Figure 7 depicts the key labor variables of the model as a function of ε, with the four regions highlighted. We assume a $\delta(\varepsilon)$ function depicted in panel (a) that turns zero at some intermediate point in Region 3. While this may seem at odds with our empirical evidence, remember that all firms experience exogenous separations at a rate $delta_0$. The second panel shows that the employment growth rate conditional on not experiencing a new realization of firm productivity, $(g(\varepsilon))$, is an increasing function of firm productivity. Growth in Regions 1 and 2 is negative. Region 3 contains both declining and stable firms; the former exist because of the rate $delta(\varepsilon)$ of separations that are lost. Growth is positive in Region 4 since these establishments are expanding because they are not only posting more vacancies, but are more successful in attracting workers conditional on a vacancy. The next panel shows the rate at which new positions are created. This is an increasing function of ε, but only above $\breve{\varepsilon}$, the job creation threshold. The third panel depicts the quit rate, which is a decreasing function of firm productivity. Finally, the probability of filling a vacancy increases with firm productivity for all ε above $\hat{\varepsilon}$. This stems from the fact that firms with higher productivity are able to offer higher wages and therefore increase the chance that an individual accepts their offer.

Putting these results together, we can see that, qualitatively, these results are consistent with the evidence of Davis, Faberman, and Haltiwanger (2006b) that we depicted in Figures 1-3. For large contractions, layoffs dominate quits, though both are relatively large in magnitude. For smaller contractions, quits are relatively more prevalent than layoffs. The model suggests that this stems from firms not wishing to replace lost workers and allowing attrition. Stable establishments have a mix of quits, layoffs, and hiring, albeit at relatively low rates. The model implies these are predominantly the result of hiring to replace lost workers. Expanding establishments have increasing rates of hires, vacancies, and vacancy yield. The model suggests these patterns stem from relatively high levels of firm productivity, which not only induces more position creation, but a higher probability of offers for those positions being accepted.

5 Structural estimation

Given the complexity of the above model, its direct structural estimation is quite cumbersome. To get an idea of how well the model fits the data, we instead take a semi-structural approach. In particular, we use the following predictions of the structural model:

1. The relevant state variable of a firm is $\varepsilon \in [0, \overline{\varepsilon}]$, which determines the productivity of the matches a firm creates. ε is governed by a Poisson process with arrival rate γ_ε and distribution upon arrival of $F(\cdot)$.

2. Below some threshold, $\tilde{\varepsilon}$, the firm shuts down.

3. Above $\tilde{\varepsilon}$, the quit rate is determined by a decreasing function $\mu(\varepsilon)$ that has the property that $\mu(\overline{\varepsilon}) = 0$.

4. The separation rate into unemployment at firms is determined by the decreasing function $\delta(\varepsilon)$.

5. Vacancies meet workers at rate η and the rate at which job matches are accepted by workers upon meeting is given by an increasing positive function $\xi(\varepsilon)$ such that $\xi(\overline{\varepsilon}) = 1$.

6. Firms post no vacancies when $\varepsilon \in [\tilde{\varepsilon}, \hat{\varepsilon}]$, replace quitting workers by posting a vacancy when $\varepsilon \in [\hat{\varepsilon}, \check{\varepsilon}]$ and post new vacancies at a rate determined by the increasing function $v(\varepsilon)$ in addition to replacing quitting workers when $\varepsilon \geq \check{\varepsilon}$, where $v(\check{\varepsilon}) = 0$.

To test these predictions of the model, instead of deriving the policy functions $v(\varepsilon)$, $\mu(\varepsilon)$, $\xi(\varepsilon)$, and $\delta(\varepsilon)$ directly from the structural model given some deep parameters, we posit that they take on quadratic forms that satisfy the following monotonicity requirements and boundary conditions implied by the structural model.

We then estimate the values of the semi-structural parameters, that consist of the structural parameters $\tilde{\varepsilon}$, $\hat{\varepsilon}$, $\breve{\varepsilon}$, γ, η and the parameters of the quadratic functions, using the Simulated Method of Moments. In particular, we simulate turnover data for finite-sized firms using the semi-structural parameters. We then choose the semi-structural parameters so that the moments implied by the simulated data are as close as possible to the moments observed in the actual data according to the appropriate metric. (For a detailed discussion of the SMM procedure, see Gouriéroux and Monfort (1996).)

We restrict our sample to observations with at least 50 and at most 1000 workers. The reason for this is that our model is not able to match the full distribution of establishment size observed in the JOLTS, since it does not satisfy Gibrat's law. For these establishments, there are 41 moments we aim to match. These are

- average establishment size, establishment weighted
- employment share of growing, stable, and shrinking establishments
- average growth rate among growing and shrinking establishments, employment weighted
- average quit rate among growing, stable, and shrinking establishments, employment weighted
- average layoff rate among growing, stable, and shrinking establishments, employment weighted

- average hiring rate among growing, stable, and shrinking establishments, employment weighted
- average vacancy rate among growing, stable, and shrinking establishments, employment weighted
- average vacancy yield among growing, stable, and shrinking establishments, employment weighted
- quit rate among establishments with positive quits, employment weighted
- share of establishments with zero quits and with positive but below average quits, establishment weighted
- probability of vacancy posting and of hiring among growing, stable, and shrinking establishments, with no quits and with quits, establishment weighted
- average vacancy rate at establishments with zero quits, with positive but below average quit rate, and with above average quit rate, employment weighted
- average hiring rate at establishments with zero quits, with positive but below average quit rate, and with above average quit rate, employment weighted
- average vacancy yield at establishments with zero quits, with positive but below average quit rate, and with above average quit rate, establishment weighted

We simulate the model weekly and aggregate the simulated data to monthly observations. This allows us to address the issue of time aggregation. For example, in the data we observe hires in month t at firms that did not have a vacancy open at the end of month $t-1$. The weekly model can account for this by having a vacancy open and filled within the same month. In addition, unlike in the model, we take into that a firm can only have an integer number of vacancies open, which implies that $v(\cdot)$ is an increasing step function.

5.1 Estimation results

TO BE COMPLETED.

6 Conclusions

In this paper, we have presented evidence that quits are an important part of labor market dynamics. This is especially true of the high-frequency (i.e., monthly) dynamics we observe in the JOLTS data. More than half of all separations are quits, and establishments with at least one quit account for a disproportionate amount of vacancies and hiring. This suggests that quits may drive a large fraction of worker recruitment. In studying the JOLTS microdata both nonparametrically and through regression analysis, we find evidence suggesting that this is indeed the case. Both hires and vacancies are positively related to the incidence of a preceding quit, even after controlling for establishment growth and establishment-specific characteristics.

We then develop a matching model that accounts for the empirical patterns we observe. The model builds upon similar matching models with endogenous job destruction and on-the-job search by differentiating between the sunk cost of creating a new position and the flow cost of advertising for a position opening. In the model, multi-worker firms face the standard decision of whether to continue or sever a match after an adverse shock to their productivity. Given the sunk cost of position creation, and on-the-job search, firms face additional decisions related to whether to replace a worker who leaves the firm, and whether to expand employment. This creates three thresholds of firm productivity that define the firms separation decision, worker replacement decision, and position creation decision. The resulting decision rules create rich employment dynamics where quits and layoffs decrease with firm productivity, vacancies and hiring increase with productivity, and complex interactions between these processes emerge when firms must decide whether to replace a worker who leaves or let a position vanish. Overall, the model produces implications that are generally consistent with our evidence and provides a flexible framework to explore both the micro-level dynamics and the cyclical volatility of employment adjustments in future research.

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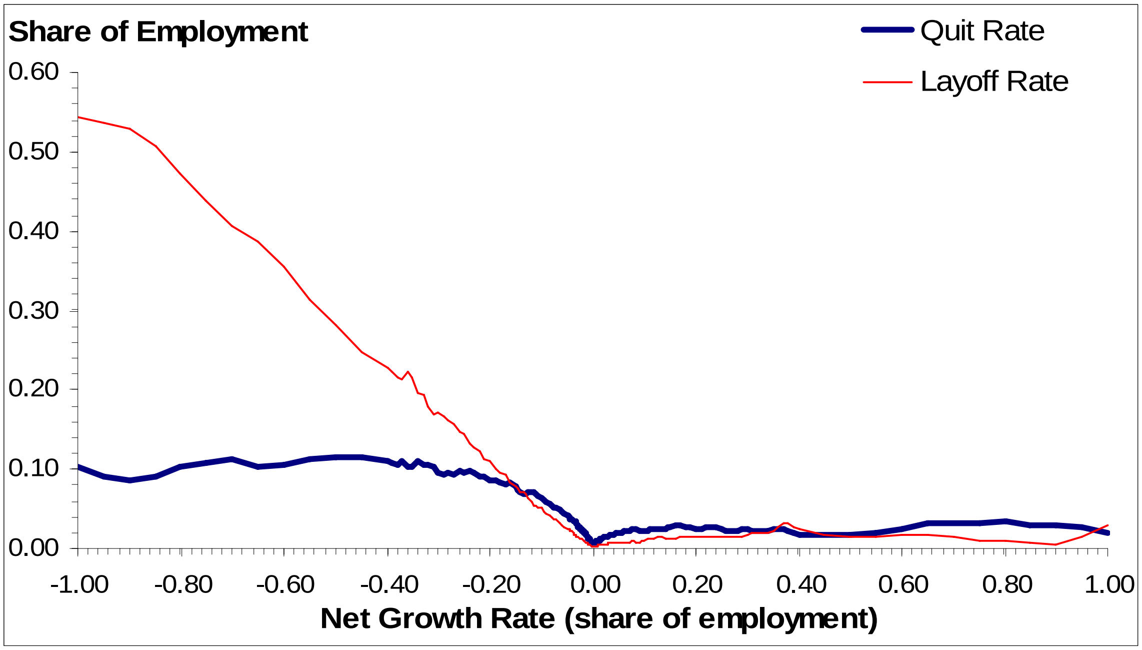
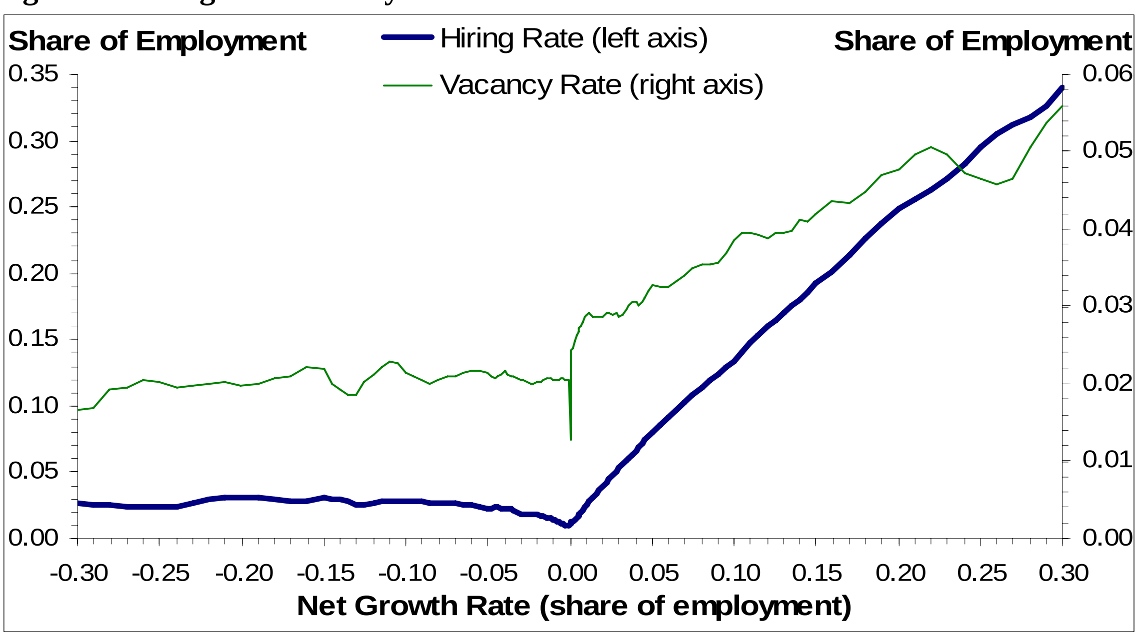
Figure 1. Quit and Layoff Rates as a Function of Establishment Growth



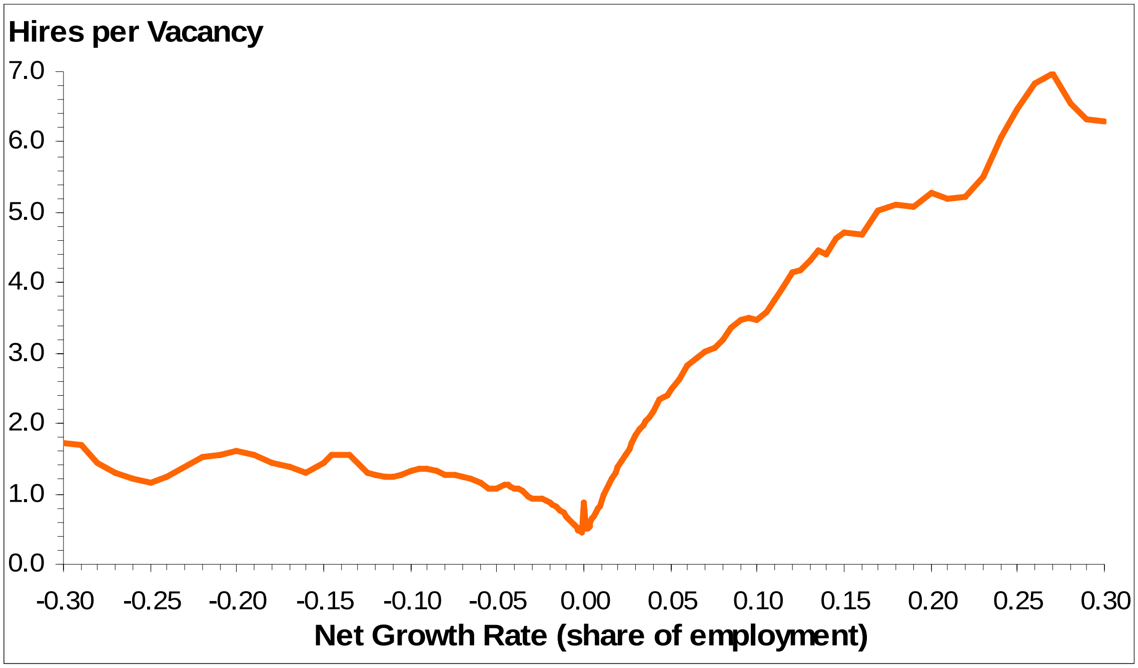
Notes: Figure depicts the quit and layoff rates as functions of the establishment-level employment growth rate (all depicted as fractions of employment), and is taken from Davis, Faberman, and Haltiwanger (2006a, p. 17). Rates are estimated over fine growth rate intervals that increase in size with the magnitude of growth. Estimates use pooled observations of JOLTS microdata, and the figure illustrates rates as a 5-interval centered moving average with a discontinuity allowed at zero-growth.

Figure 2. Hiring and Vacancy Rates as a Function of Establishment Growth



Notes: Figure depicts the hiring and vacancy rates as functions of the establishment-level employment growth rate (all depicted as fractions of employment). Rates are estimated over fine growth rate intervals that increase in size with the magnitude of growth. The figure illustrates rates as a 5-interval centered moving average with a discontinuity allowed at zero-growth. Estimates are from Davis, Faberman, and Haltiwanger (2006b) who use pooled observations of JOLTS microdata.

Figure 3. The Vacancy Yield as a Function of Establishment Growth

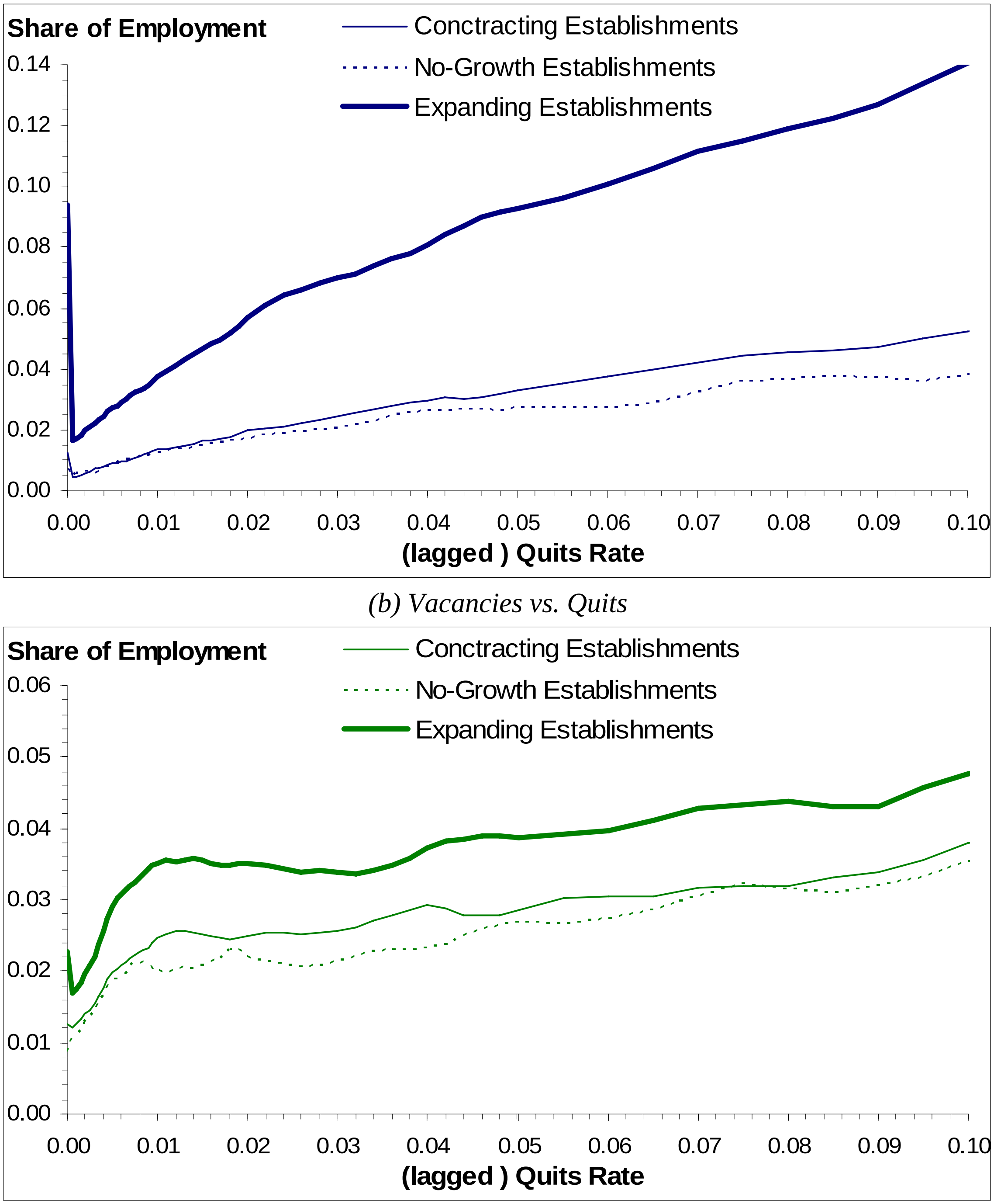


Notes: Figure depicts the vacancy yield (measured as hires per reported vacancy) as a function of the establishment-level employment growth rate. The yield is estimated over fine growth rate intervals that increase in size with the magnitude of growth. The figure illustrates rates as a 5-interval centered moving average with a discontinuity allowed at zero-growth. Estimates are from Davis, Faberman, and Haltiwanger (2006b) who use pooled observations of JOLTS microdata.

Figure 4. Hiring and Vacancy Rates vs. the Quit Rate, by Type of Establishment Growth

(a) Leading Hires vs. Quits

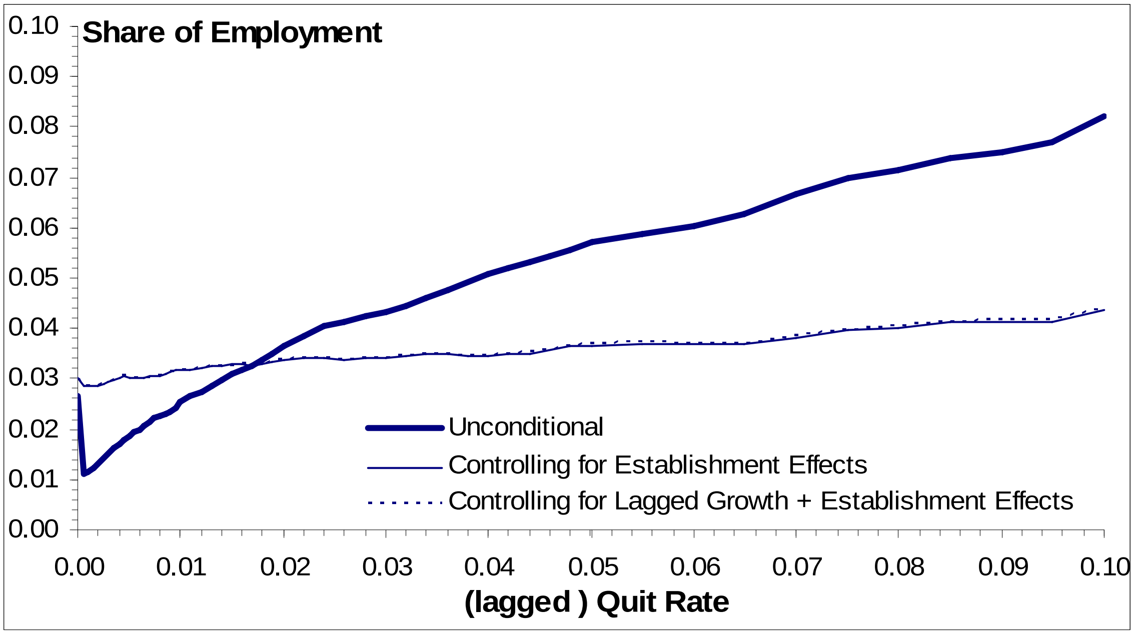
(b) Vacancies vs. Quits



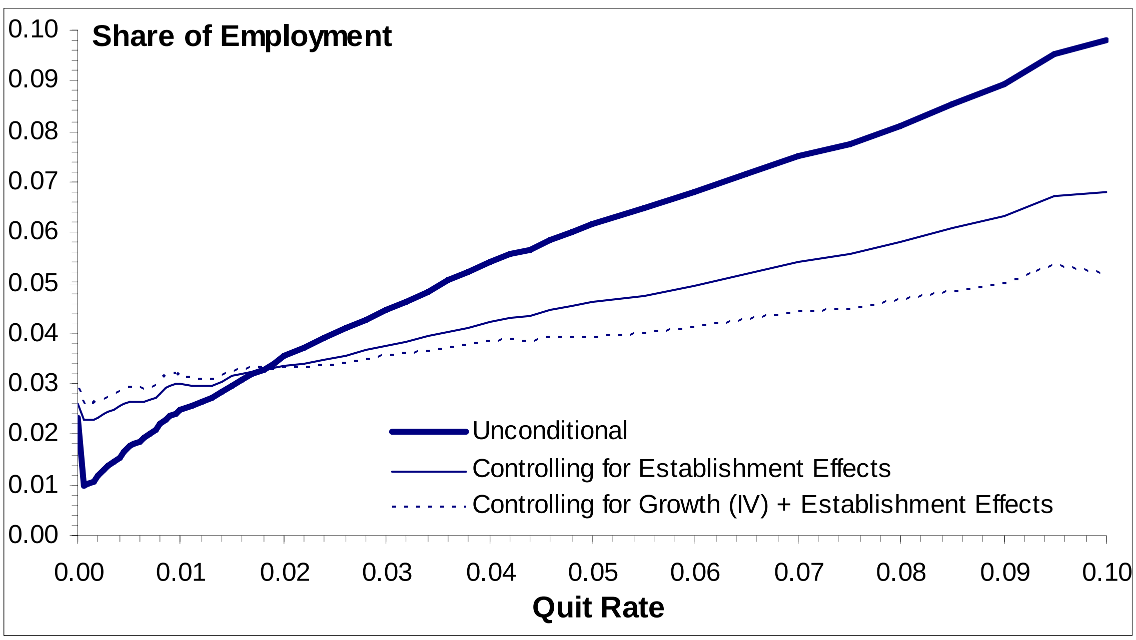
Notes: Figures depict the hires rate (top panel) and vacancy rate (bottom panel) as a function of the establishment-level quit rate (all depicted as fractions of employment) and broken out by type of establishment-level employment growth (expanding, contracting, no change). Rates are estimated over fine quit rate intervals that increase in size with the rate. Estimates are from authors' tabulations using pooled observations of JOLTS microdata, and the figure illustrates rates as a 5-interval centered moving average.

Figure 5. Hiring and Vacancy Rates vs. the Quit Rate, Regression Results

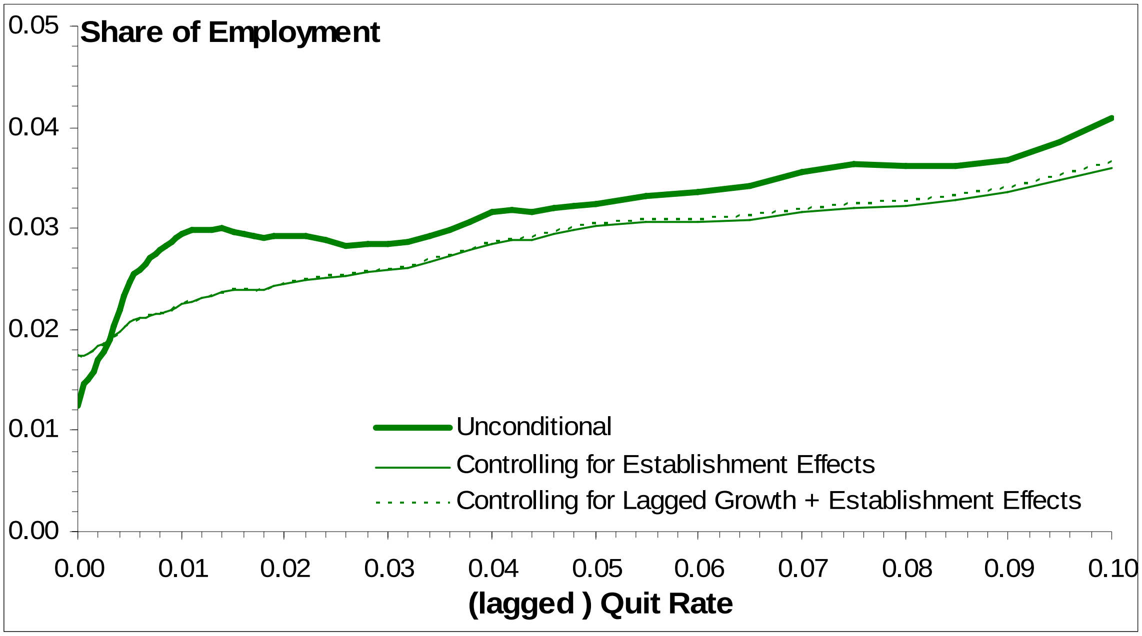
(a) Leading Hires vs. Quits



(b) Contemporaneous Hires vs. Quits

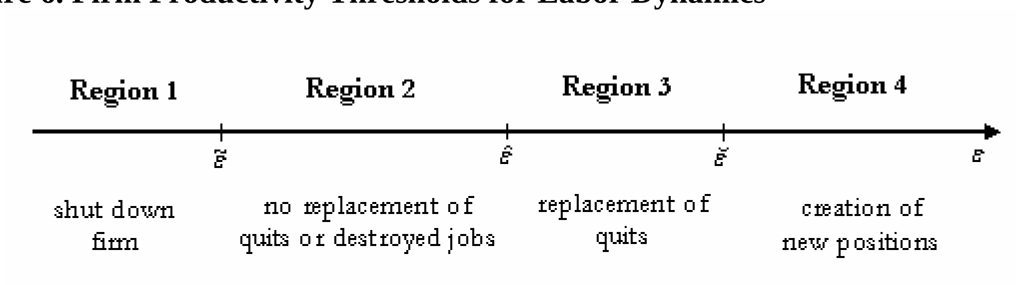


(c) Vacancies vs. Quits



Notes: Figures depict the (leading) hires rate (top panel) and vacancy rate (bottom panel) as a function of the establishment-level quit rate (all depicted as fractions of employment) and broken out by type of establishment-level employment growth (expanding, contracting, no change). Rates are estimated over fine quit rate intervals that increase in size with the rate. Estimates are from authors' tabulations using pooled observations of JOLTS microdata, and the figure illustrates rates as a 5-interval centered moving average.

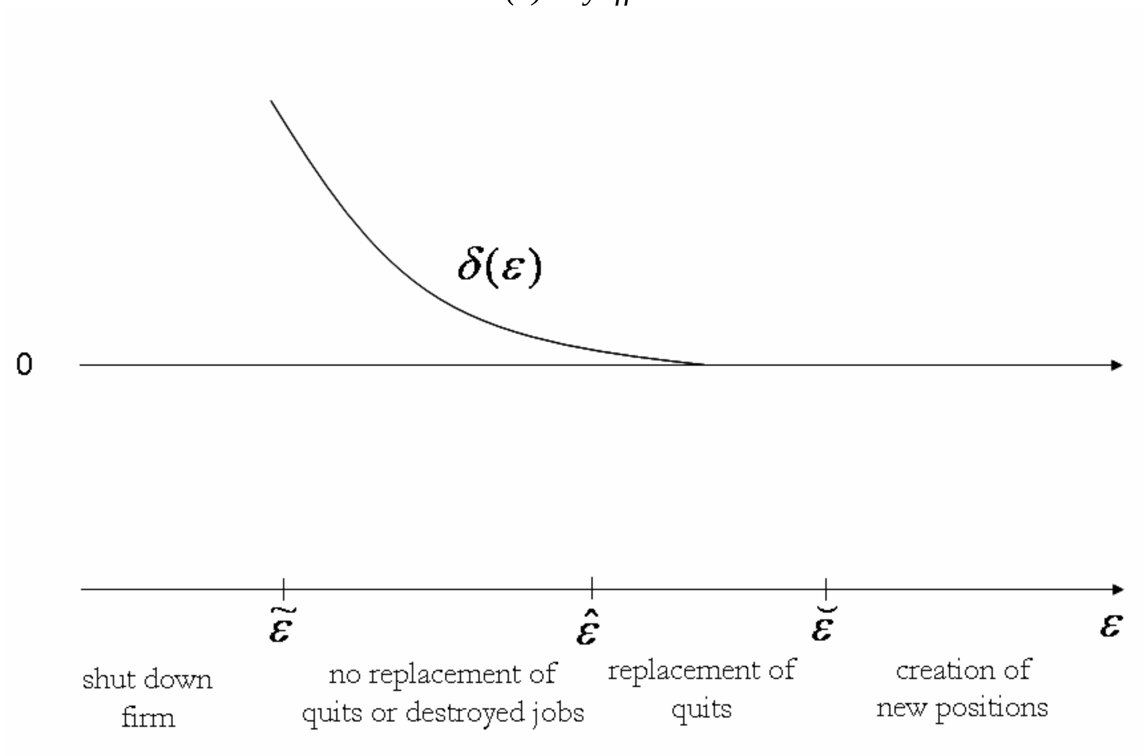
Figure 6. Firm Productivity Thresholds for Labor Dynamics



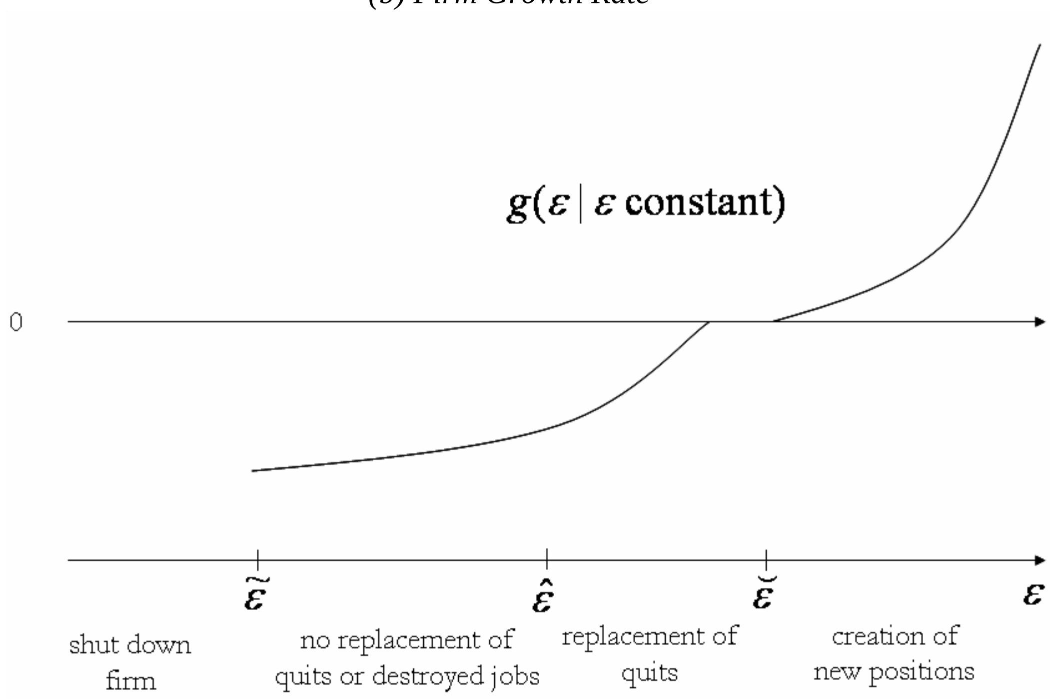
Note: Figure depicts the three endogenously-determined thresholds of the model described in the text, with the decision rules between each threshold noted. See text for details.

Figure 7. Qualitative Implications of the Model as a Function of Firm Productivity

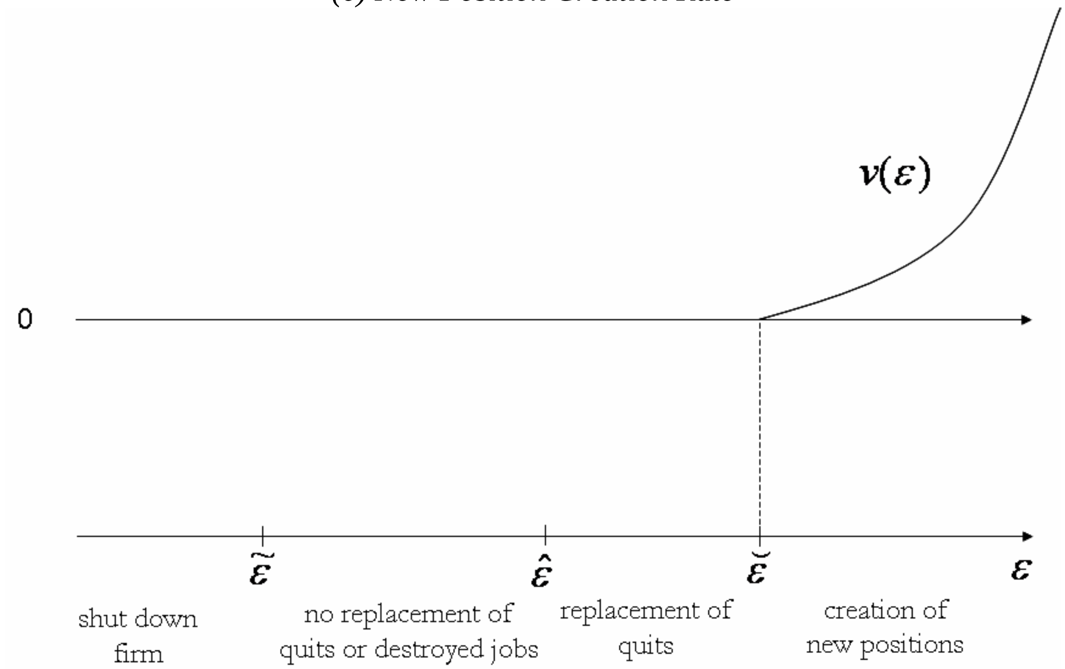
(a) Layoff Rate



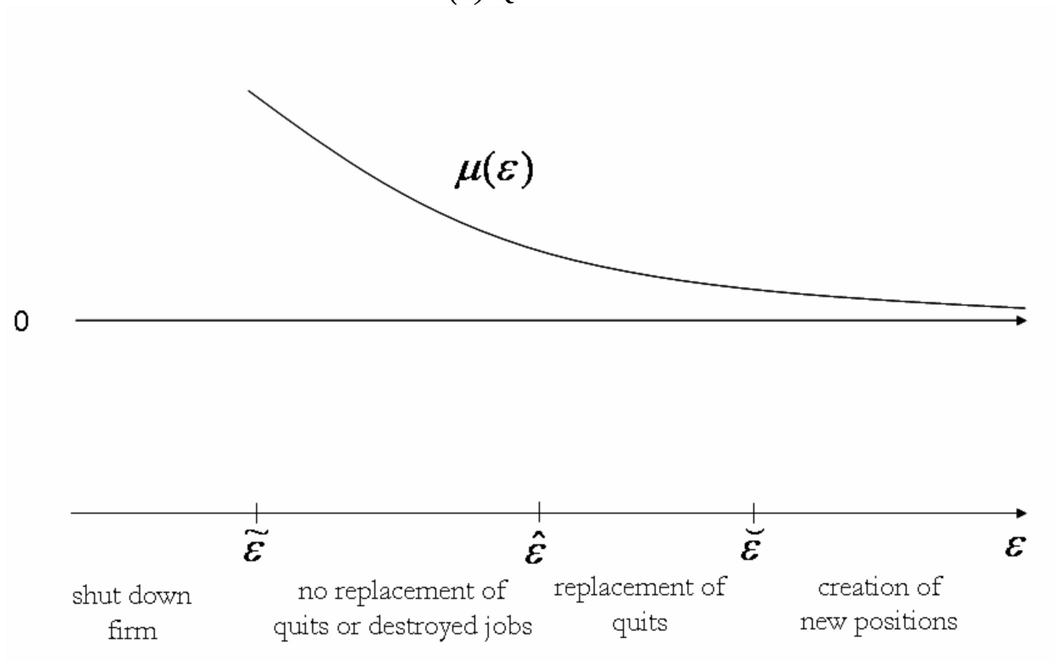
(b) Firm Growth Rate



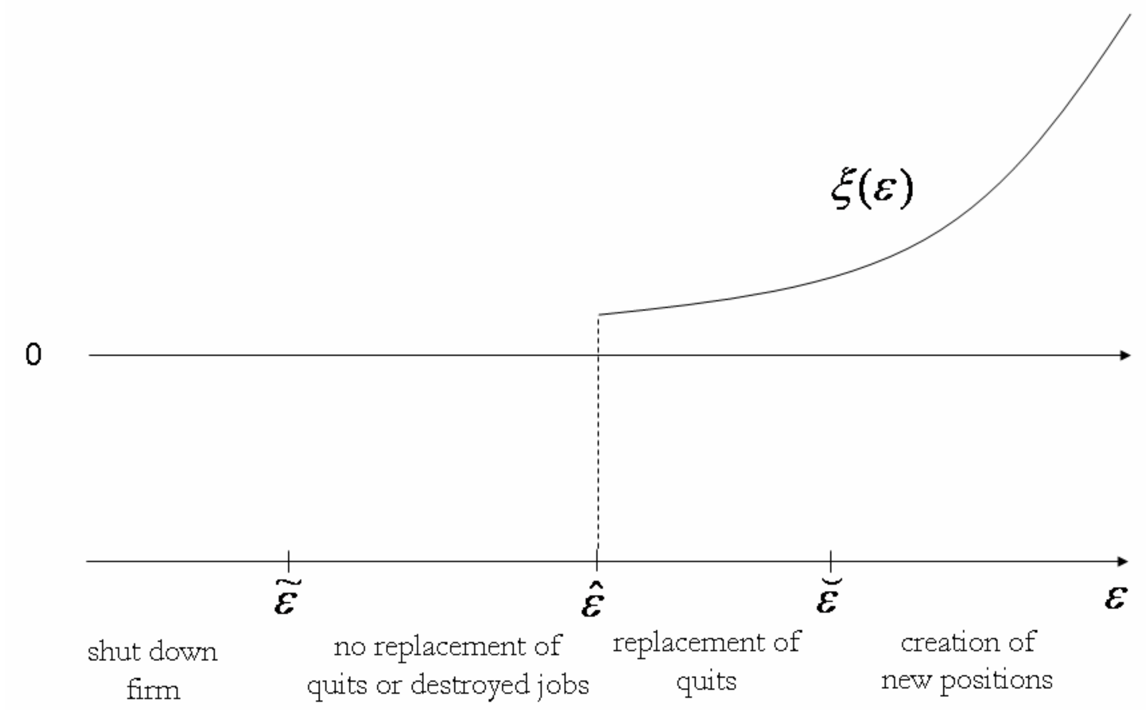
(c) New Position Creation Rate



(d) Quit Rate



(e) Vacancy Filling Probability



Note: Figure depicts the behavior of the firm-level employment and recruitment dynamics as a function of firm productivity, with endogenously-determined thresholds and decision rules illustrated. See text for details.

Table 1. Summary Statistics by Incidence of a Quit

	Full Sample	*No Previous Quit* ($q_t = 0$)	*Previous Quit* ($q_t > 0$)
Quit Rate (t)	0.017	---	0.030
Layoff Rate (t)	0.011	0.013	0.011
Hiring Rate ($t + 1$)	0.032	0.027	0.036
Vacancy Rate (t)	0.022	0.012	0.028
Share of Establishments	---	0.862	0.138
Share of Employment	---	0.425	0.575
Share of Hires ($t + 1$)	---	0.355	0.645
Share of Vacancies (t)	---	0.257	0.743

Notes: Estimates are means and (employment-weighted) standard errors (in brackets) across establishments from authors' tabulations using pooled observations of JOLTS microdata. Standard errors on rate estimates are all smaller than 0.0001.

Table 2. Frequency of Vacancies and Hiring by Quit Incidence and Establishment Characteristics

(a) Nonfarm Employment

	$\Pr(v_t > 0)$		$\Pr(h_{t+1} > 0)$	
	$q_t = 0$	$q_t > 0$	$q_t = 0$	$q_t > 0$
By Incidence of Quit	0.24	0.75	0.35	0.85
For All Establishments	0.53		0.64	

(b) Major Industry

	$\Pr(v_t > 0)$		$\Pr(h_{t+1} > 0)$	
	$q_t = 0$	$q_t > 0$	$q_t = 0$	$q_t > 0$
Natural Resources & Mining	0.20	0.52	0.35	0.78
Construction	0.13	0.43	0.37	0.78
Manufacturing	0.30	0.68	0.43	0.79
Transportation & Utilities	0.22	0.71	0.31	0.80
Retail Trade	0.17	0.58	0.34	0.81
Information	0.31	0.81	0.36	0.83
FIRE	0.20	0.82	0.26	0.86
Professional & Business Services	0.27	0.80	0.35	0.86
Health & Education	0.26	0.90	0.33	0.93
Leisure & Hospitality	0.20	0.62	0.43	0.83
Other Services	0.15	0.60	0.22	0.74
Government	0.41	0.87	0.43	0.92

(c) Establishment Size

	$\Pr(v_t > 0)$		$\Pr(h_{t+1} > 0)$	
	$q_t = 0$	$q_t > 0$	$q_t = 0$	$q_t > 0$
0-9 Employees	0.06	0.29	0.10	0.36
10-49 Employees	0.18	0.42	0.31	0.60
50-249 Employees	0.38	0.65	0.54	0.82
250-999 Employees	0.60	0.84	0.70	0.90
1000-4999 Employees	0.70	0.93	0.81	0.96
5000+ Employees	0.81	0.93	0.93	0.99

Notes: Estimates are the (employment-weighted) probabilities of a vacancy, hire, or hire conditional on a vacancy based on the incidence of at least one quit. Estimates come from authors' tabulations using pooled observations of JOLTS microdata.

Table 3. Establishment-Level Regressions, Hiring, Vacancies and the Quit Rate

(a) Dependent Variable: $h_{i,t+1}$ (Leading Hires)

	(1)	(2)	(3)	(4)
q_{it}	.222	.050	.069	.056
	[.002]	[.002]	[.002]	[.001]
g_{it}			.012	
			[.001]	
$g_{it} > 0$				.024
				[.001]
$g_{it} < 0$				.003
				[.001]
Establishment Effects?	No	Yes	Yes	Yes
R-squared	.033	.291	.291	.292

(b) Dependent Variable: h_{it} (Contemporaneous Hires)

	(1) OLS	(2) OLS	(3) IV	(4) IV
q_{it}	.592	.347	.153	.665
	[.003]	[.003]	[.090]	[.032]
g_{it}			-.307	
			[.141]	
$g_{it} > 0$				1.170
				[.061]
$g_{it} < 0$				.382
				[.062]
Establishment Effects?	No	Yes	Yes	Yes
R-squared	.120	.319	.319	.320

(c) Dependent Variable: v_{it}

	(1)	(2)	(4)	(5)
q_{it}	.103	.062	.089	.092
	[.001]	[.001]	[.001]	[.001]
g_{it}			.017	
			[.0004]	
$g_{it} > 0$				.015
				[.001]
$g_{it} < 0$				.019
				[.001]
Establishment Effects?	No	Yes	Yes	Yes
R-squared	.022	.410	.413	.413

Notes: Tables report coefficients and standard errors (in brackets) of OLS (or instrumental variables, where noted) for regressions of the noted dependent variable on the noted regressors using pooled establishment-month observations. *N = 371,997*. Regressions include establishment fixed effects where noted. For IV estimates, regressions use the lagged growth rate (or lagged growth rates conditional on being positive or negative) as the instrument(s).