Worker Flows Over the Business Cycle: the Role of Firm Quality*

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Abstract

In this paper, we study net and gross worker flows over the business cycle as a function of firm quality. Using linked employer-employee data from the LEHD program at the U.S. Census, we measure employer quality along a number of dimensions, including average pay, average churn rate and size. We first show that net job creation at high-quality firms is *more* responsive to the business cycle than that of low-quality firms; in recessions low-quality firms shrink less quickly, while in booms high-quality firms grow more quickly. We then show that, gross hire and separation rates at high-wage and low-churn firms are *less* responsive to the business cycle. While these gross flow rates decline in recessions, they decline by less in high-quality firms. Therefore the growth rate effect can be accounted for by a larger decline in job separations in low-, compared to high-, quality firms in recessions. In contrast, we find that the relatively less responsive growth rates at small firms are driven by both a greater reduction in separations, as well as a smaller reduction in hires. Finally, we analyze the replacement hire rate – hires that do not contribute to growth – and show that this rate is more negatively impacted by an economic downturn in low-quality firms. Thus, relative to high-quality firms, low-quality firms must continually replenish their workforce in booms, while they can grow on net in recessions. We conclude with a discussion of our results in the context of existing macroeconomic theories of the labor market.

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1 Introduction

Worker sorting across firms has long been thought to play a central role in labor market efficiency. Despite frictions that can inhibit this sorting process, such as search costs or imperfect learning, workers are thought to gradually move towards jobs of better overall- or match-specific quality.[1] At the same time, recessions may impede worker sorting. Several papers have noted a marked decline in worker churning and job-to-job mobility in recent recessions, with a particularly sharp downturn in job change during the Great Recession.[2] This suggests that workers' ability to move on from poor job matches or bad jobs is curtailed in times of high unemployment. A natural question, then, is in what types of jobs are workers – at least temporarily – saddled? If the business cycle has differential impacts on jobs or firms of varying quality, the consequences of reduced mobility could be very different. In this paper, we ask how firm quality interacts with the business cycle. That is, we investigate whether the employment effects of the business cycle are heterogeneous across firms of differing quality.

If resources are reallocated to higher quality firms in recessions (the classic Schumpeter 1939 cleansing effect) then we might see a commensurate flow of workers to good firms. However, the cyclical upgrading literature (Okun 1973, Bils and McLaughlin 2001) suggests that high-quality jobs may be more sensitive to the business cycle, with opportunities to move into these jobs relatively more prevalent in expansions. Further, Barlevy (2002) shows that the decline in job-to-job transitions seen in recessions has a quantitatively important effect on overall match quality, terming this the "sullying effect" of recessions. However, if the jobs available in recessions are more likely to be lower quality, then we would have a further sullying effect; workers matching in recessions would be both in lower quality matches and lower absolute quality of firms. In this paper we directly analyze the differential impact of economic conditions on net and gross worker flows as a function of firm quality.

To identify worker flows over the business cycle we use data from the Longitudinal Em-

[1] This idea goes at least as far back as the canonical work of Jovanovic (1979) and for empirical work on job mobility see Farber's 1999 survey.

[2] See in particular Lazear and Spletzer (2012), Hyatt and McEntarfer (2012).

ployer Household Dynamics (LEHD) program; a U.S. employer-employee matched database drawn from the state unemployment insurance systems. This dataset allows us to match detailed worker job histories with a rich set of firm-level characteristics. We divide firms along a number of quality dimensions including average pay, average size, and average worker churn rate. Furthermore the LEHD data allow us to track gross, as well as net, worker flows across firms. We therefore analyze quarterly employment growth rates, as well as gross hire and separation rates, as a function of the unemployment rate and firm quality from 1998 to 2008. This time period allows us to capture the 2001 recession as well as some of the decline into the 2007-09 recession.

We find that net employment growth at high-quality firms is more responsive to the business cycle than that of low-quality firms. This is true along any of our dimensions of firm quality. It is driven both by greater job destruction among high-quality firms at times of high unemployment, as well as a greater job creation in times of low unemployment. To explain these findings, we next look at gross worker flows. In contrast to their more-responsive growth rates, we find that among high-paying and low-churn firms, gross worker flows are less responsive to the business cycle; separation and hire rates both decline by less in high-, compared to low-, quality firms when the unemployment rate increases. For firm size, we see that separation rates decline by more in small firms compared to large firms and also hire rates decline by less. Lastly, we separate hires into those that do not contribute to growth, but rather contribute to replenishing the existing workforce. This measure is useful as a single statistic that captures employment decisions that are related to worker turnover. We show that these replacement hire rates are more impacted by the business cycle at low-quality firms. In other words, low-quality firms make a large amount of replacement hires in boomtimes, replenishing the stock of their workforce, and a much smaller amount in busts, relative to high-quality firms.

Our results are broadly consistent with a recent body of work looking at growth rates over the business cycle as a function of firm size. Moscarini and Postel-Vinay (2012a, hereafter

MPV), show in a number of countries including the U.S. that differential growth rates of small-, compared to large-, firms are positively related to the unemployment rate. Fort, Haltiwanger, Jarmin and Miranda (2012) analyze firm growth over the business cycle as a function of firm age and size, using U.S. data. They find that small, young, firms typically fare relatively better in cyclical contractions, although this relationship reversed in the 2007-09 recession. We contribute to this literature by showing the growth rate effect holds along a number of firm-quality characteristics, including and within firm size. Also, our added dimension of gross worker flows allows us to paint a richer picture of labor market dynamics over the business cycle, that is not possible in the other datasets used to study growth rates.

We use our body of evidence to disentangle macroeconomic models with predictions of worker mobility over the business cycle. We find a number of theories fit our data well. In particular, our results are consistent with the presence of differential wage rigidities across high- and low-quality firms. They are also consistent with the poaching story outlined in Moscarini and Postel-Vinay (2012b): High-quality firms have an easier time attracting workers in booms, so they grow relative to low-quality firms and inflate in size. During the bust they must then shed some of these workers. At the same time, low-quality firms have an easier time retaining workers in a bust, since high-quality firms are less likely to poach workers then. Furthermore, our finding that workers get stuck in low-quality firms in the recession is very much in the spirit of Barlevy (2002) where workers get stuck in low-quality matches. Our results indicate that not only do recessions cause workers to stay in worse matches, they also cause workers to stay in worse overall quality firms.

Our results have important implications for the long-lasting consequences of recessions on workers. A growing body of evidence suggests that recessions have vastly differing impacts on workers over the long run, depending on what stage of their career the recession hits them in. First, labor market conditions at the beginning of a worker's career have long-lasting scarring effects (Kahn 2010, Oreopoulos, von Wachter and Heisz 2012). Second, the consequences of job displacement have been shown to be much larger when displacement

occurs in a recession (Davis and von Wachter 2011). It therefore seems that being forced to match to a firm during an economic downturn can be incredibly damaging to a worker's career. Our finding that, relatively speaking, low-quality firms grow faster in recessions (or shrink less quickly) can potentially explain these findings. It suggests that matches occurring in downturns will be relatively stickier at low-quality firms than at high-quality firms.

The remainder of the paper proceeds as follows. Section 2 describes the data and our methodology for studying firm-level net and gross flows. It also presents aggregate trends in our data. Section 3 presents our results. Section 4 discusses various models of the business cycle and the degree to which our results are consistent. Section 5 concludes.

2 Data and Methodology

We analyze worker flows over the business cycle using data from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program. The LEHD program maintains a variety of survey and administrative data from several state and federal agencies. For this paper, we chiefly use state-level unemployment insurance (UI) wage records and the Quarterly Census of Employment and Wages (QCEW) data. Both UI and QCEW data are available for states in partnership with the LEHD program, currently all 50 states and the District of Columbia. A thorough discussion of the LEHD data is provided in Abowd et. al. (2006); a brief description follows.

State-level unemployment insurance (UI) data contain quarterly earnings for employees covered by state unemployment insurance systems, over 96% of private sector employment. A firm, as defined in this analysis, is a collection of workers who share a common unemployment insurance system identifier. Individual wage records can be linked across quarters to create individual work histories, worker flows, and earnings dynamics. The firm identifier on the UI records is used to link to information on the firm available in the QCEW data (we principally use employment size and industry). Worker demographics, namely sex and date of birth,

are available from links to the Census administrative and survey data. For this paper we largely restrict attention to the 30 states that have UI and QCEW data for every quarter of our sample period 1998:Q1-2008:Q4.[3]

These data are advantageous in that they allow us to observe both gross and net worker flows for a substantial fraction of firms in the U.S. labor market. Furthermore, we can create a rich set of firm characteristics to measure employer quality. Finally, the time period over which we can exploit a balanced panel consisting of a large number of states allows us to capture one complete business cycle containing the 2001 recession, as well as some of the employment decline in the 2007-09 recession.

We focus on three measures of firm quality: size, average wage and excess churn. Larger firms have been shown to have higher pay, better working conditions, a greater degree of benefits provision, increased productivity, and increased probability of firm survival (Brown and Medoff 1989, Hurst and Pugsley 2011). Though less studied due to data constraints, we believe it likely that higher paying firms have many of the same attributes. Serafinelli (2012), for example, presents evidence using detailed administrative data in Italy that high paying firms are more productive. Finally, equation 1 defines the excess churn rate in a given period, t, at a firm, f, where A is hires, S is separations, and B and E are beginning and end of quarter employment, respectively. Thus we define churn as hires and separations in excess of the net employment change in the period $(E - B)$, divided by average employment in the period. A firm with a high-churn rate has a high number of worker flows in excess of job flows. We take this definition, which is now standard in the literature, from Burgess, Lane, & Stevens (2000). Cambell et al. (2005) show that high churn is associated with lower productivity and lower survival rates for a select set of industries.

$$churn_{tf} = \frac{A_{tf} + S_{tf} - |E_{tf} - B_{tf}|}{.5 * (E_{tf} + B_{tf})} \tag{1}$$

[3]For some analyses we reduce our sample to 25 states that have complete establishment-level worker flows data for the entire length of the panel.

Our exercise in this paper is to analyze how firms of different qualities are impacted by the business cycle. We therefore construct time-invariant firm quality measures by taking average size, wage and churn within a firm (to be more precise, a firm-state) over our entire sample period. This avoids the well-known reclassification bias problem (discussed, for example, in MPV), though our results are robust to other measures.[4] Figure 1 shows employment-weighted kernel densities of each measure of firm quality. The top left panel shows the distributions of firm-level average churn rates; the top right panel shows the distribution of average monthly wages (for employees who work an entire quarter, in 2008 dollars); the bottom left panel shows the distribution of average firm size, which is the size of the state tax identity on the 12th day of the first month of the quarter, averaged over the life of the tax identification number. All of these distributions have long right tails; to avoid potential data disclosure issues in these graphs we cap churning at 2, average wages at $12,000, and firm size at 15,000. As can be seen, we have substantial variation across firms over this time period in all measures.

In our subsequent analysis we divide firms into discrete categories based on these measures. For pay and churn, we use employment-weighted quintiles as dividing points. The lowest wage firms are those paying on average less than $1,800 a month in 2008-adjusted dollars (where the average worker earns less than $21,600 for a full-time work year), while the highest wage firms are those paying more than $5,000 a month (where the average worker earns more than $60,000 for a full-time work year).[5] The highest churn firms are those with average churn rates above 0.43, while the lowest churn firms are those with average churn rates below 0.08. For size, we use 5 categories: less than 20 employees, 20-50, 50-250, 250-500, and greater than 500, following Fort et al. (2012).[6]

[4] In particular, we have experimented with using a two-quarter moving average for each characteristic as in Fort et al. (2012) and we will also check robustness to using average quality in an initial period of measurement (as in MPV).

[5] These percentile points are rounded up to the nearest $10.

[6] However, it is worth noting that our measure of size is the employment size of the state tax entity. Both Fort et al. and MPV use firm size data from the BDS, which contains information on both establishment-level employment and national employment. Our measure of firm size is correlated with the national size of the firm (0.75) but is not an exact match, more closely approximating the size of the firm in the state. BDS

In this paper, we will analyze net growth rates as well as gross flow rates. To calculate these rates, we aggregate our firm-level data to the year-quarter-industry-wage quintile-churn quintile-size category, by summing employment and worker flows in each cell.[7] This level of aggregation allows us to control for industry and each firm characteristic in our analysis, while still enabling us to capture employment dynamics driven from firm births and deaths.[8]

Table 1 presents employment-weighted summary statistics by firm category for our rates of interest, which we define next. The quarterly growth rate for a firm quality type, q, is defined in equation 2 as net employment change among all firms of type q (firms indexed 1 to F_q) divided by average employment over the quarter, t, among these firms. As can be seen in table 1, average growth rates range from 0.007 to 0.01, with a few differences across firm categories. Smaller firms have slightly higher growth rates, likely due to a correlation between age and size as noted in Haltiwanger et al. (2010), as do lower paying firms.

$$\text{growth rate}_{tq} = \frac{\sum_{f=1}^{F_q}(E_{tf} - B_{tf})}{.5 * \sum_{f=1}^{F_q}(E_{tf} + B_{tf})} \tag{2}$$

Hire and separation rates are defined in equations 3 and 4, respectively, as the total number of hires or separations in quarter, t, at firms of quality, q, divided by total employment in the quarter (starting employment plus new hires). These gross worker flows are not available in most datasets, even those containing measures of net employment growth, and herein lies much of our contribution. Table 1 indicates that hire and separation rates vary widely across firm category, from 0.05 to 0.34, and are highly correlated within firm category. These rates are highly positively related to churn, since firms with higher churn will have greater hire

measures of firm size are newly available in the LEHD data but were not yet available at the time of this analysis.

[7] Our industry measure is a slightly aggregated version of the two-digit NAICS codes, though in principle we could use much more disaggregated industry definitions.

[8] While in principle, we could conduct our analysis at the individual firm level, growth, hire and separations rates are misleadingly large in the period in which a firm starts or closes. At the individual firm level, these outliers create problems for our estimation, so we prefer the somewhat aggregated analysis presented here.

and separation rates. They are also larger in lower paying and smaller firms, showing that churn is correlated with lower firm quality among these other dimensions.

$$\text{hire rate}_{tq} = \frac{\sum_{f=1}^{F_q} A_{tf}}{\sum_{f=1}^{F_q} (A_{tf} + B_{tf})} \tag{3}$$

$$\text{separation rate}_{tq} = \frac{\sum_{f=1}^{F_q} S_{tf}}{\sum_{f=1}^{F_q} (A_{tf} + B_{tf})} \tag{4}$$

Finally, we will be interested in an alternative hiring rate which we call the replacement hire rate. We define this rate (equation 5) as the total number of hires above and beyond those contributing to net employment growth (or all hires if the firm shrank) divided by total employment. This statistic is useful as it indicates patterns in hiring related to churn, rather than hiring that contributes to growth. As shown in table 1, replacement hire rates range from 0.05 to 0.32. Also, comparing these with gross hire rates (in columns 3 and 4) we see that a large share of hiring is replacement hiring.[9] That is, most hiring does not contribute to growth but rather is turnover driven, serving to replenish the preexisting stock of workers. Replacement hire rates are largest in high churn, low paying, small firms, again because they are highly related to firm churn.

$$\text{replacement hire rate}_{tq} = \frac{\sum_{f=1}^{F_q} A_{tf} - \max[0, \sum_{f=1}^{F_q} (E_{tf} - B_{tf})]}{\sum_{f=1}^{F_q} (A_{tf} + B_{tf})} \tag{5}$$

To gain a general sense of hiring over the business cycle, we first look at differential growth rates across our lowest and highest quality firm quintile or size buckets. We simply subtract the growth rate in the highest quality/largest bucket from that in the lowest/smallest. MPV

[9] We are by no means the first to point this out. See, for example, Lazear and Spletzer (2012).

do a similar exercise comparing growth rates at large and small firms. Following MPV, we detrend these differential growth rates using a Hodrick-Prescott filter. These differential growth rates are plotted in figure 2 along with the national unemployment rate (dashed line), which has also been detrended. Throughout the paper, we use the national unemployment rate as our measure of market conditions.

The top left graph shows the differential growth rate across high- and low-churn firms, where lower churn indicates higher quality. Though noisy, this differential growth rate very closely tracks the national unemployment rate. That is, when unemployment is high, high-churn firms grow relatively more quickly (or shrink less quickly) than low-churn firms, while when unemployment is low, high-churn firms grow less quickly. Furthermore, the correlation between the detrended differential growth and unemployment rates, also shown on the graph, is positive and significantly different from zero.

The top right panel shows the differential growth rate of low-, compared to high-, wage firms. Here the pattern is broadly consistent with the low quality firms faring relatively better in times of high unemployment and worse in times of low unemployment. Though, this pattern does appear to break down somewhat during the jobless recovery following the 2001 recession, the correlation between detrended rates is still overall positive and significant.

We see a similar, though somewhat less clear pattern in the bottom panel, which plots the differential growth rate in firms with less than 20 employees compared to firms with more than 500. Overall the correlation between detrended rates is still positive and significant, though the pattern is certainly less pronounced than in the other two graphs. This somewhat mirrors that the lack of a consensus in the literature on firm size (see MPV and Fort et al.).

These figures, broadly speaking, provide evidence that worse quality firms fare relative better in recessions and high-quality firms fare relatively better in boomtimes. That is, the differential growth rates for low-, compared to high-, quality firms are countercyclical.

We turn next to differential separation and hire rates, plotted in figures 3 and 4, along with the unemployment rate. These gross flow rates exhibit very different patterns than the

net growth rates. For churn and wage, differential separation and hire rates look roughly procyclical; when the unemployment rate is low, low-quality firms hire and separate at greater rates than high-quality firms, while the opposite is true in times of high unemployment. As indicated in the graphs, the correlations for churn and wage are negative and highly significant.

In contrast, the pattern is actually reversed for firm size. Here, we see differential hire and separation rates that are positively correlated with the unemployment rate. In the early period the differential growth rates do appear to be procyclical, but in the more recent period they track more closely the unemployment rate. Small firms have relative larger hire and separation rates in economic downturns, compared to large firms, and the opposite is true in boomtimes.

Figure 5 plots differential replacement hire rates for low, compared to high, quality firms. Since this is a measure of churn-related hires and gross hire and separation rates are highly related to churn, we expect to see a similar pattern here. Indeed, again, contrary to growth rates, differential replacement hire rates look broadly procyclical, for churn and wage, and countercyclical for size. The top left panel shows that high-churn firms make relatively more replacement hires in busts, while low-churn firms make relatively more replacement hires in boomtimes. We see a similar pattern for low, compared to high, wage firms. And, again, both correlations are large and negative. Size exhibits the opposite pattern with a differential replacement hire rate that is strongly positively correlated with the unemployment rate.

In the next section we investigate these patterns in a regression framework where we can control for many potentially confounding factors. Specifically, we estimate regressions of the form specified in equation 6. We regress $rate_{tq}$, which could be a growth, separation, hire or replacement hire rate among firms of quality, q, in time period, t, on the national unemployment rate (U_t), a vector of firm quality indicators (FC_q) corresponding to the quintiles or size buckets and their interactions. We omit the lowest quality bucket. We additionally control for industry fixed effects and X_t, a vector of controls for the time period

(quarter dummies to control for seasonality and a time trend). We will estimate separate regressions for each firm quality type, churn, wage and size, as well as those that include controls for all firm quality types and their interactions with the unemployment rate. Finally, we will cluster our standard errors by firm quality-time period, since this is the level of variation underlying our key explanatory variables.[10] All regressions are weighted by average employment over the quarter.

$$rate_{tq} = \alpha_0 + \alpha_1 U_t + FC_q \alpha_2 + [U_t * FC_q]\alpha_3 + X_t \alpha_4 + I^{industry} + \varepsilon_{tq} \tag{6}$$

3 Results

3.1 Growth Rates

Table 2 presents our core results for the growth rate analysis, summarizing the coefficients on the unemployment rate and its interactions with firm characteristics. The first three columns present results for separate regressions for each firm quality category, while in the final column we control for all categories and their interactions with the unemployment rate.

The main effect of the unemployment rate, shown in the top row, can be interpreted as its impact on the growth rate for the lowest quality firm bucket – the omitted category in each regression. Column I shows that growth rates in firms with the highest churn rates are modestly, negatively impacted by the unemployment rate, but the coefficient of -0.0010 is only marginally significant. Column II shows that low wage firms have more responsive growth rates; a one percentage point increase in the unemployment rate corresponds to a highly significant 0.005 point decline in the growth rate. This effect is quite large given that average growth rates are roughly 0.008. Column III shows that among the smallest firms, growth rates are not at all responsive to the business cycle. Finally, in column IV, the coefficient on the unemployment is actually a positive, strongly significant 0.0042. Thus

[10] The results presented here do not yet reflect clustering.

firms in the lowest wage, highest churn, smallest size category actually have higher growth rates when the unemployment rate is larger.

For easier interpretation of the interaction effects, see figure 6 where we plot the coefficients and their 95% confidence intervals (dashed lines) as a function of firm quality. So that the levels are meaningful, we add the main unemployment rate effect to each coefficient (but do not adjust the confidence intervals) and also highlight 0 on the y axis. Thus each number on the graphs can be interpreted as the total impact of the national unemployment rate on the growth rates among firms of a given quality category. The blue lines come from columns I-III where each firm characteristic enters in a separate regression, while the red lines come from column IV in table 2 where we control for all firm characteristics.

Looking first at churn in the top left panel, we see that for all firms not in the highest churn quintile, the unemployment rate has a large, negative, impact on the growth rate. The 95% confidence intervals show that these impacts are strongly statistically significant. Controls for firm size and average wage do not impact the coefficients on the interaction terms, they merely shift up the level of the line. We therefore find that lower churn (and therefore higher quality) firms are much more sensitive to the business cycle; while a one percentage point increase in the unemployment rate had only a modest 0.001 point reduction in the growth rate of high churn firms, it is associated with a decline of roughly 0.008 at lower churn firms. Furthermore, the figure shows that the effect is very similar across firms in churn quintiles 1 through 4, while the effect in the highest churn quintile really stands out.

The top right panel of figure 6 presents coefficients on the interactions between average wage quintile and the national unemployment rate. The blue line shows that the impact of the unemployment rate on the growth rate declines (grows more negative) roughly linearly with firm wage. Compared to the main effect of a -0.005, growth rates in the highest wage bucket, for example, decline by almost 0.01, in total, and this effect is strongly significant. However, the red line shows that controlling for churn and size does impact the coefficients.

This is because wage and churn are highly negatively correlated; controlling for churn absorbs most of the differential growth rate effect. The line being roughly flat indicates that in this specification, there is no difference in the responsiveness of growth rates to the unemployment rate between high- and low-wage firms. However, with churn and wage highly correlated, it is unclear whether we have enough variation to separately identify impacts across churn and across wage.

Finally, our size results confirm the MPV finding that growth rates of larger firms are more responsive to the business cycle. In the lower left panel of figure 6, we see that as firm size increases, responsiveness grows more negative roughly linearly before leveling off at a fairly high rate; for example in firms with more than 500 employees, a one point increase in the unemployment rate corresponds to a 0.009 point decline in the growth rate.

These results present a consistent picture of high-quality firms faring worse in times of high unemployment and better in times of low unemployment, relative to low quality firms; their growth is much more responsive to the business cycle. These effects are true within industry and are therefore not driven by particular industries being more sensitive to the business cycle.

3.2 Gross Hires and Separation Rates

Why is it that low-quality firms continue to grow, or shrink less quickly, in the recession? Because in the LEHD we can measure gross flows, as well as net changes in employment, we can create a much more nuanced picture of these firms. We begin by studying gross separation and hire rates, to learn the extent to which movements in each are contributing to the declining growth rates in high-quality firms.

Table 3 summarizes results from the separation rate regressions. The coefficient on the unemployment rate across specifications is negative and significant; at low quality firms, separation rates fall when the unemployment rate rises. The coefficients, ranging from a 0.008 to a 0.016 decline in the separation rate in response to a one percentage point increase

in the unemployment rate, are sizeable given mean separation rates of roughly 0.10 to almost a third in the highest churn firms. Though firms are more likely to make layoffs in a recession, these findings are consistent with an offsetting decline in voluntary quits (e.g., Shimer 2005, Hall 2005a).

Interestingly, the positive, significant interaction effects across all specifications show that the response of separation rates to the business cycle is less negative in higher quality firms. This is also seen in figure 7 which plots these coefficients (adding back in the main effect of the unemployment rate) and their 95% confidence intervals. Here we see that as firm quality increases, the impact of the unemployment rate on separation rates declines in magnitude. This result holds across all firm quality measures, regardless of whether we control for the other firm characteristics. In firms with lower churn or higher wages, as well as in larger firms, separation rates are less negatively impacted by the business cycle. For firm size, these regression results are counter to the somewhat noisy differential separation rates reported in figure 3. It seems that for size, our controls for industry and seasonality are especially important.

Our separation rate findings could be for two reasons: First, higher quality firms may be more likely to make layoffs in recessions. Second, the impact of the recession on voluntary quits may be smaller in magnitude (declining by less) in high-quality firms. Without direct information on the reasons for worker mobility, we cannot distinguish between the two. However, whether voluntarily or involuntarily, it does appear that high-quality firms, relative to low-quality firms, lose their stock of workers in recessions and this contributes to their declining growth rates. Or put another way, low-quality firms lose their stock of workers in boomtimes and, relatively speaking, are less impacted in recessions.

Table 4 and figure 8 summarize our results from the hire rate regressions. The main effects on the unemployment rate are negative and significant across specifications, ranging from -0.004 to -0.013, modest-sized effects given the sample mean hire rates at low quality firms range from 0.2 to 0.33. As one would expect, at times of higher unemployment, firms

are less likely to make hires.

Table 4 also shows positive interaction effects for churn interacted with the unemployment rate, or for wage quintile interactions. The negative impact of the unemployment rate on the hire rate is somewhat offset in high quality firms, and offset by more as firm quality increases. This is reflected in the top two panels of figure 8, which show that as firm quality increases, the impact of the unemployment rate on the hire rates declines in magnitude, i.e., moves closer to zero. This is true for wage and size, both with and without controls for other firm characteristics. For firm size we see a U-shaped effect, implying that hire rates are most negatively impacted in mid-sized firms, while the largest and smallest firms experience only modest impacts. We find that small firms experience the least impact on their hiring rates during times of higher unemployment, consistent with our aggregate results discussed above.

Interestingly, then, the growth rate effect, that low-wage and high-churn firms are less impacted by the business cycle, is entirely driven by their relatively greater reduction in separation rates. For them, hires go in the opposite direction. Therefore, it is not the case that low-quality firms have an easier time hiring workers in a recession, but rather they are more able to hold on to their existing workforce. In contrast, the growth rate effect among small firms is driven by both a smaller reductions in hires as well as a greater reduction in separations, relative to larger firms.

3.3 Replacement Hire Rates

Having analyzed growth rates and gross hire and separation rates, we turn now to an alternative hire rate. We are interested in hires that do not contribute to growth, that is hires above and beyond those that contribute to net growth – or all hires if the firm does not grow. This measure is highly correlated with the gross hire and separation rates, since as mentioned above, most hiring and separating contributes to churn, not to growth. However, we find it useful since it captures succinctly the degree to which firms hire simply to replenish their stock, i.e., hiring that is purely driven by worker turnover.

Results on replacement hire rates are presented in table 5 and figure 9. Here we see the main effect on the unemployment rate is negative and statistically significant, ranging from -0.003 to -0.012. Thus in the lowest quality firm categories, the replacement hire rate falls as the unemployment rate rises. Like separation rates, this negative effect is somewhat offset in higher quality firms. As can be seen in the figure, replacement rates decline by much less in high-quality firms, compared to low-. Hires not contributing to growth increase in boomtimes for low-quality firms, while this happens to a much smaller extent in high-quality firms. Thus it appears that the decline in job change observed in recessions disproportionately impacts workers matched to bad jobs. In better labor markets, these workers would have much more quickly moved on to another job, and firms would have needed to make new hires to replace them.

4 Discussion

We have shown that high-quality firms are more sensitive to the business cycle in terms of their growth rates. In contrast, they experience smaller fluctuations in both separation and hire rates. Therefore, for churn and wage, the more negative impact on growth rates at high-quality firms in recessions is being driven by a smaller decline in separations, while hires go in the opposite direction – high-quality firms experience a smaller reduction in hires. For size, the growth rate effect is driven by a smaller decline in hires as well as a greater decline in separations. Furthermore, high-quality firms are less sensitive to the business cycle in terms of turnover-driven hiring. We now attempt to interpret this rich set of patterns, in light of several existing theories of labor market dynamics.

First, since at least as far back as Schumpeter (1939), economists advanced the notion that recessions serve a "cleansing" mechanism, reallocating resources from least to most productive.[11] Our results on growth rates are strongly counter to this prediction, since,

[11] Many theoretical papers seek to explain this pattern by exploiting a friction that inhibits resources from being allocated optimally. In recessions, productivity falls for all firms, thus making the least productive

relatively speaking, we see resources flowing to lower quality firms. We are therefore consistent with a small literature that finds empirical evidence inconsistent with the cleansing model (e.g., Bowlus 1993, Davis, Haltiwanger and Schuh 1996). As we discuss later, we view our results as very much in the spirit of Barlevy (2002) who develops a theory incorporating declining job-to-job transitions in the recession to explain these contradictory findings. However, his model does not have implications per se regarding match quality of new hires over the business cycle. We must therefore look elsewhere.

Our results are also somewhat at odds with a long line of research on credit constraints facing small firms. Gertler and Gilchrist (1994) and Sharpe (1994) among others find small firms have a disproportionate response to recessions and argue this is driven by the disproportionate impact of a credit market tightening. However, Chari, Christiano and Kehoe (2007) show that the differential responsiveness by firm size is a function of the type of recession, with small firms more responsive to monetary policy shocks and large firms more responsive to NBER recessions. Furthermore, Fort et al. (2012) note that the impact of recessions on small firms seems to vary with time period and with the way recessions are measured, since they do not find a consistent pattern over a long time period and across different measures of economic contraction. Our results, for instance, are consistent with MPV who use the unemployment rate (in deviations from its HP-filtered trend) to measure recessions. We do not wish to take a stand on this inconclusive literature, since our focus is on firm quality, not size per se. We simply point out that more information can be gleaned from the wider range of firm characteristics we use.

It could be that high-quality firms experience more cyclical demand in the product market. The cyclical upgrading literature (e.g., Okun 1973 or Bils and MchLaughlin 2001) finds a positive correlation between average wages within an industry and its employment cyclicality; in expansions, workers move from low-wage to high-wage industries, working their

ventures no longer viable. These resources can then be reallocated to more productive ventures. See for example Hall (1991), Mortensen and Pissarides (1994), Caballero and Hammour (1994, 1996) and Gomes, Greenwood and Rebelo (2001).

way up the quality ladder. Though our analysis is within industry, it is certainly possible that the same dynamics driving the industry-level positive correlation could also drive a positive correlation within industry.[12] However, this literature is sparse on the underlying mechanisms driving this result.[13] Instead, it could be that at the time periods studied, the particular aggregate shocks relatively favored low wage industries, and that need not be the case over time.

Another set of hypotheses are drawn from the literature on internal labor markets and managerial discretion. For example, the "pit stop" view that in booms managers are focused on growth and in busts they are focused on efficiency (see for example Koenders and Rogerson 2005) might predict our finding if low-quality firms are always closer to the margin of survival and must therefore always focus on efficiency. Alternatively, managers may be differentially risk averse across different firm types. More risk averse managers may not take advantage of growth opportunities to the same degree, and their firms may be less cyclical as a result. It might be reasonable to think that managers at small firms are less risk averse. However, our finding holds not only across firm size, but also for other firm characteristics controlling for size, suggesting risk aversion is unlikely to be the mechanism.

A final theory in the family of firm personnel practices that we explore is related to wage rigidity. A longstanding literature (see for example Shimer 2004 or Hall 2005b among many others) points to downward wage rigidities as an explanation for reduced labor demand in recessions. After experiencing an aggregate negative productivity shock, firms cannot afford to hire or keep workers if they cannot lower wages by a commensurate amount. Perhaps larger, higher quality firms, with a greater presence of internal labor market patterns, face more downward wage rigidity, and therefore are forced to make more layoffs in recessions.

[12] Holmes and Stevens (2012), for example, argue that within manufacturing, small firms are less impacted by trade-driven competition in the product market since they produce to a more niche, local market.

[13] Okun (1973) proposes a model where all sectors benefit from positive productivity shocks but employment growth in the high-quality sector puts upward pressure on wages in the low quality sector. The high-quality sector does not face wage pressure if it has a queue of workers waiting to fill vacancies. The low-quality sector therefore cannot expand as much. This model does well in predicting patterns during expansions but less well in predicting the mirror image in contractions.

Lower quality firms may be able to reduce pay of their existing workforce and therefore be able to keep them. The degree to which nominal wages are downwardly rigid remains a completely open empirical question with evidence on all sides (see Pissarides 2009 for a survey). Our findings that high-quality firms shrink more in recessions and are relatively more likely to make separations, but are also relatively more likely to make hires, is consistent with the literature finding that starting wages are more procyclical than incumbent wages (Martins, Solon and Thomas 2010). To our knowledge no one has looked at wage rigidity as a function of firm quality, but that would be an interesting area for future research.

However, we find an ad hoc assumption of differential wage rigidity somewhat less satisfying. One foundation for differential wage rigidity is found in the queuing literature. Suppose high-quality firms build up a queue of workers who wish to work there, driven for example by an efficiency wage (Akerlof and Yellen 1985), imperfect information (Weiss 1980) or explicit personnel policies (Okun 1973). They would then find it easier to adjust the size of their workforce without adjusting wages. A corroborating piece of evidence comes from the cyclical upgrading literature which finds that wages are more cyclical in low-paying industries (Bils and McLaughlin 2001). These theories nicely explain why high-quality firms would not increase wages during an expansion, however, they are somewhat less successful in explaining why a firm would not lower wages in a bust.

Rather than a queuing theory, one might think of an efficient market clearing theory of compensating differentials. High-quality firms are better places to work, thus in equilibrium, they might also be more volatile, in order for the marginal worker to be indifferent between working there and a low-quality firm. We find this plausible, but are much more interested in the underlying mechanisms driving this increased volatility. We believe a search-theoretic framework a fruitful place to start and we turn there next.

Moscarini and Postel-Vinay (2012b) develop a search model in which firms compete for worker talent, but high-quality firms can offer more generous contracts. In boomtimes, high-quality firms are therefore more successful in poaching the best workers away from

low-quality firms. In busts, job-to-job transition rates decline substantially so low-quality firms are able to keep their workforce. High-quality firms, in contrast, spent the boom inflating the size of their workforce and in the bust must make layoffs. Our finding that small firms, relatively speaking, make more hires and experience fewer separations in downturns is strongly consistent with this theory and supports the MPV finding that the differential growth rate of small-, compared to large-, firms increases in times of high unemployment. We also view our finding that low-wage and high-churn firms experience fewer separations as highly consistent with the spirit of this theory, though they do not also make more hires.

Taking stock, both a differential wage rigidities story, and a search-theoretic motivation a la MPV are consistent with our set of findings. To disentangle the two, we would need information on the reasons for worker separations. Differential wage rigidities would suggest that at high-quality firms involuntary separations increase in downturns, relative to low-quality firms. However, the MPV model would suggest that voluntary separations fall more at low-quality than at high-quality firms in busts. In principle, we can proxy for voluntary and involuntary separations in the LEHD by whether or not the worker experienced a gap in earnings upon moving. In future work, we hope to examine these relationships.

5 Conclusion

In this paper, we use employer-employee matched U.S. data to study net and gross worker flows over the business cycle as a function of firm quality. We find that low-quality firms fare relatively better in the recession; their growth rates shrink by less. This is because separation rates at low-wage and high-churn firms fall by more. It looks as though high-quality firms are more likely to make layoffs in an economic downturn, while still keeping up a modest amount of hiring. Also, at small firms, a relatively smaller effect on their employment growth rate is driven by both a larger decline in separations as well as a smaller fall in hiring. Finally, we find sizeable negative effects of the unemployment rate on replacement hire rates

at low-quality firms, compared to high-quality firms. This set of results is consistent with the need for low-quality firms to continually replenish their stock of workers in boomtimes when they lose their workforce to high-quality firms, while in busts they can grow, relative to high-quality firms. In contrast, high-quality firms grow relatively faster in boomtimes and experience relatively more separation in busts. As we have said, these findings are consistent with several models of the labor market, but especially the MPV poaching model described above.

Furthermore, this set of facts is suggestive of two important implications for workers matching in recessions. First, low-quality firms may have an easier time attracting and retaining high-quality workers in a recession. We might therefore see that among workers matching in recessions, workers will be overqualified, relative to the firms that hire them. Second, relatively speaking, low-quality firms have an easier time retaining workers in recessions, since, as we have shown, they shrink less quickly. Therefore a worker matching to a low-quality firm in a recession is likely to stay there for longer; he or she will have less of an opportunity to make a job-to-job transition to a high-quality firm. In our data, we can look at both of these effects directly and we do so in Kahn and McEntarfer (2013).

While previous research has emphasized match quality may decline in recessions due to a lack of workforce reallocation (Barlevy 2002), our evidence here suggests an additional sullying effect. The types of jobs workers get stuck in are more likely to be low-quality. This is evident in our finding that, relatively speaking, low-quality firms have an easier time growing in the bust, while high-quality firms want to reduce the size of their workforce. One interpretation of our results is that the reduced ability to move on to better matches caused by a recession has a greater impact on workers in low-quality firms compared to those in high-quality firms. These results have implications then for the costs of recessions, both in the short- and long-run. These results have important implications for the literatures on the differential impact of recessions of workers. For example, that entering the labor market in a recession (Kahn 2010, Oreopoulos, von Wachter and Heisz 2010) or being displaced from

a long-term job in a recession (Davis and von Wachter 2010) has particularly long-lasting, negative wage impacts, could potentially be explained by these workers spending more time in low-quality firms.

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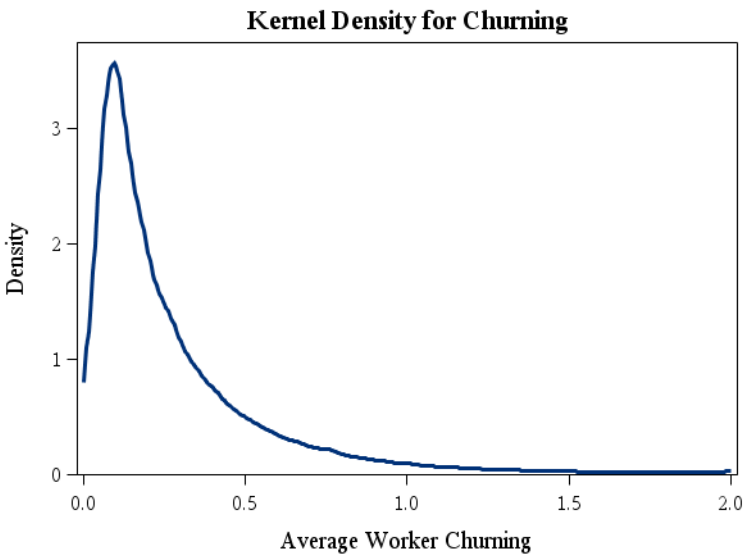
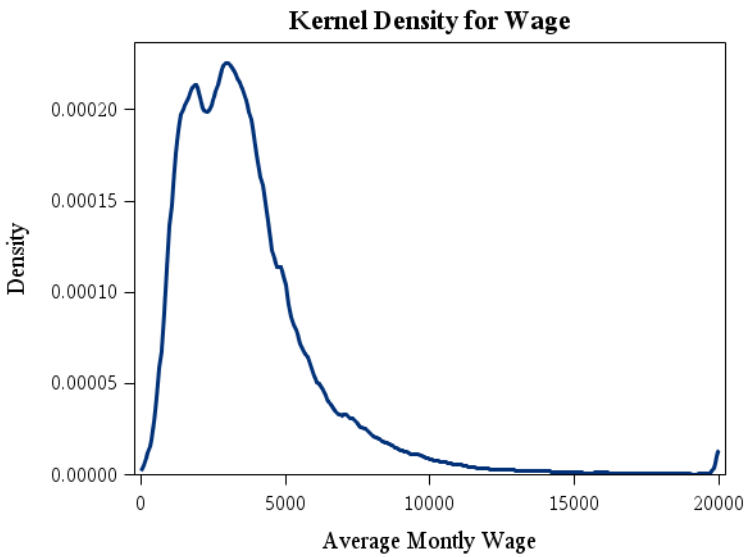
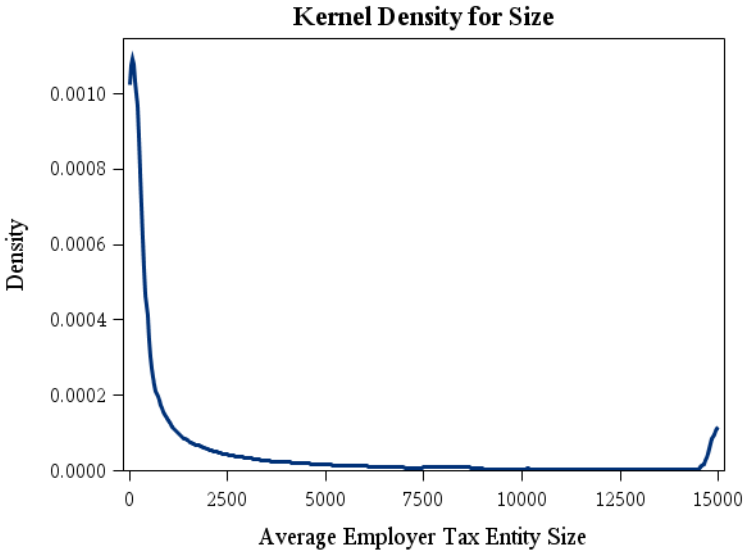
Figure 1: Distributions of Firm Churning, Average Wage, and Size

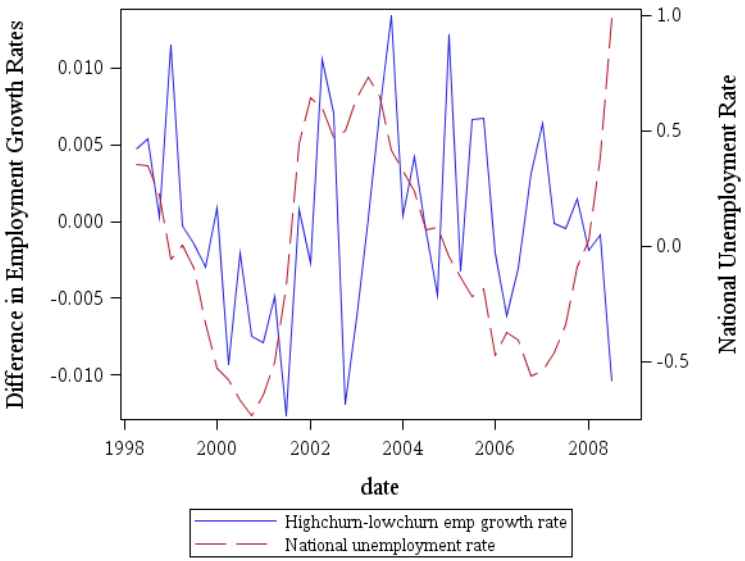


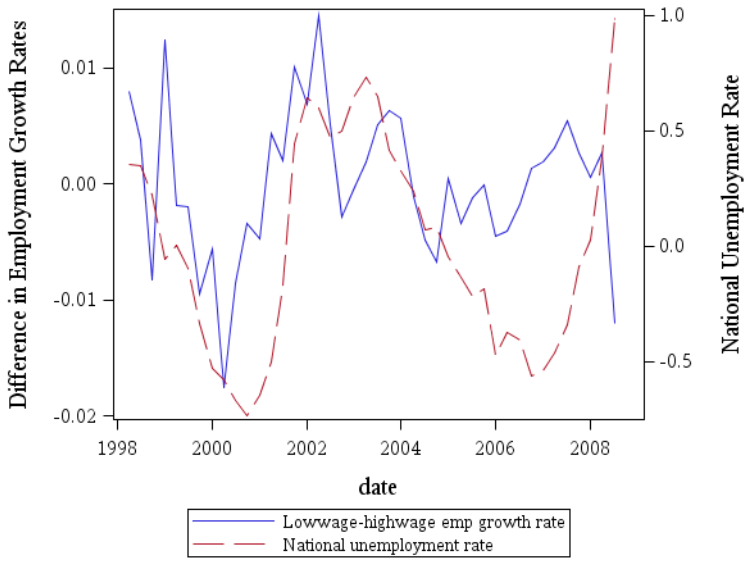


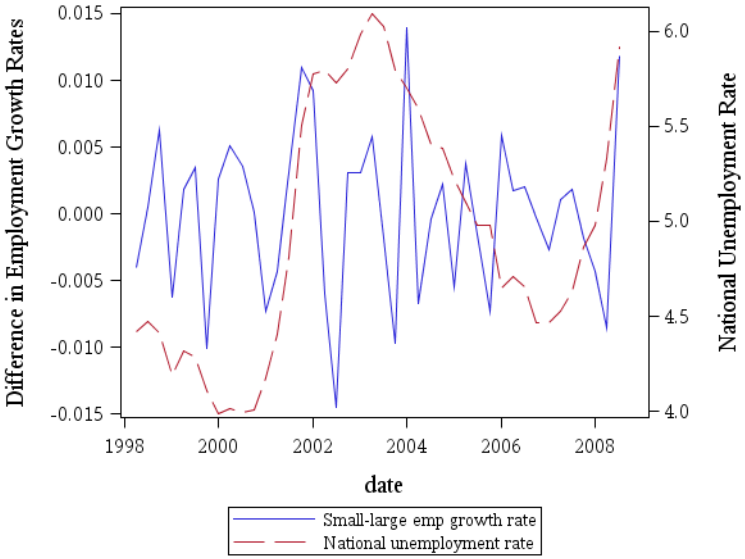


Note: Firm churning is capped at 2, Firm size at 15,000 employees, and firm average wages at 20,000/mo ($2008)

Figure 2: Differences in Employment Growth Rates





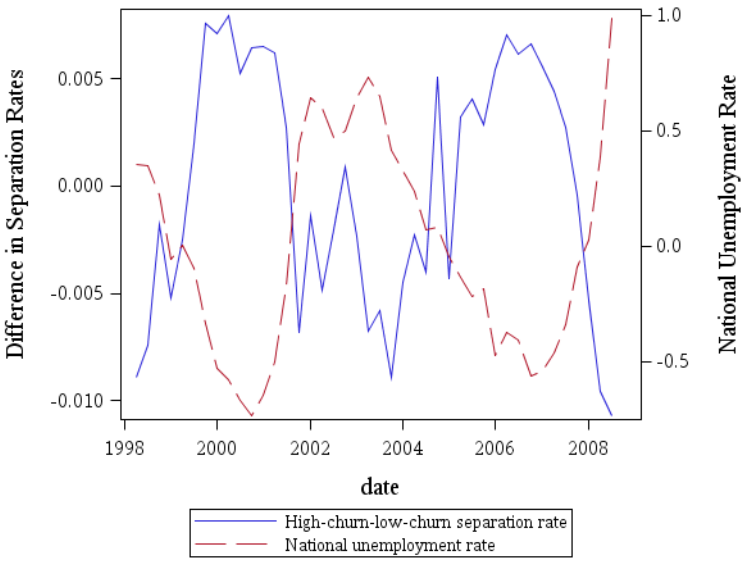


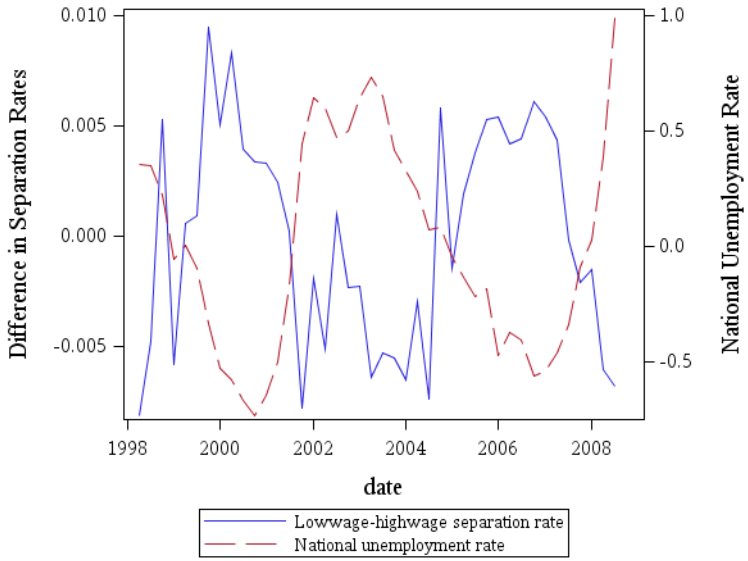
Correlations:

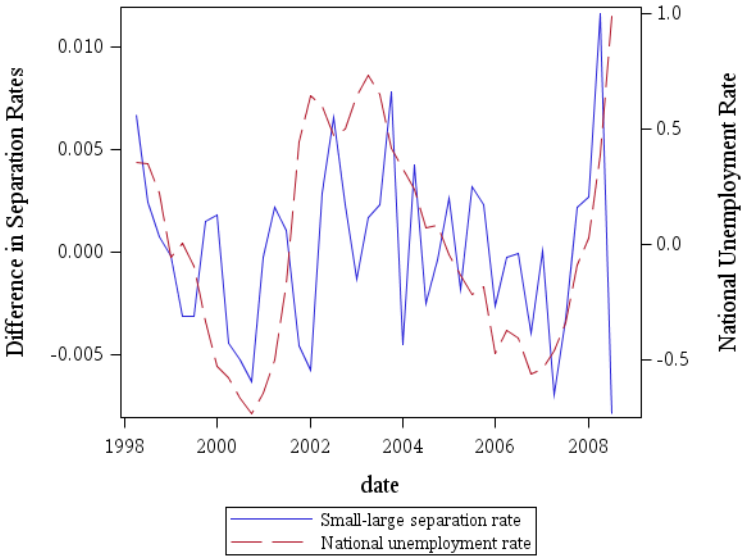
Difference High Churn-Low Churn Employment Growth and Unemployment Rate: 0.174
Difference Low Wage-High Wage Employment Growth and Unemployment Rate: 0.349
Difference Small Firm-Large Firm Employment Growth and Unemployment Rate: 0.130

Note: Both employment growth rates and unemployment rates are HP filtered. Data are from 25 state LEHD sample, private employers only

Figure 4: Differences in Separation Rates





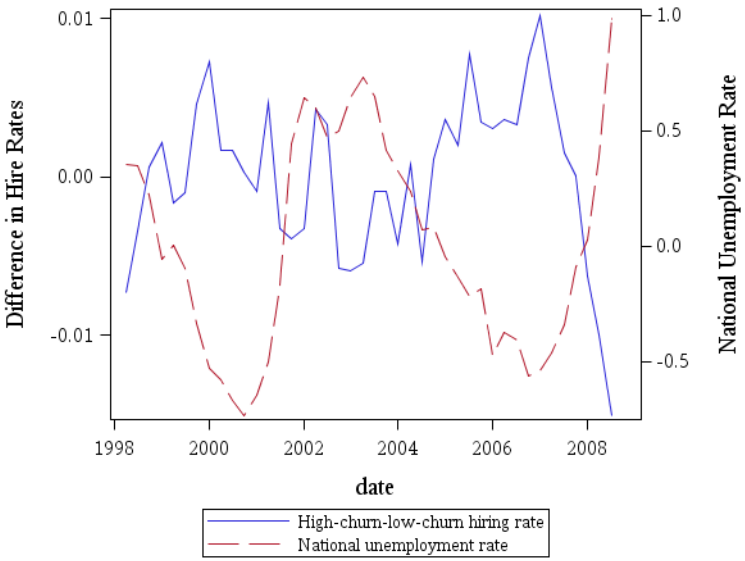


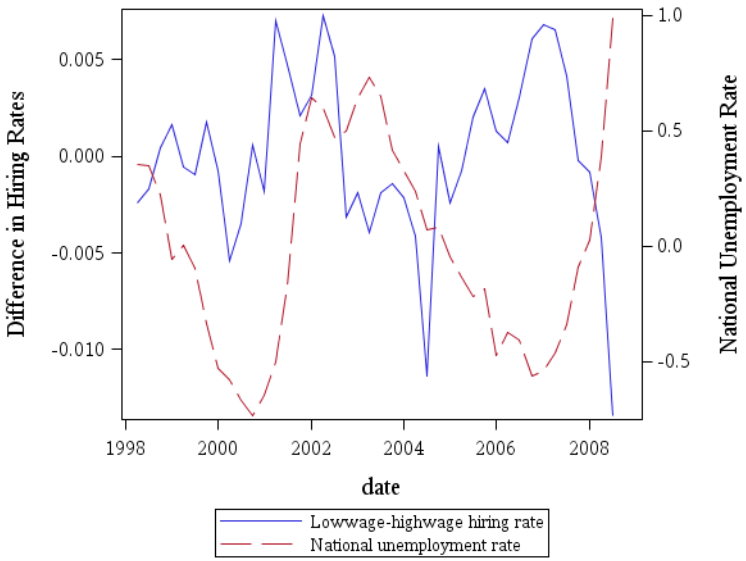
Correlations:

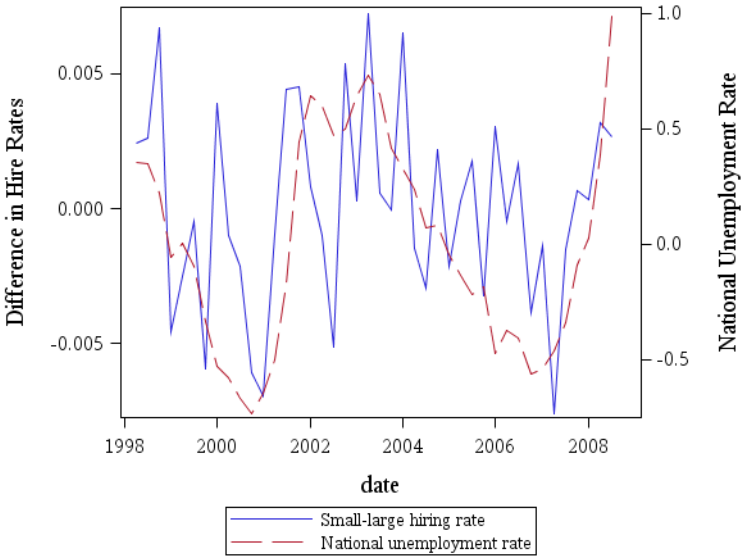
Difference High Churn-Low Churn Separation Rate and Unemployment Rate: -0.841
Difference Low Wage-High Wage Separation Rate and Unemployment Rate: -0.758
Difference Small Firm-Large Firm Separation Rate and Unemployment Rate: 0.255

Note: Both separation rates and unemployment rates are HP filtered. Data are from 25 state LEHD sample, private employers only

Figure 3: Differences in Hire Rates





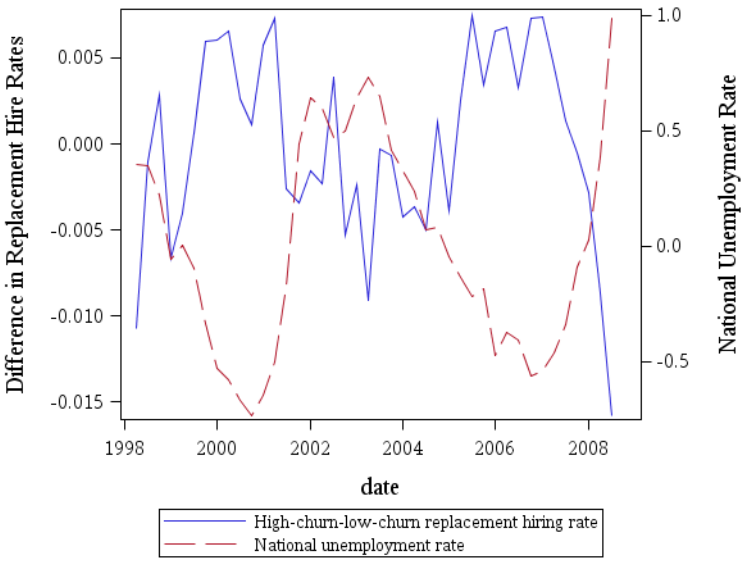


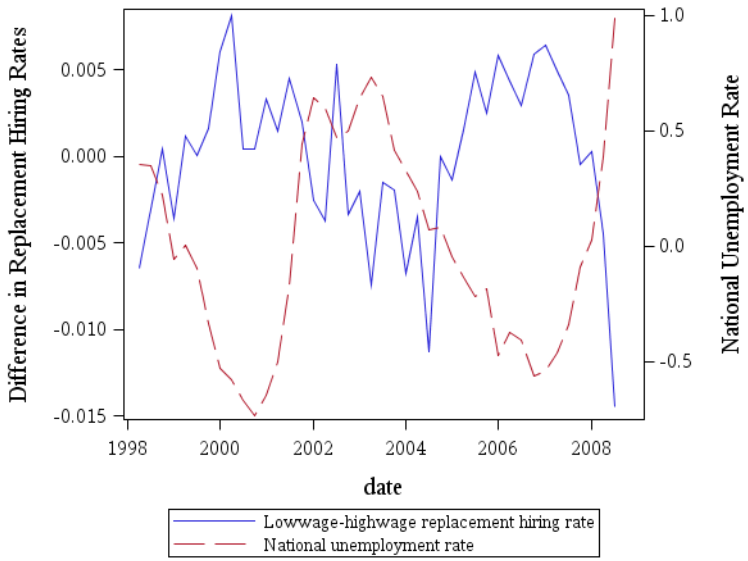
Correlations:

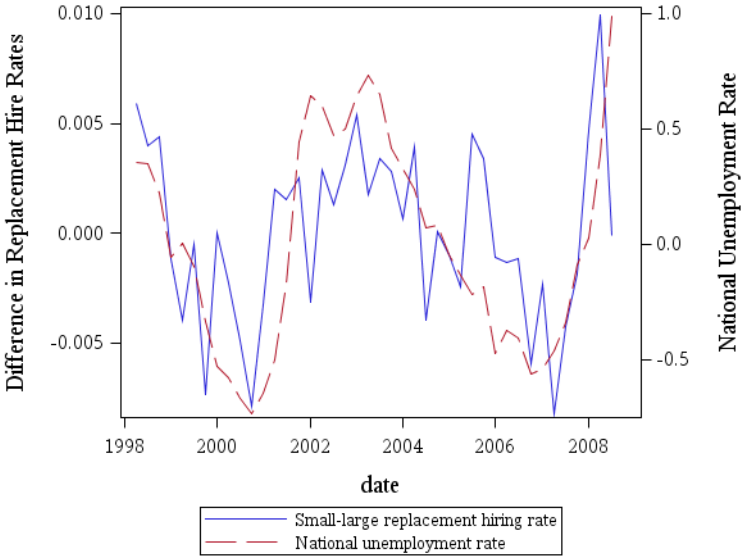
Difference High Churn-Low Churn Hire Rate and Unemployment Rate: -0.669
Difference Low Wage-High Wage Hire Rate and Unemployment Rate: -0.356
Difference Small Firm-Large Firm Hire Rate and Unemployment Rate: 0.476

Note: Both hire rates and unemployment rates are HP filtered. Data are from 25 state LEHD sample, private employers only

Figure 5: Differences in Replacement Hire Rates





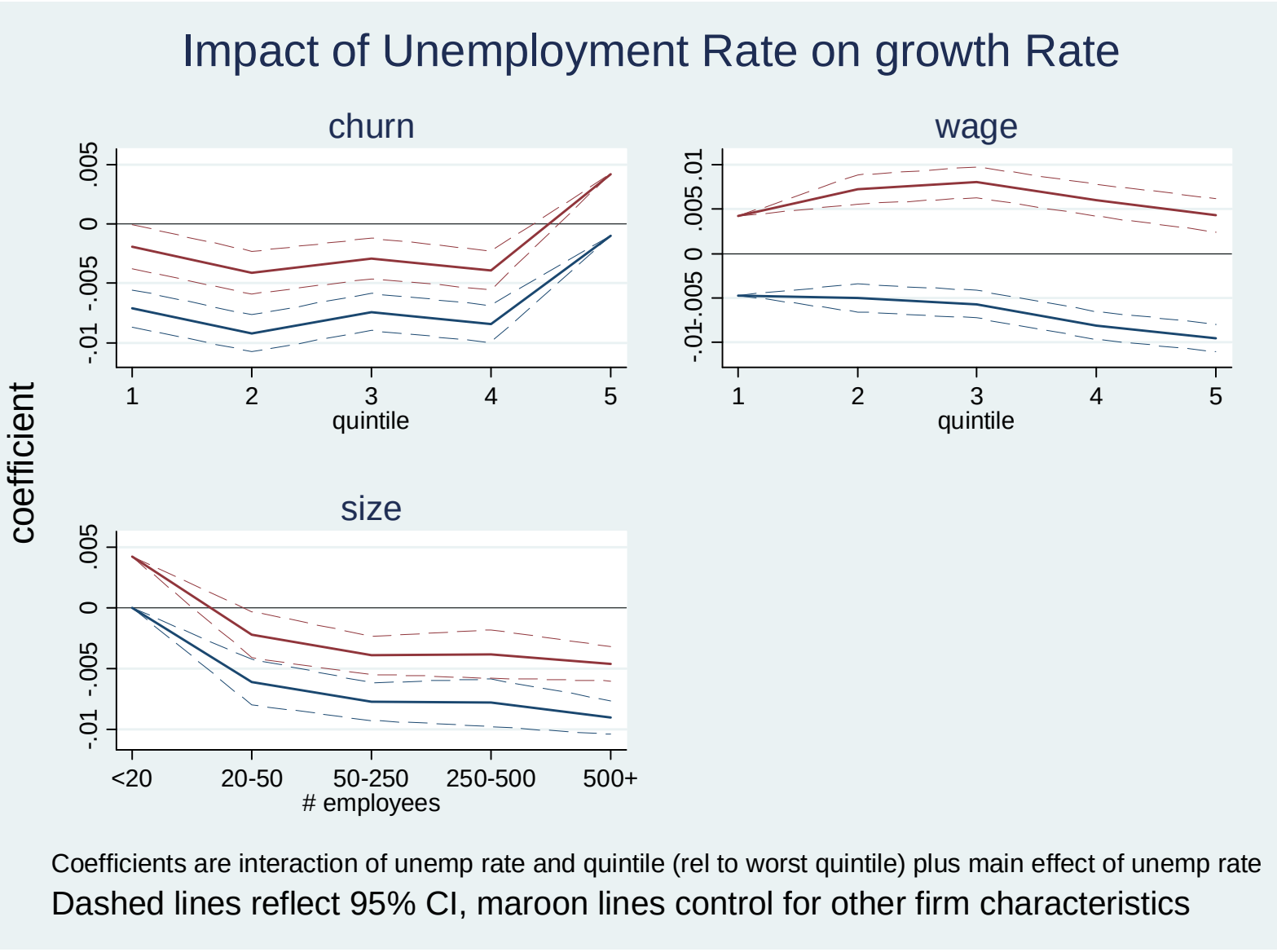


Correlations:

Difference High Churn-Low Churn Replacement Hire Rate and Unemployment Rate: -0.737
Difference Low Wage-High Wage Replacement Hire Rate and Unemployment Rate: -0.704
Difference Small Firm-Large Firm Replacement Hire Rate and Unemployment Rate: 0.589

Note: Both replacement hire rates and unemployment rates are HP filtered. Data are from 25 state LEHD sample, private employers only

Figure 6:



Coefficients are interaction of unemp rate and quintile (rel to worst quintile) plus main effect of unemp rate

Dashed lines reflect 95% CI, maroon lines control for other firm characteristics

Figure 7:

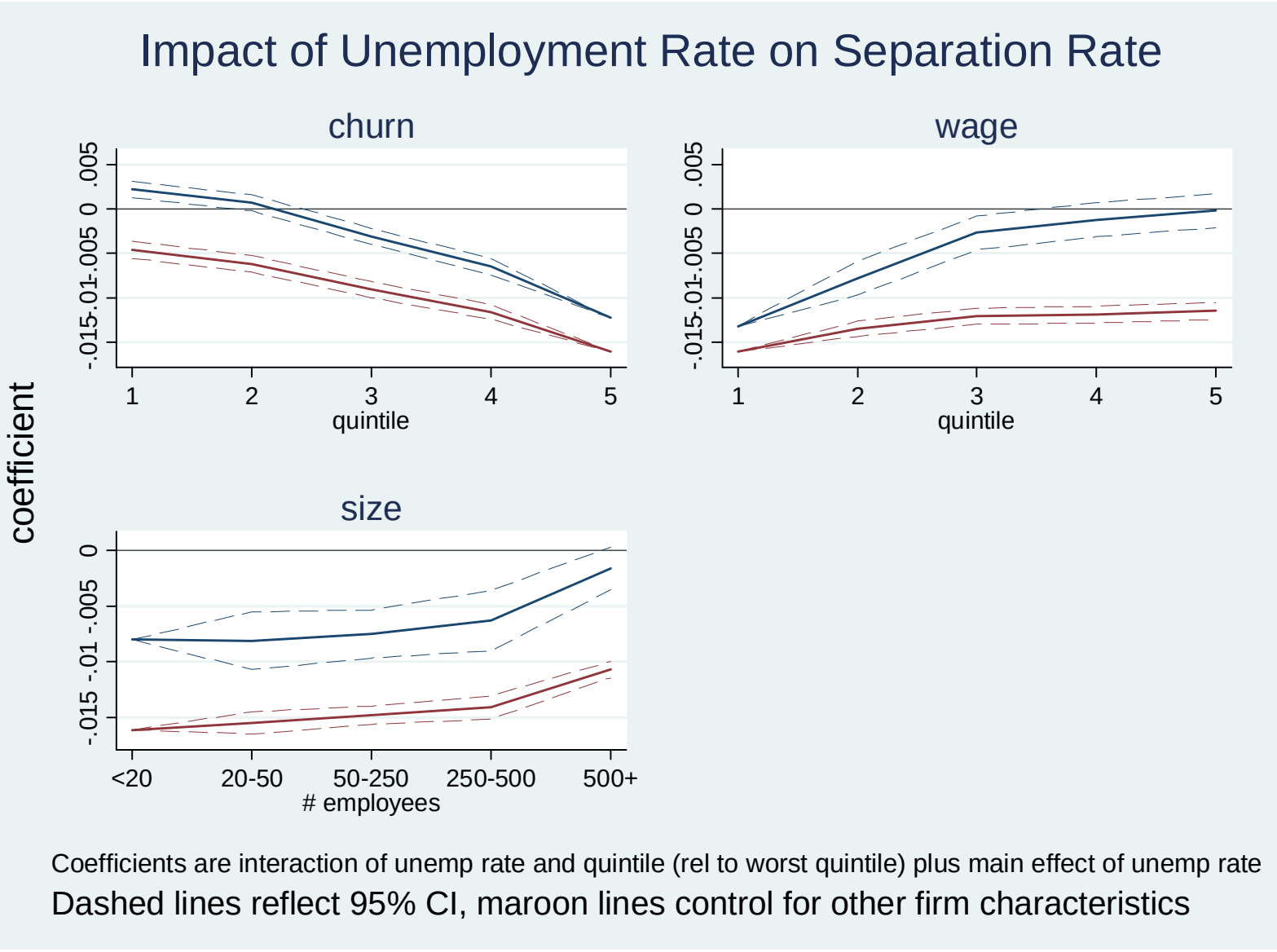
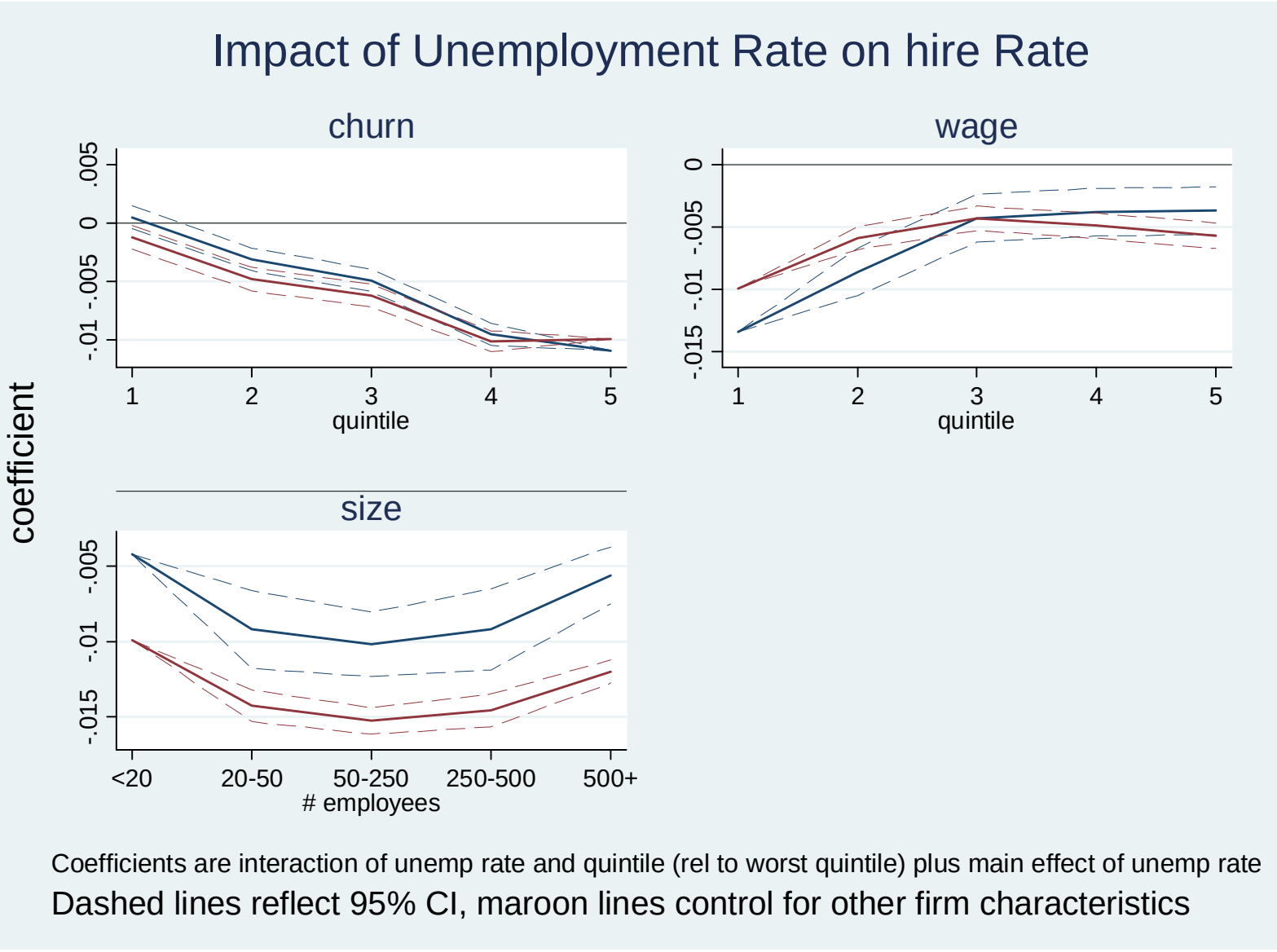

Impact of Unemployment Rate on Separation Rate
churn
wage
size
coefficient
-.015
-.01
-.005
0
.005
1
2
3
4
5
quintile
<20
20-50
50-250
250-500
500+
employees
Coefficients are interaction of unemp rate and quintile (rel to worst quintile) plus main effect of unemp rate
Dashed lines reflect 95% CI, maroon lines control for other firm characteristics

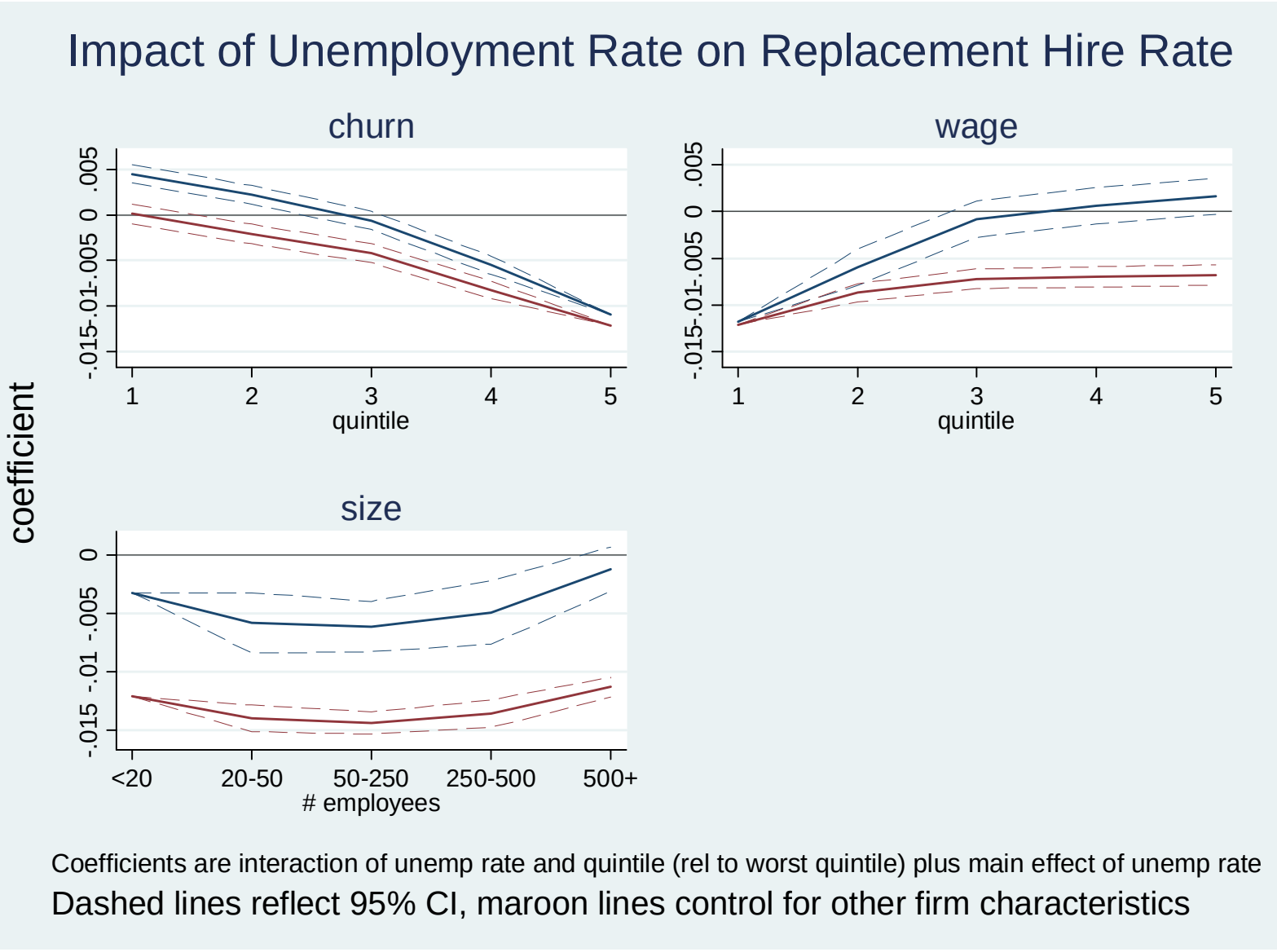
Figure 8



Coefficients are interaction of unemp rate and quintile (rel to worst quintile) plus main effect of unemp rate

Dashed lines reflect 95% CI, maroon lines control for other firm characteristics

Figure 9:


Impact of Unemployment Rate on Replacement Hire Rate
churn
wage
size
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-.015 -.01 -.005 0 .005
1 2 3 4 5
quintile
<20 20-50 50-250 250-500 500+
employees
Coefficients are interaction of unemp rate and quintile (rel to worst quintile) plus main effect of unemp rate
Dashed lines reflect 95% CI, maroon lines control for other firm characteristics

Table 1: Employment weighted means, by firm type

	Growth Rate	Separation Rate	Hire Rate	Replacement Rate	Unemp Rate
Churn:					
Lowest quintile	0.007	0.059	0.060	0.046	4.976
2nd	0.007	0.083	0.085	0.070	4.973
3rd	0.008	0.123	0.124	0.106	4.970
4th	0.009	0.183	0.185	0.165	4.967
Highest Quintile	0.008	0.338	0.338	0.319	4.940
Wage:					
Lowest quintile	0.010	0.271	0.273	0.253	4.962
2nd	0.008	0.183	0.184	0.165	4.962
3rd	0.007	0.129	0.130	0.113	4.964
4th	0.008	0.108	0.110	0.094	4.971
Highest Quintile	0.007	0.093	0.095	0.080	4.967
Size:					
<20 employees	0.010	0.187	0.190	0.172	4.967
20-50	0.009	0.183	0.185	0.169	4.963
50-250	0.007	0.170	0.171	0.156	4.961
250-500	0.007	0.155	0.155	0.137	4.962
>500	0.008	0.128	0.130	0.112	4.968

Weighted by Average Employment Over the Quarter

Table 2: Growth Rates by Firm Characteristics and Economic Conditions				
	I	II	III	IV
National Unemployment Rate	-0.0010	-0.0047	-0.00003	0.0042
(U)	[0.00057]+	[0.00057]**	[0.00058]	[0.0008]**
U * 4th quintile churn	-0.0074			-0.0081
	[0.00078]**			[0.00081]**
U * 3rd quintile churn	-0.0064			-0.0071
	[0.00078]**			[0.00086]**
U * 2nd quintile churn	-0.0082			-0.0083
	[0.00078]**			[0.00090]**
U * 1st quintile churn	-0.0061			-0.0061
	[0.00078]**			[0.00092]**
U * 5th quintile wage		-0.0048		0.0001
		[0.00078]**		[0.00093]
U * 4th quintile wage		-0.0034		0.0018
		[0.00078]**		[0.00090]+
U * 3rd quintile wage		-0.0010		0.0038
		[0.00078]		[0.00087]**
U * 2nd quintile wage		-0.0003		0.0030
		[0.00078]		[0.00082]**
U*Large firm (>500 employees)			-0.0090	-0.0088
			[0.00069]**	[0.00070]**
U*250-500 employees			-0.0078	-0.0080
			[0.00098]**	[0.00099]**
U*50-250 employees			-0.0077	-0.0081
			[0.00078]**	[0.00079]**
U*20-50 employees			-0.0061	-0.0064
			[0.00098]**	[0.00070]**

Regressions weighted by average employment over the quarter

Regressions control for main effects of firm quality and a constant, quarter fe's, a timetrend and industry fe's.

Table 3: Separation Rates by Firm Characteristics and Economic Conditions				
	I	II	III	IV
National Unemployment Rate (U)	-0.0123	-0.0132	-0.0080	-0.0161
	[0.00033]**	[0.00070]**	[0.00081]**	[0.00042]**
U * 4th quintile churn	0.0058			0.0045
	[0.00046]**			[0.00042]**
U * 3rd quintile churn	0.0092			0.0070
	[0.00046]**			[0.00045]**
U * 2nd quintile churn	0.0130			0.0099
	[0.00046]**			[0.00047]**
U * 1st quintile churn	0.0145			0.0115
	[0.00046]**			[0.00048]**
U * 5th quintile wage		0.0130		0.0046
		[0.00096]**		[0.00048]**
U * 4th quintile wage		0.0120		0.0042
		[0.00096]**		[0.00047]**
U * 3rd quintile wage		0.0105		0.0040
		[0.00096]**		[0.00046]**
U * 2nd quintile wage		0.0054		0.0026
		[0.00096]**		[0.00043]**
U*Large firm (>500 employees)			0.0064	0.0054
			[0.00096]**	[0.00037]**
U*250-500 employees			0.0017	0.0020
			[0.00136]	[0.00052]**
U*50-250 employees			0.0005	0.0013
			[0.0011]	[0.00041]**
U*20-50 employees			-0.0001	0.0006
			[0.0013]	[0.00050]

Regressions weighted by average employment over the quarter

Regressions control for main effects of firm quality and a constant, quarter fe's, a timetrend and industry fe's.

Table4: Hire Rates by Firm Characteristics and Economic Conditions				
	I	II	III	IV
National Unemployment Rate	-0.0109	-0.0134	-0.0042	-0.0099
(U)	[0.00035]**	[0.00070]**	[0.00080]**	[0.00051]**
U * 4th quintile churn	0.0014			-0.0002
	[0.00048]**			[0.00045]
U * 3rd quintile churn	0.0060			0.0037
	[0.00048]**			[0.00048]**
U * 2nd quintile churn	0.0078			0.0051
	[0.00048]**			[0.00050]**
U * 1st quintile churn	0.0114			0.0087
	[0.00049]**			[0.00051]**
U * 5th quintile wage		0.0097		0.0042
		[0.00096]**		[0.00052]**
U * 4th quintile wage		0.0096		0.0050
		[0.00096]**		[0.00050]**
U * 3rd quintile wage		0.0091		0.0056
		[0.00096]**		[0.00049]**
U * 2nd quintile wage		0.0048		0.0040
		[0.00095]**		[0.00046]**
U*Large firm (>500 employees)			-0.0014	-0.0021
			[0.00095]**	[0.00039]**
U*250-500 employees			-0.0050	-0.0047
			[0.00135]**	[0.00055]**
U*50-250 employees			-0.0060	-0.0054
			[0.00110]**	[0.00044]**
U*20-50 employees			-0.0050	-0.0044
			[0.0013]**	[0.00053]**

Regressions weighted by average employment over the quarter

Regressions control for main effects of firm quality and a constant, quarter fe's, a timetrend and industry fe's.

Table 5: Replacement Hire Rates by Firm Characteristics and Economic Conditions				
	I	II	III	IV
National Unemployment Rate (U)	-0.0109	-0.0118	-0.0032	-0.0121
	[0.00037]**	[0.00070]**	[0.00096]**	[0.00048]**
U * 4th quintile churn	0.0054			0.0039
	[0.00051]**			[0.00049]**
U * 3rd quintile churn	0.0103			0.0079
	[0.00051]**			[0.00052]**
U * 2nd quintile churn	0.0131			0.0100
	[0.00051]**			[0.00054]**
U * 1st quintile churn	0.0154			0.0122
	[0.00051]**			[0.00055]**
U * 5th quintile wage		0.0134		0.0053
		[0.00097]**		[0.00055]**
U * 4th quintile wage		0.0124		0.0051
		[0.00097]**		[0.00054]**
U * 3rd quintile wage		0.0110		0.0049
		[0.00097]**		[0.00052]**
U * 2nd quintile wage		0.0058		0.0034
		[0.00097]**		[0.00049]**
U*Large firm (>500 employees)			0.0020	0.0008
			[0.00096]*	[0.00042]+
U*250-500 employees			-0.0017	-0.0015
			[0.00136]	[0.00059]*
U*50-250 employees			-0.0029	-0.0023
			[0.00108]**	[0.00047]**
U*20-50 employees			-0.0026	-0.0019
			[0.00080]*	[0.00048]**

Regressions weighted by average employment over the quarter

Regressions control for main effects of firm quality and a constant, quarter fe's, a timetrend and industry fe's.