NBER WORKING PAPER SERIES

CYCLICAL JOB LADDERS BY FIRM SIZE AND FIRM WAGE

John Haltiwanger
Henry Hyatt
Lisa B. Kahn
Erika McEntarfer

Working Paper 23485
http://www.nber.org/papers/w23485

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2017

This paper is an integration of two working papers "Employment Cyclicality and Firm Quality" by Kahn and McEntarfer (NBER Working Paper #20698, 2014) and "Cyclical Reallocation of Workers Across Employers by Firm Size and Firm Wage" (NBER Working Paper #21235, 2015) by Haltiwanger, Hyatt and McEntarfer. We cite both of these papers extensively (referring to them as KM (2014) and HHM (2015)) for sensitivity and robustness analysis that is not included in this integrated paper. Collectively, we thank participants at many seminars and workshops for many helpful comments and suggestions where these working papers have been presented. We also thank Alex Mas, Richard Rogerson, Chris Stanton, and participants at the Labor and Employment Relations Association sessions at the Allied Social Science Associations 2017 Meeting for help with the merged paper. Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Cyclical Job Ladders by Firm Size and Firm Wage
John Haltiwanger, Henry Hyatt, Lisa B. Kahn, and Erika McEntarfer
NBER Working Paper No. 23485
June 2017
JEL No. E24,E32,J63

ABSTRACT

We study whether workers progress up firm wage and size job ladders, and the cyclicality of this movement. Search theory predicts that workers should flow towards larger, higher paying firms. However, we see little evidence of a firm size ladder, partly because small, young firms poach workers from all other businesses. In contrast, we find strong evidence of a firm wage ladder that is highly procyclical. During the Great Recession, this firm wage ladder collapsed, with net worker reallocation to higher wage firms falling to zero. The earnings consequences from this lack of upward progression are sizable.

John Haltiwanger
Department of Economics
University of Maryland
College Park, MD 20742
and NBER
haltiwan@econ.umd.edu

Henry Hyatt
Center for Economic Studies
U.S. Census Bureau
4600 Silver Hill Road
Washington, DC 20233
henry.r.hyatt@census.gov

Lisa B. Kahn
Yale University
School of Management
P. O. Box 208200
New Haven, CT 06520
and NBER
lisa.kahn@yale.edu

Erika McEntarfer
U.S. Census Bureau
Center for Economic Studies
4600 Silver Hill Road
ACSD HQ-5K179
Washington, DC 20233
erika.mcentarfer@census.gov

1 Introduction

The firm a worker matches to increasingly matters for earnings outcomes.[1] Moreover, there is considerable evidence that high paying firms are also more productive firms.[2] How do workers find jobs in high-paying, high-productivity firms? There is much evidence that job mobility plays a critical role in earnings growth over the life cycle.[3] However, less is known about a worker's progression up the firm pay and productivity ladder, even though theoretical work points to this pattern of upward mobility. Indeed, in the large class of job ladder models beginning with Burdett and Mortensen (1998), the search frictions that inhibit workers from matching to better firms are gradually overcome through on-the-job search. This class of models suggests that the poaching of workers away from low paying and towards high paying firms plays an important role in career trajectories.

At the same time, recessions impede worker mobility (Lazear and Spletzer (2012), Davis, Faberman and Haltiwanger (2012), Hyatt and McEntarfer (2012a)). For example, in the Great Recession the voluntary quit rate fell in half.[4] This reduced mobility may especially impact movements up the job ladder. As hypothesized by Moscarini and Postel-Vinay (2009, 2013), during slack markets, when there is less competition for workers, firms at the bottom of the job ladder can more easily retain workers who ordinarily would have been poached away.[5] However, little is known about the direction and cyclicality of worker flows across firms.

In this paper, we test whether workers tend to move up a firm job ladder via job-to-job moves, and the cyclicality of such moves. We explore firm ladders along two dimensions, size and wage, since both are linked to job quality and productivity in theory and empirical

[1] A substantial fraction of the rise in earnings inequality in the U.S. over the last thirty years can be attributed to increased pay dispersion across firms (Barth et al. (2016), Card, Heining, and Kline (2016), Song et al. (2015)).

[2] See, for example, Abowd, Kramarz and Margolis (1999), Dunne et. al. (2004), and Abowd et. al. (2005).

[3] See, among others, Topel and Ward (1992), Keith and McWilliams (1999), Bjelland et al. (2011), Hyatt and McEntarfer (2012b), and Fallick, Haltiwanger, and McEntarfer (2012).

[4] See Figure 1 of Davis and Haltiwanger (2014).

[5] Moscarini and Postel-Vinay (2013) develop a dynamic Burdett and Mortensen-style search model with a job ladder where firms at the top of the ladder can more easily attract hires by offering higher wages. The implication is that in a downturn firms at the bottom of the job ladder can more easily grow since their workers are less likely to be poached away by firms at higher rungs.

work.[6] Surprisingly, we see little evidence of a firm size ladder. Workers do not tend to move from small to large firms. This is partly because small, young firms are a net attractor of workers making job-to-job moves. In contrast, we find strong evidence of a firm wage ladder in that workers tend to flow, on net, from low wage to high wage firms via direct job-to-job moves. Furthermore, this movement is strongly procyclical, slowing to almost zero in recessionary periods. These dynamics have important consequences for mobility and earnings growth over the business cycle. For example, in the Great Recession, movement out of the bottom rung of the wage ladder declined by 85%, with an associated 40% decline in earnings growth.

This paper thus contributes the first direct evidence on job-to-job moves across firm size and firm wage ladders over the business cycle. Previous evidence on whether firms at the top of the ladder poach from those at the bottom has been limited, especially for the U.S.[7] To measure these moves, we use matched employer-employee data from the Longitudinal Employer Household Dynamics (LEHD) database from 1998-2011. We define a job-to-job move (or a "poaching flow") as one where a worker moves directly from one employer to another. The data allow us to ask whether workers move on net from small or low wage firms to large or high wage firms. We indeed find evidence in favor of a firm wage ladder where high wage firms grow 0.7% per quarter through poaching flows. In contrast, low wage firms lose 1.2% of employment per quarter. Thus, on net, more workers move up the ladder than down. However, we see little evidence of a firm size ladder, where poaching modestly moves workers in the *wrong* direction, from large to small firms.

We then investigate employment cyclicality by firm size and firm wage, using both time series and state-time variation. Previous evidence on this question has been only indirect. Moscarini and Postel-Vinay (2012, hereafter MPV (2012)) show, across a range of countries, that employment growth is more cyclically sensitive at large firms than at small firms. This

[6] A key feature of the stationary equilibrium in Burdett and Mortensen (1998) is that higher wage firms are larger. See Brown and Medoff (1989) for empirical evidence that firm size and wages are positively linked. See Foster et. al. (2008) for empirical evidence that firm size and productivity are positively linked.

[7] Moscarini and Postel-Vinay (2009, 2016) show that large employers have a greater share of hires directly from other firms than from non-employment, relative to small employers. However, they do not explore whether workers tend to move, on net, from small to large firms. Bagger and Lentz (2016) and Sorkin (2016) present evidence that firms with a high poaching rank (i.e., a firm that is high in the ranking of firms hiring workers from others) are more likely to be high wage and high productivity firms.

cyclical pattern is consistent with their poaching model where large firms have an advantage attracting workers because they offer higher wages. This advantage is greater in tight markets when there is more competition for workers. Their model predicts that large firms grow more quickly in booms via poaching, and shrink more quickly in busts, relative to small firms. However, MPV lack the data to directly test whether overall employment changes are driven by poaching. Furthermore, their result that large firms are more cyclically sensitive is at odds with the conventional wisdom in a long literature (beginning with Gertler and Gilchrist (1994)) suggesting that small firms are more cyclically sensitive because of credit constraints.

In order to address these two issues, we decompose the overall employment effect into components accounted for by poaching and by moves to and from non-employment. We examine the cyclicality of all three types of moves across the job ladder using two cyclical indicators: the HP-filtered unemployment rate and the change in the unemployment rate. The former was used in MPV (2012) as an indicator of labor market tightness, while the latter proxies for cyclical contractions and expansions and may better align with credit crunches.[8]

Our results confirm the MPV (2012) finding that employment at large firms is more sensitive to the unemployment rate than that at small firms. However, this effect is driven in equal parts by poaching moves and moves to and from non-employment, even though the primary theoretical driver in MPV (2012) is poaching moves. Furthermore, we find that while large firms shrink faster than small firms in times of high unemployment, the opposite is true in times of rising unemployment. Small firms shrink relative to large firms in cyclical contractions. This is true for both overall employment and its two components, poaching and moves to and from non-employment. This helps reconcile the differing views on the cyclical sensitivity of small firms from the previous literature. Each emphasizes a different aspect of the business cycle. Credit crunches are primarily coincident with economic contractions, while labor market slackness is primarily coincident with periods of high unemployment that often last long into economic expansions.

In contrast, we find strong evidence in favor of a cyclical firm wage ladder. Net poaching

[8]The change in the unemployment rate better aligns with NBER dated recessions than the HP-filtered unemployment rate. As is well known, the two measures have diverged in the jobless recovery era.

moves up the job ladder significantly decline in downturns, regardless of the cyclical indicator used. Thus the wage ladder aligns well with the implications of search theory that workers tend to make moves up the job ladder but this progress is impeded in downturns. However, these poaching effects do not necessarily imply that overall employment is more cyclically sensitive at high wage firms, as the Moscarini and Postel-Vinay (2013) model suggests. This is because moves to and from non-employment tend to offset poaching effects. In particular, low-wage firms are able to grow in expansions despite losing a large share of their workers through poaching by increasing hires from non-employed workers. These results highlight the importance of directly examining poaching flows to test the job ladder models. Examining overall employment changes incorrectly supports a firm size ladder and provides only mixed evidence for a firm wage ladder.

Thus, even though the job ladder models imply a tight link between firm size and wage, we find very different poaching patterns. Despite the well-known positive correlation between firm wage and size (Brown and Medoff, (1989), Haltiwanger et al. (2012)), there are many factors that may drive a wedge in this relationship. We explore one such factor, firm age. Firms are born small and then exhibit an up-or-out dynamic that takes some time to unfold.[9] This pattern suggests there are young firms that are highly productive and fast growing but small. Consistent with this notion, we find that small young firms poach workers on net from all along the size distribution.[10] This can help explain why we see little evidence of a firm size ladder. Most of the previous literature on the job ladder has tended to focus on firm size, usually because of measurement issues. However, we show that because of the rich life cycle dynamics of firms that coincide with size, firm wage is likely a much better proxy for the job ladder. We find that once we control for firm age that there is more support for a firm size ladder although the firm wage ladder is much more apparent.

In the final part of the paper we focus on the firm wage ladder, which is robustly consistent with the predictions of job ladder models. As we have shown, upward mobility via poaching slows in downturns.[11] The facts we uncover in this paper may then have impor-

[9]See, e.g., Haltiwanger, Jarmin and Miranda (2013).

[10]These findings are consistent with Sorkin (2016) who uses a revealed preference approach to show that workers do prefer high wage firms but also that compensating differentials accounts for a substantial fraction of the variation in pay across firms.

[11]This result is very much in the spirit of Barlevy (2002) who shows in a calibration exercise that the

tant implications for the consequences of recessions for workers. To better understand these consequences, we first examine the causes of the slowdown in upward mobility, allowing for both the overall rate and the direction of mobility to impact worker flows. We then ask what this collapse in the job ladder implies for wage growth over the business cycle.

We show that cyclical variation in the firm wage ladder can be decomposed into two distinct components: the overall pace of job-to-job moves and the propensity to move up the ladder, conditional on changing jobs.[12] We find that it is a decline in the propensity to move up the ladder that accounts for most of the cyclical variation in the firm wage ladder. In expansions, we find that 1.2% of workers at low wage firms are reallocated up the ladder. This movement declines by 40% in contractions, driven almost entirely by a decline in the probability of moving out of the bottom rung, conditional on making a move. The Great Recession saw an 85% drop in this upward mobility.

This reduced upward mobility has important consequences for earnings growth. On average, earnings increase by about one log point per quarter from job-to-job transitions, with about 60% of this increase coming from directional moves up the ladder.[13] The increase in earnings from these directional moves is highly procyclical, declining by about 13% in contractions, relative to expansions, with both the overall pace in job-to-job flows and the propensity for workers to move up the ladder contributing substantially. In the Great Recession, the 85% drop in mobility out of the bottom rung of the ladder is associated with a 40% decline in earnings growth. As is well known, job-to-job moves play an important role in career advancement, especially for young workers (Topel and Ward (1992)). It is also well known that young workers are particularly hard hit in recessions (Hoynes, Miller, and Schaller (2012)) and bear long-lasting consequences of these early impacts (Kahn (2010), Oreopoulos, von Wachter and Heisz (2012), Altonji, Kahn, and Speer (2016)). These earnings losses from a lack of upward mobility may be especially important and persistent for young workers.

Overall our findings help us understand the nature and importance of the high pace of

decline in voluntary mobility seen in recessions has a quantitatively important negative effect on match quality, terming this the "sullying effect" of recessions.

[12] The former will impact upward mobility since, as we have shown, job-to-job moves tend to go in that direction.

[13] Workers also make wage gains through lateral moves.

worker churning in the U.S. labor market. Using a newly developed database of job-to-job flow measures, our findings show that this worker churn is associated with movement up the firm wage ladder. Moreover, our findings show that the well-known pattern of procyclical churning is also associated with a very procyclical firm wage ladder. Given that workers are much more likely to move up the job ladder during booms and that movements up the ladder are critical for earnings growth, our findings highlight the importance of tracking not only the magnitude of labor market churn but the direction of such churn over the business cycle.

The paper proceeds as follows. Section 2 provides a description of the data and the methodology for measuring job-to-job flows. Section 3 presents the main analysis and results on the firm size and firm wage ladders. We present the main findings from the national time series, and also show patterns hold exploiting state-by-quarter variation. Given the somewhat surprising results by firm size, we then consider sensitivity analysis of the results by firm size, and in particular the important role of firm age. Section 4 presents analysis of the nature of the cyclical firm wage ladder and implications for mobility and earnings gains. Section 5 has concluding remarks.

2 Data

2.1 LEHD Overview

We use linked employer-employee data from the Longitudinal Employer-Household Dynamics (LEHD) program at the U.S. Census Bureau to examine the flows of workers across firms. The LEHD data consist of a link between two data sets: (1) quarterly worker-level earnings submitted by employers for the administration of state unemployment insurance (UI) benefit programs and (2) establishment-level data collected for the Quarterly Census of Employment and Wages (QCEW) program. The UI wage data are associated with "firms" in the form of a state-level employer identification number (SEIN). SEINs typically capture the activity of a firm within a state in a specific industry. As of this writing, 49 states, DC, Puerto Rico, and the Virgin Islands share QCEW and UI wage data with the LEHD program as part of the Local Employment Dynamics (LED) federal-state partnership. LEHD data coverage is quite broad; state UI covers 95% of private sector employment, as well as state and local government.[14]

The LEHD sample used in this paper is a balanced panel of 28 states spanning 1998:Q1 to 2011:Q4. We choose this start date and sample of states trading off the need for a long time series with the desire for broad coverage across the U.S.[15] Our 28 states include many of the largest states so that our sample accounts for 65% of national private sector employment.

Our goal is to measure worker flows across firm wage and size ladders. Firm size in the LEHD data is defined using the U.S. Census Bureau's Longitudinal Business Database (LBD).[16] Firm size is the national size of the firm in March of the previous year; we use three size categories: "large" firms employ 500 or more employees, "medium" firms employ 50-499 employees, and "small" firms employ 0-50 employees.

MPV (2012) present indirect evidence in support of their predictions using a very similar size definition. Indeed, firm size is often used as a proxy for productivity or profitability. However, because this firm size measure neglects the life cycle dynamics of firms, we explore heterogeneity with respect to firm age in some of our analyses below. Firm age is obtained from the LBD and defined at the national level as the age of the oldest establishment in the first year of a firm's existence, and aging naturally afterwards. We use two age categories: "young" firms are those up to 10 years of age, while firms who are 11 or more years of age are "mature."

We define our firm wage measure at the SEIN-quarter level using the average earnings per worker of full-quarter workers.[17] We classify firms into employment-weighted quintiles and categorize firms as high wage if they are in the top two quintiles, medium wage if in the next two quintiles, and low wage if they are in the bottom quintile. We use these categories

[14] For a full description of the LEHD data, see Abowd et al. (2009).

[15] Our 28 states are CA, FL, GA, HI, ID, IL, IN, KS, ME, MD, MN, MO, MT, NC, NJ, ND, NM, NV, PA, OR, RI, SC, SD, TN, VA, WA, WI, and WV. Other states have data series that start in subsequent years. While we restrict our analysis to the pooled 28-state sample, we do allow our measures of job-to-job flows to be informed by moves into and out of other states as their data become available.

[16] Haltiwanger et al. (2014) describes the methodology for linking information from the LBD on firm characteristics with the LEHD data.

[17] Full quarter workers are those employed in the prior, current and subsequent quarter by the firm. We might also be interested in using a national firm wage but such a measure is not readily available. However, based on crosschecks with the LBD, we find that state- and national-level firm wages are highly correlated.

for expositional convenience since in unreported results we have found that the patterns for the quintiles within our high and medium groups are similar (see KM (2014)). We use only full-quarter earnings because we cannot measure start and stop dates in the LEHD data. This also means that our firm wage ranking in a given quarter is independent of the quality of entering and exiting workers. This mitigates concerns of reverse causality and other related issues that we discuss next.

We do not explicitly control for worker heterogeneity in our ranking of firms. This simplification may result in measurement error for our firm ranking variables. In the case of firm wages, assortative matching or other kinds of sorting may be especially important drivers of worker mobility in addition to the job ladder models we test. However, several features of our analysis and results mitigate concerns in this case. First, for the firm wage analysis, we restrict our attention to movement across firms in higher and lower paying quintiles, a characterization that is unlikely to be reversed by this type of measurement error. Second, as noted, our firm wage ranking is independent of the quality of transitioning workers, limiting the scope for at least that form of worker heterogeneity to influence rankings. Third, this type of measurement error works against our finding evidence of a firm wage ladder since, in a pure sorting model, moves would not have a direction, on average. In addition, as we show below, earnings gains from moving up and earnings losses from moving down the firm wage ladder are sizable in both directions. If mobility were instead primarily driven by workers making better matches to their type, we should see wage gains for all types of moves, on average. Finally, KM (2014) conduct robustness exercises that suggest controlling for worker heterogeneity is not critical in this context. They find, for example, that the firm wage ladder results are robust to classifying wage quintiles within state and industry, a crude way to control for heterogeneity and other omitted factors.[18] They also show that wage ladder results are robust to classifying firms based on Abowd, Kramarz, and Margolis (1999, AKM) style firm fixed effects.[19]

A more general model with firm heterogeneity and worker heterogeneity is certainly

[18]There could be differences across industries in the propensity to use part-time workers, for example.

[19]Caution is required in making too much of the robustness using the AKM fixed effects to rank firms. An exogenous mobility assumption is required to interpret the AKM firm fixed effects as capturing differential firm quality. Such an assumption is inconsistent with the job ladder models that motivate our analysis.

plausible and may yield additional insight for understanding worker moves by firm size and wage. However, for the most part, we leave this exploration for future work.[20] Our objective is to quantify the basic facts about the directional and cyclical patterns of job-to-job flows by firm wage and firm size. We now turn to this objective.

2.2 Job-to-Job Flows in the LEHD data

In the LEHD, it is possible to categorize worker moves by starting point and destination. This allows us to measure whether a worker hired by one firm appears to have been poached away from another firm or whether they came from non-employment. This distinction is important for understanding the cyclical job ladder model.

To identify hires and separations that reflect poaching, as in the job ladder models discussed above, we would like to isolate voluntary moves. However, a principal challenge to doing so in the LEHD is that there is no information on why a worker left one job and began another. Instead, we infer that a move was voluntary if a worker separates from a job and begins work at a new job within a short time period, and involuntary if the worker faced a lengthy period with no earnings.[21] We longitudinally link workers' job histories across firms using the approach described in Hyatt and McEntarfer (2012b). We link the main job in each quarter of an individual worker's employment history. Using quarterly earnings we infer approximately when workers left and began jobs. When a worker separates from a job and begins work at a new job within a short time period, we classify it as a poaching (job-to-job) flow. Transitions between jobs which involve longer spells of non-employment are classified as flows to and from non-employment.[22]

Given that we do not observe precise start and end dates of jobs in the LEHD data, we

[20] While progress has been made on theoretical models that contain both forms of heterogeneity in steady state, there is a paucity of such models for cyclical dynamics – particularly models that have a meaningful definition of firm size.

[21] Using the measures described in this section, Hyatt et al. (2014) find a high correlation between separations to non-employment in the LEHD data and layoffs in the Job Openings and Labor Turnover Survey (JOLTS), and an even higher correlation (just under one) between separations to employment in the LEHD and quits in the JOLTS.

[22] Our data universe differs slightly from that used in the public use data, which publishes quarterly worker flows for workers employed on the first day of the quarter, see Hyatt et al. (2014). We instead use all workers employed during the quarter, which results in higher levels of worker flows but almost identical trends as the public use data. HHM (2015) show that results on firm size are similar in the public-use Job-to-Job Flows data, which are available for download at `http://lehd.ces.census.gov/data/j2j_beta.html`.

consider three alternative approaches to defining job-to-job flows, following HHM (2015).[23] First, the most liberal approach is to identify a hire or separation as part of a job-to-job flow when the new main job begins in the same quarter or in the quarter after a separation from a former main job. It thus classifies a move as one to/from non-employment only if the worker had a full quarter with no earnings. This approach, which we refer to as the within/adjacent quarter approach, allows for the fact that workers may take breaks between their last day on one job and their first day on a new job, even if the move was voluntary. However, it likely misclassifies some non-employment spells as job-to-job flows.

Second, the most conservative approach we take is to identify a job hire or separation as part of a job-to-job flow only when the separation from a former main job and hire to a new main job occur in the same quarter. We refer to this as the within quarter approach. This method likely results in fewer non-employment spells being misclassified, relative to the within-adjacent approach, but does not allow for as much leeway in terms of time off in between jobs.

The third approach begins with the within/adjacent quarter job-to-job flows and imposes an additional restriction based on the earnings dynamics around the time of the transition. We infer the amount of time a worker might have taken off during the transition by comparing earnings in the transition quarter to earnings in the surrounding quarters. We classify a move as job-to-job if earnings losses during the quarter imply at most a transition time of one month with no work, and as a move to/from non-employment if the earnings losses are larger. This measure categorizes 90% of the within quarter moves as job-to-job and 60% of the adjacent quarter moves.[24] In what follows, we call this the no earnings gap approach.

Figure 1 shows the different job-to-job flow series. Using each of the three approaches to identify job-to-job flows, we then define poaching hires as the total number of hires associated with a job-to-job flow and poaching separations as the total number of separations associated with a job-to-job flow. Conceptually, there should be a poaching hire for every identified

[23] In addition to these three approaches to distinguishing poaching vs. nonemployment flows, HHM (2015) also implement a continuous time correction that follows Shimer (2012) and Mukoyama (2014) and find that results are similar using this approach.

[24] Specifically, we classify a transition as a job-to-job flow for a within quarter move if the total earnings in all jobs for a worker in the quarter of transition is at least 2/3 of the average total earnings on all jobs in the quarter prior and the quarter after the transition, and, for an adjacent quarter move if the sum of earnings in t and $t+1$ is at least 5/6 of the sum of earnings in $t-1$ and $t+2$.

poaching separation and vice versa, and, for the most part, the time series track each other closely.[25] For comparison, we also include the Current Population Survey (CPS) based job-to-job flow series from Fallick and Fleischman (2004).[26] We generate poaching rates by dividing by employment and plot seasonally adjusted series (using the X-11 procedure) for each rate. We also indicate NBER recessions with shaded regions.

The within quarter definition yields levels that are below the CPS, the within/adjacent yields levels that are above the CPS, and the no earnings gap approach yields levels that are about the same as the CPS. Moreover, all series are highly correlated.[27] For the sake of brevity, we proceed with the within/adjacent approach for the remainder of the paper. We do this to remain consistent with the public domain job-to-job flows series and because this approach is unlikely to misclassify a true poaching move as a move from non-employment. The limitation of the within/adjacent approach is that some of the measured job-to-job flows likely include spells of non-employment. We therefore also provide robustness using the no earnings gap approach and note, in addition, that results are robust to the within approach as well.[28]

Using the within/adjacent approach, Figure 2 presents a decomposition of total hires and separations into their poaching and non-employment components. Hires and separa-

[25]For the within quarter definition, a difference across hires and separations will only arise if the move is from or to a state outside of the 28 state sample. For the within/adjacent quarter definition and the no earnings gap approach, there can also be differences in the exact quarter that the hire took place, relative to the separation; they can be off by one quarter.

[26]Job-to-job moves are identified in the CPS based on panel data and individuals' survey responses. Since the CPS sample is restricted to workers who can be tracked across months, even if a job transition is made, the number of poaching hires in a month identically equals the number of poaching separations.

[27]All pairwise correlations of LEHD series exceed 0.98 with the correlation between the within/adjacent and the no earnings gap at 0.997. Moreover, the CPS series has a correlation of 0.91 with the within quarter LEHD series, 0.96 with the within/adjacent quarter LEHD series, and 0.95 with the no earnings gap series.

[28]Some additional measurement issues for the LEHD based job-to-job flows are discussed in more detail in HHM (2015). For example, we will erroneously classify a job-to-job transition as a flow to/from non-employment when we cannot observe the worker's origin or destination. This includes flows to and from federal employment (approximately 2% of employment) and to parts of the non-profit and agriculture sectors. It also includes moves outside of our 28 state sample, if the move is to a state at a point in time when that state was not in the LEHD. Once a state's data becomes available, we can match moves across states in and out of our core sample and do use these to classify whether the move was job-to-job or to/from non-employment. By 2004 almost all states have data available so one might be concerned that the time series patterns may be noisier in the early years of our sample. Our analysis presented below suggests otherwise and a more thorough analysis by Henderson and Hyatt (2012) shows that the omission of states has a discernable but small effect on job-to-job flow rates.

tions to/from non-employment are similarly turned into rates by dividing by employment.[29] As can be seen, poaching hires (solid line) and separations (dashed line) exhibit a pronounced downward trend and evident procyclicality.[30]. Hires from non-employment (dot-dash line) rise during expansions and separations to non-employment (dotted line) increase substantially early in contractions and especially in the Great Recession. Net employment changes can be gleaned by subtracting separations from hires in each category. Because poaching hires approximately equal poaching separations at the aggregate level, net employment growth is driven by net movement into and out of non-employment. In expansions, hires from non-employment exceed separations to non-employment, resulting in overall employment growth. In contractions, the opposite is true.

2.3 Cyclical Indicators

We consider two alternative cyclical indicators: the change in the unemployment rate and deviations in the unemployment rate from an HP-filtered trend. Figure 3 illustrates the two alternatives at the national level. As is evident, the change in the unemployment rate is much more closely linked to the NBER reference cycles than is the HP-filtered unemployment rate. During NBER contractions, the change in unemployment is positive while it tends to be zero or negative during NBER expansions. The HP-filtered unemployment rate exhibits a related but different pattern; it rises during contractions but remains high long after recoveries are underway. This holds not only for the Great Recession but also for the 2001 downturn. The correlation between the HP-filtered unemployment rate and the change in the unemployment rate is only 0.15.

[29]Employment is measured here as the number of dominant jobs in any given quarter, where for an individual worker, the dominant job is defined as the highest paying job in that quarter.

[30]The decline in job-to-job flows over this time interval has been noted by Hyatt and McEntarfer (2012a, 2012b) in the LEHD data. Hyatt and Spletzer (2013) show that this decline is also apparent in the CPS job-to-job flows data, and that contemporaneous declines can be seen in many other measures of employment dynamics.

3 Empirical Analysis of the Reallocation of Workers Across Firm Size and Firm Wage Classes

It is useful to start with the following simple identity for Net Job Flows (NJF) at firm f:

$$NJF_f = H_f - S_f = H_f^p - S_f^p + H_f^n - S_f^n \tag{1}$$

where H is hires, S is separations, H^p is poaching (job-to-job) hires, S^p is poaching separations (workers that separate via a job-to-job flow), H^n is hires from non-employment and S^n is separations into non-employment. Firms can grow through net reallocation of workers via job-to-job moves ($H^p - S^p$), which, in the spirit of MPV (2012) we will call "net poaching," and through net moves to/from non-employment ($H^n - S^n$). A firm gains employment via net poaching by hiring more workers *away* from other firms than it loses *to* other firms. A firm gains employment through flows to/from non-employment if it hires more non-employed workers than it separates to non-employment (e.g. through layoffs).

The job ladder models discussed above predict that net poaching should be positive and procyclical at large, high wage firms, and negative and countercyclical at small, low wage firms. Large high wage firms can, by definition, more easily poach workers away from other jobs by offering higher wages. In contrast, small low wage firms will have difficulty both attracting workers, and retaining incumbents. They should thus experience net employment losses through poaching, and instead grow through hires from non-employment. Furthermore, the poaching advantage afforded firms at the top of the job ladder is larger in a tight market when competition for workers is greater, and conversely their advantage is smaller in a slack market.

There exists no direct evidence on the direction of net poaching, i.e., whether workers tend to move from small, low wage firms to large, high wage firms through job-to-job moves. Indirect evidence on the cyclicality of net poaching is presented in MPV (2012) for a range of countries. They show that the differential NJF (net job flow) rate across large and small firms increases in times of low unemployment. That is, large firms grow relative to small firms when unemployment is low, and large firms shrink relative to small firms when unemployment is high. Their unemployment measure is the HP-filtered unemployment rate, which aligns with periods when the poaching advantage at large firms should be greatest (tight markets) and weakest (slack markets). The cyclical pattern they uncovered is consistent with their poaching model, but they have no direct evidence tying net employment changes to poaching. Their results could instead be driven by moves to and from non-employment.

In this section, we make four contributions relative to the previous literature. First, we directly examine the direction of net poaching by firm size and firm wage in the U.S. Second, we examine the cyclical pattern of net job flows (NJF) by firm size and firm wage. We also decompose these moves into the contributions from net poaching and moves to/from non-employment. This analysis by firm size enables us to examine whether the MPV (2012) result on net job flows is being driven by net poaching. Third, as part of this cyclical analysis, we examine two cyclical indicators, the HP-filtered unemployment rate and the change in the unemployment rate. As is well known, the stages of the business cycle are more nuanced than a simple tight-slack dichotomy. By bringing in an additional measure that proxies for expansions and contractions, we help reconcile the MPV (2012) findings that suggest large firms are more cyclically sensitive with the conventional wisdom that it is actually small firms that are more cyclically sensitive because of credit constraints. Fourth, we provide guidance as to why the patterns of net job poaching are likely to differ by firm wage and firm size. In the job ladder models discussed above, wage and size go hand-in-hand. But these models do not take into account the firm life-cycle dynamics: a firm may be small because it is less productive and lower paying or because it is new.

We begin by examining the aggregate patterns in the data and then investigate cyclicality in regression analysis.

3.1 Aggregate Patterns

Figure 4 shows the two margins of hires and separations for large and small firms in the top and bottom panels, respectively, while Figure 5 shows the same for high wage and low wage firms, respectively. To construct these series, we sum each type of hire and separation within a firm size or wage category, and convert to rates by dividing by total employment in the quarter in the category.[31] Beginning with the top panel of Figure 4, notice first that at large firms the poaching hire rate (solid line) is much larger than the non-employment hire rate (dash-dotted line). Large firms do indeed make a greater fraction of their hires through poaching than through non-employment. In contrast, small firms (lower panel of Figure 4) make a greater fraction of their hires from non-employment. Both of these patterns are consistent with the job ladder model. Also consistent with these models, poaching is procyclical; job-to-job moves (both hires and separations) decline in NBER dated recessions and rebound in recoveries.

Consider next net poaching, which can be gleaned by comparing poaching hires to poaching separations. A striking finding from Figure 4 is that net poaching is modestly negative for large firms and modestly positive for small firms in all quarters. That is, the poaching hire rate (solid line) is slightly below the poaching separation rate (dashed line) for large firms and the opposite is true at small firms. This is at odds with the notion that large firms are at the top of the ladder; instead, they are roughly just as likely to lose workers from poaching as to gain them.

Since net poaching for both large and small firms is modest in magnitude in all quarters, net employment changes are driven by worker flows in and out of non-employment. Furthermore, both large and small firms have substantial cyclical fluctuations in hires from non-employment and separations to non-employment. Small firms have an especially pronounced increase in separations to non-employment (dotted line) in the Great Recession. This is a preview of the results to come where the non-employment margin plays an important role in the differential response of large and small firms over the business cycle.

In contrast to the results on firm size, Figure 5 shows patterns that are much more consistent with the job ladder model. First, like large firms, high wage firms make a greater fraction of hires through poaching than from non-employment; like small firms, low wage firms exhibit the opposite pattern. However, unlike large firms, high wage firms have positive net poaching – the poaching hires line is always above the poaching separations line. The opposite is seen at low wage firms where net poaching is negative.

Moreover, net poaching has an evident procyclical pattern: the magnitudes of the gaps

[31] All aggregate flows in this section have been seasonally adjusted using the X-11 procedure.

between poaching hires and poaching separations is largest late in expansions and smallest during times of economic contractions. In fact, during the Great Recession these gaps almost completely disappear for both high and low wage firms – high wage firms make almost no net employment gains through poaching and low wage firms experience no net employment losses through poaching. The figure also shows important movements into and out of non-employment over the business cycle for both groups. Typically, the non-employment margin generates little variation in net employment changes (NJF) at high wage firms (hires from non-employment usually equal separations to non-employment). However, in downturns, they achieve net employment losses through increased separations to non-employment. In contrast, the impact of the non-employment margin on net employment growth at low wage firms is close to zero in recessions but large and positive in booms.

Figure 6 makes clearer the starkly different patterns of net poaching flows by firm size and firm wage classes. Net poaching for high wage firms (solid line) is large and positive while net poaching for low wage firms (dashed line) is large and negative. We find that high wage firms grow 0.7% per quarter, on average, through job-to-job moves of workers. This is because, on net, more workers move up the job ladder than down. In contrast, low wage firms lose on average 1.2% of employment through job-to-job moves each quarter. Movement up the firm wage ladder is thus sizable and important. Also, as evident in Figure 6, there are strong cyclical patterns. For example, in the boom periods of 2000 and 2005, high wage firms gain nearly 1% in employment through poaching and low wage firms lose 1.5-2% of employment. In recessionary periods, this movement slows dramatically and is essentially at zero during the Great Recession. In contrast, net poaching for large (dot-dash line) and small (dotted line) firms is small in magnitude (-0.16% for large firms and 0.23% for small firms) and exhibits relatively little variation over the cycle.[32]

[32]Figure 6b of HHM (2015) which uses the no earnings gap approach shows almost identical patterns to Figure 6. For example, the average net poaching rates using the no earnings gap approach are 0.7% (-1.1%) for high (low) wage firms and -0.18% (0.28%) for large (small) firms.

3.2 Employment Cyclicality and the Job Ladder: Regression Analysis

Recall that in the Moscarini and Postel-Vinay (2013) framework, large firms have more cyclically sensitive employment. This is because their ability to poach workers away from smaller firms by offering higher wages becomes less important in slack markets. We can use our decomposition to directly test the contribution of poaching (job-to-job) moves to employment growth over the business cycle. We test the differential cyclicality of employment at large vs. small and high wage vs. low wage firms using three specifications. First, we present results from regressions at the national-quarter level to help quantify the cyclical patterns evident in Figures 4, 5 and 6. In these, we regress various job flow measures on the HP-filtered unemployment rate or the change in the unemployment rate, and control for a linear time trend. However, because the national analysis reflects only a relatively small number of aggregate observations, we also present two specifications using state-level fluctuations in economic conditions and job flows. These regressions take the following form:

$$Y_{st} = \gamma_s + \pi_{qt} + \beta * CYC_{st} + \epsilon_{st} \tag{2}$$

where s is state, t is quarter, CYC_{st} is the cyclical indicator at the state-by-quarter level. We use the state-level unemployment rate to construct the two alternative cyclical indicators: the change in the unemployment rate and the HP-filtered unemployment rate. For each cyclical indicator, we provide two specifications. Specification 1 defines π_{qt} so that it includes seasonal dummies and a time trend. Specification 2 defines π_{qt} as a full set of time dummies for every quarter. The former permits national and state-specific variation to influence the estimated relationships while the latter uses only state-specific variation. We cluster standard errors at the state level.

The key left hand side variables are differential net flows – either for overall net job flows or for the components in terms of net poaching and net non-employment flows. For the large-small comparison, the differential net job flow is the net employment change at large firms minus that at small firms. Just as the net job flow can be decomposed into components due to poaching and non-employment (as in equation 1), we can decompose the differential rate into a differential poaching rate and a differential non-employment rate. These variables thus enable us to ask whether large firms grow relative to small firms over the business cycle, and whether they achieve relative employment gains through poaching or through movements to and from non-employment. We can make a similar comparison across high and low wage firms. These flows are defined at the national or state level.[33] All are converted to rates by dividing by total employment in the relevant cell (e.g., by firm type either at the national or state level as appropriate).

Regression results for the three specifications are presented in Table 1. To help facilitate the comparison of estimates, Figure 7 shows the patterns of coefficients for each dependent variable across specification and cyclical indicator. In the main text we focus on these differential flows. We provide additional analyses of each of the gross flows by firm type in Appendix B.

We begin with the firm size comparison in the top panel of Table 1. We find that net job flows for large firms are more sensitive to fluctuations in the HP-filtered unemployment rate than small firms (left panel). From column 1 row 1, a one percentage point increase in the national unemployment rate is associated with a 0.116 percentage point (17%) decrease in the differential growth rate, significant at the 5% level. This effect holds in both of the state specifications as well. The next two rows of the table show that both net poaching flows and net hires from non-employment contribute to this finding. Using the point estimates, we find that each contributes about half of the total effect, though these are only marginally significant or insignificant. This is again true for both the national and state specifications, though the non-employment margin is especially dominant in state specification 2. Therefore, consistent with MPV (2012), we find employment growth at large firms is more cyclically sensitive than that at small firms when defining the cycle based on HP-filtered unemployment rates. However, differential poaching only modestly contributes to this effect.

Appendix Table A.1 provides an alternative version of Table 1 that uses the no earnings gap approach to define job-to-job moves. Here, we find that virtually all of the differential

[33] At the national level, we seasonally adjust variables using X-11. At the state level, we do not seasonally adjust, as we choose a more parsimonious specification where there are common seasonal effects or common time effects that absorb seasonality. KM (2014) shows results are robust to allowing for different seasonality and time effects for each firm wage quintile.

employment growth sensitivity is driven by the non-employment margin. Support for the firm size ladder is thus even weaker under this alternative definition of job-to-job moves. The remainder of Appendix Table A.1 shows that the results presented in the rest of this section are robust to the alternative definition.

The right panel of Table 1 summarizes results using the first-differenced unemployment rate. In stark contrast, the growth rate effect is actually in the opposite direction when using this cyclical indicator. In a cyclical contraction, large firms grow relative to small firms. This effect is especially pronounced using the state-level variation. This is driven by a large increase in the net hires from non-employment at large, relative to small firms. There are also modest effects on net poaching that are inconsistent across specifications. Thus small firms shrink more quickly in contractions than large firms, especially on the non-employment margin. Underlying this effect is a differential increase in separations to non-employment by small firms, while hires fall at similar rates for large and small firms (see Appendix B). This indicates that small firms likely make more layoffs in contractions. Also, there is no evidence of any gains on poaching for small firms in contractions, though the need to shed workers could overwhelm any potential easing in poaching ability. These results thus do suggest that small firms get hit harder in contractions than large firms (*à la* Gertler and Gilchrist (1994)).

Turning to the bottom panel, we find strong support for the cyclicality of the firm wage ladder. A one percentage point increase in the national unemployment rate is associated with a 0.269 percentage point decrease in the differential growth rate, a more than 100% drop. Thus employment at high wage firms is indeed more cyclically sensitive than that at low wage firms. This effect holds in the first state specification as well, though not in the second where we rely solely on state deviations from the national economy. Furthermore, from the next two rows, this effect is entirely attributed to poaching (since there is essentially no effect on the non-employment margin). In times of higher unemployment, net poaching by high wage firms declines relative to net poaching by low wage firms. This is true across national and both state specifications.

The first-differenced unemployment rate results show an even stronger poaching effect. In contractions, high wage firms have much lower growth through poaching, relative to low wage firms. This mirrors Figure 6, where we showed that net poaching *toward* high wage firms fell roughly to zero in the Great Recession, as did net poaching *away* from low wage firms. This effect is also present at the state level, though the magnitude is much smaller in specification 2. However, poaching effects do not necessarily generate net increases in employment because the non-employment effect goes in the opposite direction. In contractions, low wage firms have a greater decline in net hires form non-employment. These effects are large in magnitude and significance. Underlying the non-employment margin is a substantial decline at low wage firms in hires from non-employment, relative to high wage firms, as well as a modest relative decrease in separations to non-employment at low wage firms (see Appendix B). Thus, in a contraction, low wage firms shift towards poaching hires, and away from non-employment hires. This is why the overall growth rate effect is inconsistent across specifications; it depends which margin wins out.

To summarize, cyclical net poaching patterns across high- and low-paying firms are consistent with job ladder models. Differential net poaching of high wage firms relative to low wage firms declines substantially in times of high unemployment and times of increasing unemployment. Outside the scope of job ladder models, we find that net movement to and from non-employment at least partially offsets this effect during periods of increasing unemployment. In contrast, cyclical net poaching patterns across large and small firms are less consistent with job ladder models. Even though differential net job flows go in the "right" direction using the HP filtered unemployment – as in MPV (2012) small firms grow relative to large firms in times of high unemployment – poaching flows only modestly contribute to this effect, while the non-employment margin makes up the difference. Furthermore, using the first difference unemployment rate, we find that employment declines for small firms relative to large firms in times of rising unemployment both due to net poaching (in most specifications) and movements to/from non-employment.

These results highlight the importance of decomposing net job flows (NJF) into their net poaching and net non-employment flow components. We see that poaching results for the high wage-low wage comparison are quite robust to national and state variation and to the different cyclical indicators. However, impacts on net job flows are less consistent because of offsetting effects through the non-employment margin. In contrast, the net job flows for the large-small comparison do align well with the dynamic poaching model, but underlying these effects is a sizable impact on non-employment. The poaching effects move in the "wrong" direction, on average and exhibit only modest cyclicality.

3.3 Why Do the Results Differ So Much Between Firm Wage and Firm Size?

In this subsection, we investigate why the patterns differ so much between firm size and firm wage. We first note that there is a positive relationship between firm size and firm wage. Estimating a simple specification relating the firm-level log real earnings per worker to log firm size (with quarter fixed effects) yields a positive, highly statistically significant relationship but an R-squared of only about 0.04. Firm size by itself thus accounts for little of the overall variance in earnings per worker across firms, which is not surprising since there are many factors that underlie differences in wages across firms.

One of the reasons firm size may be a much less good proxy for the productivity of a firm is the role of firm age. Recent work has highlighted the importance of distinguishing between small, young firms and small, mature firms (Haltiwanger, Jarmin and Miranda (2013)). At least some small, young firms are highly productive and are in the process of growing to become large firms.

Figure 8 shows net poaching rates for small young firms, small mature firms, and large mature firms.[34] As already noted, large mature firms have almost zero net poaching with basically no cyclical pattern. Interestingly, small, young firms do exhibit positive net poaching flows: they hire more workers via poaching from other firms than they lose to other firms. Apparently, one of the reasons that large firms exhibit zero net poaching is that workers are on net being poached away to small, young firms. For small, mature firms we see evidence of negative net poaching flows that move with the business cycle. The cyclical pattern and sign actually look fairly similar to low wage firms, though magnitudes are smaller. In addition, small, mature firms do lose more workers to poaching than large, mature firms. This is weak evidence in support of a directional firm size ladder within age group, where small, mature

[34]Medium size young firms look similar to young, small firms in unreported results. Results are not reported for young large firms since such firms are virtually non-existent.

firms are at the bottom and large, mature firms are at a higher rung.

Table 2 reports the results of the differential net job flows and components for alternative groupings of firms by size and age. We report state specification 1 for the state-quarter level regressions, which allows for both national and state variation in economic conditions. The comparison across mature firms in the top panel looks fairly similar to the overall size comparison from Table 1. A deviation in unemployment above its trend yields a larger decline in net job flows of large, mature firms relative to the net job flows of small, mature firms and this is driven about equally by net poaching and net hires from non-employment effects. In addition, since overall poaching goes in the "right" direction in comparing small, mature to large, mature firms, we deem that there is more support for the job ladder models here. For the large-mature vs. small-young comparison, we do still find that net job flows are more cyclically sensitive among large-mature firms, but more of this is driven by net hires from non-employment.

The results using the change in unemployment continue to point to factors outside the scope of the firm size job ladder models.[35] Small, mature and small, young businesses both exhibit a greater decline in net job flows in contractions than large, mature firms and this is driven especially by the responsiveness of net hires from non-employment. This suggests a possible role for credit constraints across all small firms, both young and mature. In addition, there are modest effects on net poaching showing that both small, mature and small, young firms lose net employment through poaching in contractions, relative to large, mature firms.

Finally, a potential limitation of the firm size results is that variation in firm size across industries may reflect differences in technology and minimum efficient scale - factors not part of the wage posting models. Table 3 considers a robustness check using terciles of the employment-weighted industry distribution to define relative firm size classes. Strikingly, results using relative size within industry are very similar to those using absolute size in Table 1.

[35] There are a couple of recent exceptions to note here, which do incorporate some of these features into models of on-the-job search. First, Coles and Mortensen (2016) incorporate business entry, growth, and exit into a model of random labor market search. Also, Schaal (2015) introduces business dynamics into a model of directed labor market search.

4 Implications for Mobility and Earnings Growth over the Business Cycle

In the previous section we established the presence of a firm wage ladder that is strongly procyclical. This means that career enhancing moves up the ladder will be much more likely to take place in booms than in busts. We know that recessions have persistent impacts on the careers of young workers, when job-to-job transitions are most important for earnings growth.[36] Some of this might be accounted for by the fact that the career progression of all workers slows in downturns. In this section, we attempt to quantify the impacts of recessions on mobility and earnings growth. Since we find at best weak evidence of a firm size ladder, we restrict our attention to the wage ladder.[37]

Table 4 shows the time averages of job-to-job moves by origin and destination and the time averages of the associated earnings changes.[38] Several patterns are worth noting. First, in the origin-destination (O-D) matrix, the diagonal is large – many workers transit from job-to-job within firm groups. Second, transitions up the ladder are more likely than down the ladder; moves from low-to-medium, medium-to-high, and low-to-high are more likely than moves in the opposite directions. This is obviously what underlies the patterns of net poaching flows by firm wage presented above. Third, in the earnings change matrix, workers moving up the job ladder experience large earnings gains while those moving down the ladder experience large earnings losses. Fourth, the earnings gains from moving up exceed the losses from moving down. Finally, workers making lateral moves also experience earnings increases. This pattern reflects, in part, the coarseness of the firm wage grid used for the analysis but may more generally also reflect workers making better idiosyncratic matches.

[36] See Kahn (2010), Oreopoulos, von Wachter and Heisz (2012), and Altonji, Kahn, and Speer (2016).

[37] For this analysis, we consider a sample restricted to job-to-job flows where we can identify the ranking of the firm wage group by the origin and the destination of the flow. This restricts attention to workers engaged in job-to-job flows to and from private sector jobs within our 28 state sample. We find that the net poaching patterns by firm wage are almost identical for this slightly restricted sample (as will become apparent). There are some very modest differences in magnitudes of the flows which we will note in our discussion.

[38] Earnings changes are defined as total earnings in the quarter after the move minus total earnings in the quarter before the move. We omit the quarter of the move itself to limit the impact of weeks worked, which may be lower during the transition. We include all earnings in the pre- and post- quarters, even those that may be part of an additional transition, because that would otherwise place a too large (and selected) restriction on the sample.

Table 4 thus indicates that job-to-job moves result in average earnings growth, especially for workers moving up the ladder. Through impacts on mobility, recessions affect earnings growth by both reducing the overall mobility rate and the likelihood of moving up the ladder, conditional on moving. For the former, an overall decline in mobility will impact the job ladder since, as we have shown, the direction of moves tends to be up the ladder. For the latter, even if overall moves did not decline, mobility up the ladder could still be inhibited in downturns if there were a relative shift in where workers go, conditional on making a move. To gain a better understanding of the cyclicality of the firm wage ladder, we decompose it into these two possible drivers: (i) the cyclicality of job-to-job moves overall; and (ii) the cyclicality in the propensity for workers who are transitioning to move up the ladder. We first consider mobility, then we discuss what these changes in mobility over the business cycle imply for earnings growth.

Consider the following definitions for the number of poaching hires (H_t^i) and the number of poaching separations (S_t^i) at date t (year-quarter) for wage groups i equal to high wage (h), medium wage (m) and low wage (l) groups:

$$
\begin{aligned}
H_t^h &= F_t^{hh} + F_t^{lh} + F_t^{mh} \\
S_t^h &= F_t^{hh} + F_t^{hl} + F_t^{hm} \\
H_t^m &= F_t^{mm} + F_t^{lm} + F_t^{hm} \\
S_t^m &= F_t^{mm} + F_t^{ml} + F_t^{mh} \\
H_t^l &= F_t^{ll} + F_t^{ml} + F_t^{hl} \\
S_t^l &= F_t^{ll} + F_t^{lm} + F_t^{lh}
\end{aligned} \tag{3}
$$

where F_t^{ij} is the number of workers who move make a job-to-job move from wage group i to wage group j.

Total job-to-job flows J_t are given by:

$$
J_t = H_t^h + H_t^m + H_t^l = S_t^h + S_t^m + S_t^l. \tag{4}
$$

noindent Net poaching hires for each group i (Net_t^i) are given by:

$$\begin{aligned} Net_t^h &= F_t^{lh} - F_t^{hl} + F_t^{mh} - F_t^{hm} \\ Net_t^m &= F_t^{lm} - F_t^{ml} + F_t^{hm} - F_t^{mh} \\ Net_t^l &= F_t^{hl} - F_t^{lh} + F_t^{ml} - F_t^{lm}. \end{aligned} \tag{5}$$

Transition probabilities can be defined as follows for these poaching flows (these are probabilities of making a move from i to j, conditional on making any move at all):

$$\lambda_t^{ij} = F_t^{ij}/J_t. \tag{6}$$

This enables rewriting the net poaching hires for each group as:

$$\begin{aligned} Net_t^h &= J_t * (\lambda_t^{lh} - \lambda_t^{hl} + \lambda_t^{mh} - \lambda_t^{hm}) \\ Net_t^m &= J_t * (\lambda_t^{lm} - \lambda_t^{ml} + \lambda_t^{hm} - \lambda_t^{mh}) \\ Net_t^l &= J_t * (\lambda_t^{hl} - \lambda_t^{lh} + \lambda_t^{ml} - \lambda_t^{lm}). \end{aligned} \tag{7}$$

This generates a simple decomposition of net poaching hires into the variation in the overall pace of job-to-job flows J vs. the differential probabilities λ^{ij}. These differentials are precisely the comparisons of the off-diagonal of the O-D matrix. This helps us see why the off-diagonals are so important for the sign and volatility of the net poaching hires.

Note that the above is for a decomposition of net poaching hires in levels. This can be expressed in terms of the rates of employment simply where $Netr_t^i = Net_t^i/E_t^i$ where E_t^i is the employment for wage group i and $Jr_t = J_t/E_t$ with E_t being total employment:

$$\begin{aligned} Netr_t^h &= (E_t/E_t^h) * (Jr_t * (\lambda_t^{lh} - \lambda_t^{hl} + \lambda_t^{mh} - \lambda_t^{hm})) \\ Netr_t^m &= (E_t/E_t^m) * (Jr_t * (\lambda_t^{lm} - \lambda_t^{ml} + \lambda_t^{hm} - \lambda_t^{mh})) \\ Netr_t^l &= (E_t/E_t^l) * (Jr_t * (\lambda_t^{hl} - \lambda_t^{lh} + \lambda_t^{ml} - \lambda_t^{lm})). \end{aligned} \tag{8}$$

This is an exact decomposition of the net poaching hire rates into terms involving the inverse employment shares, the overall poaching rates, and the transition probability differences. Note that this decomposition does not require any steady state assumptions. It is a simple accounting decomposition for each period. We can easily generate three counterfactuals for each net poaching flow by holding two of the components constant (at their time averages from 1998:Q2 to 2011:Q4) and allowing the third to vary with time. This highlights the respective roles of (1) the job-to-job transition rate, (2) the likelihood of that transition resulting in a move from one wage category into another, and (3) the share of employment in the different employment categories. In practice we focus on effects (1) and (2); variation in the third component is not very meaningful since by definition the share of employment within each group will be roughly constant over time.[39]

The decomposition is summarized in Table 5 and Figure 9. Figure 9 provides insights into which factors drive the level and variation in the net poaching rates. We compare the observed net poaching series for high and low wage firms to the counterfactuals that only allow the transition matrix (λ_t^{ij}) or the job-to-job flow rates (Jr_t) to vary.[40]

As can be seen, both counterfactuals track the levels of the observed series closely. However, it is apparent that the vast majority of the cyclicality in net poaching rates is accounted for by variation in the transition matrix. Variation in the overall job-to-job flow rate accounts for much less of the cyclical fluctuations in the net poaching series. It can account for some because, as noted above, the majority of poaching moves are up the ladder, so a decline in overall moves will impact upward mobility relatively more. However, it is not nearly enough to explain these large cyclical fluctuations in net poaching. We need to also incorporate the pattern that in busts, even though all moves are less likely, moves *up* the ladder become especially unlikely.[41]

[39]There is some variation in the third component because there is variation in the share of workers who are not full quarter. Recall firm average wages are defined using only full-quarter workers, as are wage quintile cut-points that define the h, m and l groupings. However, non full-quarter workers naturally factor in to the transition probabilities.

[40]The observed net poaching rates in Figure 9 exhibit very similar patterns to those in Figure 6 but differ slightly in magnitudes given that the former is restricted to workers making transitions to/from private sector firms within our 28 state sample. For example, net poaching from low wage firms averages -1.1% in Figure 9 and -1.2% in Figure 6.

[41]One concern might be that this shift in the transition matrix towards moves down the ladder is driven by measurement error. Recall that we are using the within/adjacent quarter definition of job-to-job flows. One

Table 5 summarizes the patterns in the figure. We first present time series correlations between the observed and counterfactual net poaching rates and then the relative contribution of each component to the overall time variation in net poaching rates. For the latter, we use a simple bivariate regression: $Cov(Observed, Counterfactual)/Var(Observed)$.[42] As Figure 9 indicated, both the overall transition rate and the O-D transition matrix are highly correlated with the observed net poaching series. However, variation in the transition matrix explains the vast majority of variation in net poaching: 72% of net poaching for high wage firms and 77% for low wage firms. In contrast, variation in overall job-to-job mobility explains less, 28%, and 30% of the variation in net poaching rates at high and low wage firms, respectively.

What do our findings imply for net reallocation of workers up the job ladder? Using the tabulations from Figure 9, in expansions, we find that 1.21% of low wage workers are reallocated up the ladder on net each quarter. In contrast, in contractions this reallocation rate is only 0.73%. This implies about a 40% decline in the net reallocation of workers away from low wage firms in the average contraction compared to the average expansion. In the depth of the Great Recession in 2009:1, there is an 85% decline; only 0.19% of workers at low wage firms were reallocated up the ladder. These sharp declines are driven primarily by a decline in the probability of moving out of the bottom rung, conditional on moving, rather than from impacts in the overall mobility rate. The component due to variation in the transition matrix declines by 40% from the average expansion to contraction period while the component due to variation in the overall mobility rate declines by only 4%.[43] The magnitude of the latter is mitigated by the declining trend in overall mobility in combination with the fact that the expansions are on average early in our sample period. Still, it is evident that the decline in net moves up the job ladder seen in recessions is sharp and primarily due to variation in the transition matrix, conditional on moving, and not the overall decline in mobility.

might be concerned that this approach catches more movements to non-employment, especially for moves down the ladder in busts. However, as emphasized above, the overall net poaching patterns over the cycle by firm wage are very robust to using alternative definitions.

[42] See also Shimer (2012) and Hyatt and Spletzer (2016).

[43] Unlike the variance accounting exercise Table 5 that takes into account covariances, these expansion-to-contraction comparisons across different counterfactuals do not have to add up to the total.

This reduced mobility has important consequences for earnings growth over the business cycle. To focus on the contribution of these factors, we consider the following expression, which allows us to quantify off-diagonal moves into components driven by the overall job-to-job flow rate and the transition matrix:

$$Jr_t * \sum_{ij, i \neq j} \lambda_t^{ij} * \Delta log(Earn_t^{ij}). \tag{9}$$

The expression in (9) is the earnings gains from workers moving up or down the ladder. On average, we find these moves are associated with a 0.56% earnings increase on a quarterly basis. If we include "diagonal moves" (e.g., high wage-to-high wage moves) we find that job-to-job moves are responsible for total earnings gains of about 1% per quarter. Thus off-diagonal moves (the focus of our decomposition) make up more than half of the overall earnings gains from job changes, even though they are less than half of overall moves. This implies substantial economy-wide earnings gains from workers moving up and down the ladder.

We can also quantify how these earnings gains vary over the business cycle. For this purpose, we focus on the contribution of the changing pattern of job-to-job flows over the cycle. We thus calculate a version of equation (9) that fixes earnings gains conditional on type of move at its time average (the bottom panel of Table 4), while allowing the transition matrix (λ_t^{ij}) and the probability of making any move (Jr_t) to vary.[44]

Figure 10 plots the time series of earnings gains from moving up and down the ladder (solid line). These are procyclical and exhibit a declining trend. We also plot two counterfactual distributions, one holding constant the overall mobility rate (dotted line) and the other holding constant the transition matrix (dot-dash line) at their time averages. We find that variation in both job-to-job flows and transition probabilities contribute to the procyclicality. It is the declining trend in job-to-job flows that yields a trend decline in the earnings gains

[44] We abstract away from changes in $\Delta log(Earn_t^{ij})$ over the business cycle because of measurement issues. Hahn, Hyatt, and Janicki (2017) find that the time series variation in log earnings gains and losses from making job-to-job transitions is procyclical but largely reflects procyclical variations in hours per worker. They make this inference based on the small number of states where hours per worker are available in the LEHD data infrastructure. Procyclical variation in hours as workers transit from job-to-job is interesting but beyond the scope of the focus of this paper.

from such transitions.

Taking average earnings changes for each type of move from Table 4, reduced mobility implies that wage growth from off-diagonal job-to-job moves is 13% smaller in contractions than in expansions. As with some of the calculations above, the magnitude of this difference is mitigated by the secular decline in overall mobility in combination with the fact that contraction years are on average later in the data than expansion years. The Great Recession had an especially adverse impact on the earnings gains from climbing the ladder. The quarterly earnings gains, on net, from climbing the ladder reached a cyclical peak of 0.63% in early 2006. This fell by 47% in the trough in 2009:1 to 0.34%. Both the cyclicality of the transition matrix and the decline in overall mobility contributed significantly to this decline (with a slightly higher contribution due to the decline in mobility). Most of the reduction in earnings gains from 2006:1 to 2009:1 is from a decline in the contribution of workers moving up from the bottom rung of the ladder. Recall this movement declined by 85% of this time period. The associated earnings gains declined by 40% from a peak of 0.69% in 2006:1 to 0.39% in 2009:1.[45]

5 Conclusion

In this paper, we use LEHD data to calculate worker flows across the firm size and firm wage distributions. We then test implications of the Burdett and Mortensen (1998) job ladder model, as well as the dynamic implications in Moscarini and Postel-Vinay (2013). We find strong evidence of a firm wage ladder in that job-to-job flows move on net from low wage to high wage firms. On net, high wage firms gain 0.7% of employment on a quarterly basis, and low wage firms lose 1.2% through poaching. Furthermore, consistent with the dynamic implications in Moscarini and Postel-Vinay (2013), this movement is procyclical. Net reallocation from low wage to high wage firms via poaching slows almost to zero in recessionary periods. In contrast, we see little evidence of a firm size ladder. Workers do not tend to move from small to large firms. This is partly because small, young firms experience

[45]The overall earnings gains from directional moves is lower than that from workers climbing from the bottom rung of the ladder. This is because, as seen in equation (9), the overall earnings gains includes the earnings losses from workers who make moves down the ladder.

positive net poaching: they hire more workers from poaching than the workers they lose to poaching.

The collapse of the firm wage job ladder in recessions is accounted for both by a decline in the pace of overall mobility but also by a decline in the propensity of a given job-to-job move to yield advancement up the job ladder. This second effect accounts for most of the cyclical fluctuations in net poaching from low wage to high wage firms. Furthermore, the job ladder yields significant earnings gains. Overall job-to-job flows yield about a 1% increase in earnings per worker each quarter. Nearly 60% of these gains are from workers, on net, moving from lower to higher paying firms. Interestingly, workers who make lateral moves on the firm wage ladder also tend to obtain earnings gains that are not as large as those climbing the ladder but are still substantial. During recessions, the earnings gains from moving up the ladder decline substantially both due to the decline in the pace of the overall ladder and the propensity for a given job-to-job move to yield upward movement.

We find that upward progress from the bottom rung of the job ladder declines by 40% in contractions, relative to expansions. In the Great Recession, this progress slowed by 85%, with an associated decline in earnings growth of 40%. These effects may especially impede the advancement of young workers for whom job-to-job moves are most important (Topel and Ward (1992)) and can help account for the lasting impact of recessions on earnings for this group (Kahn (2010), Oreopoulos, von Wachter and Heisz (2012), Altonji, Kahn, and Speer (2016)).

Our findings also highlight the importance of taking into account moves to and from non-employment. They have a substantial impact on employment changes for both firm wage and firm size. Hires from non-employment decline sharply and separations to non-employment increase substantially in contractions especially for workers at low wage and small firms. The effects for small firms are substantial enough that small firms shrink both overall and relative to large firms in contractions. This finding is not inconsistent with recent evidence (which we also confirm) that large firms experience greater declines in net employment during times of high unemployment. We show that reconciling these seemingly inconsistent findings relies on distinguishing between times of economic contractions vs times of high unemployment. The latter are times that in the last few decades increasingly occur well after an economic recovery has begun and persist. We also show that the MPV (2012) finding of more cyclically sensitive employment at large firms than at small firms, is driven in equal parts by the non-employment and poaching margins, though the Moscarini and Postel-Vinay (2013) model only focuses on the latter.

Indeed, our findings on the non-employment margin are not well accounted for by cyclical job ladder models. This is not surprising since, among other things, models of on-the-job search usually assume a constant separation rate to non-employment. Yet we find an important role for separations to non-employment during contractions especially for small and low wage firms. There are of course job search models that have endogenous job destruction inducing separations to non-employment that intensify in recessions (e.g., Mortensen and Pissarides (1994)), but these usually abstract away from the job ladder. Our evidence suggests an important area for future research should be to develop models of cyclical on-the-job search that capture the sharp decline in hires from non-employment and increase in separations to non-employment during economic downturns. Another area for future research suggested by our findings is to integrate firm life-cycle dynamics into job search models featuring a job ladder. Our findings highlight the important role that young, small firms play in firm dynamics including their role in the job ladder. We show that the positive net poaching by young, small firms away from other firms is important for understanding the job ladder.

References

[1] Abowd, John, Bryce Stephens, Lars Vilhuber, Fredrik Andersson, Kevin McKinney, Marc Roemer, and Simon Woodcock. 2009. "The LEHD Infrastructure Files and the Creation of the Quarterly Workforce Indicators." In *Producer Dynamics: New Evidence from Micro Data*, 68, Studies in Income and Wealth, ed. Timothy Dunne, J.Bradford Jensen and Mark J. Roberts, 149-230. Chicago: University of Chicago Press.

[2] Abowd, John, Francis Kramarz, and David Margolis. 1999. "High Wage Workers and High Wage Firms." *Econometrica* 67(2): 251-333.

[3] Abowd, John, John Haltiwanger, Ron Jarmin, Julia Lane, Paul Lengermann, Kristin McCue, Kevin McKinney, and Kristin Sandusky. 2005. "The Relation among Human Capital, Productivity, and Market Value: Building Up from Micro Evidence." In *Measuring Capital in the New Economy*, 65, Studies in Income and Wealth, ed. Carol Corrado, John Haltiwanger, and Dan Sichel, 153-204. Chicago: University of Chicago Press.

[4] Altonji, Joseph, Lisa Kahn, and Jamin Speer. 2016. "Cashier or Consultant? Entry Labor Market Conditions, Field of Study, and Career Success." *Journal of Labor Economics* 34(S1, part2): S361-S401.

[5] Barlevy, Gadi. 2002. "The Sullying Effect of Recessions." *Review of Economic Studies* 69(1): 65-96.

[6] Barth, Erling, Alex Bryson, James Davis, and Richard Freeman. 2016. "It's Where You Work: Increases in the Dispersion of Earnings across Establishments and Individuals in the United States." *Journal of Labor Economics* 34(S2, Part 2): S67-S97.

[7] Bagger, Jesper, and Rasmus Lentz. 2016. "An Equilibrium Model of Wage Dispersion with Sorting." Unpublished draft, University of Wisconsin.

[8] Bjelland, Melissa, Bruce Fallick, John Haltiwanger and Erika McEntarfer. 2011. "Employer-to-Employer Flows in the United States: Estimates Using Linked Employer-Employee Data." *Journal of Business and Economic Statistics* 29(4): 493-505.

[9] Brown, Charles, and James Medoff. 1989. "The Employer Size-Wage Effect." *Journal of Political Economy* 97(5): 1027-1059.

[10] Burdett, Kenneth, and Dale Mortensen. 1998. "Wage Differentials, Employer Size, and Unemployment." *International Economic Review* 39(2): 257-273.

[11] Card, David, Jörg Heining, and Patrick Kline. 2015. "Workplace Heterogeneity and the Rise of West German Wage Inequality." *Quarterly Journal of Economics* 128(3): 967-1015.

[12] Coles, Melvyn, and Dale Mortensen. 2016. "Equilibrium Labor Turnover, Firm Growth and Unemployment." *Econometrica* 84(1): 347-363.

[13] Davis, Steven, Jason Faberman, and John Haltiwanger. 2012. "Labor Market Flows in the Cross Section and Over Time." *Journal of Monetary Economics* 59(1): 1-18.

[14] Davis, Steven and John Haltiwanger. 2014. "Labor Market Fluidity and Economic Performance." NBER Working Paper No. 20479.

[15] Dunne, Timothy, Lucia Foster, John Haltiwanger, and Kenneth Troske. 2004. "Wage and Productivity Dispersion in United States Manufacturing: The Role of Computer Investment." *Journal of Labor Economics* 22(2): 397-429.

[16] Fallick, Bruce, Fleischman, Charles. 2004. "Employer-to-Employer Flows in the U.S. Labor Market: The Complete Picture of Gross Worker Flows." FEDS Working Papers 2004-34, Federal Reserve Board.

[17] Fallick, Bruce, John Haltiwanger, and Erika McEntarfer. 2012. "Job-to-Job Flows and the Consequences of Job Separations." U.S. Federal Reserve Board Finance and Economics Discussion Series Paper #2012-73.

[18] Foster, Lucia, John Haltiwanger, and Chad Syverson. 2008. "Reallocation, Firm Turnover and Efficiency: Selection on Productivity or Profitability?" *American Economic Review* 98(1): 394-425.

[19] Gertler, Mark, and Simon Gilchrist. 1994. "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms." *Quarterly Journal of Economics* 109(2): 309-340.

[20] Hahn, Joyce, Henry Hyatt, and Hubert Janicki. 2017. "Job Ladders and Growth in Earnings, Hours, and Wages." Unpublished draft, U.S. Census Bureau.

[21] Haltiwanger, John, Henry Hyatt, and Erika McEntarfer. 2015. "Cyclical Reallocation of Workers Across Employers by Firm Size and Firm Wage." NBER Working Paper No. 21235.

[22] Haltiwanger, John, Henry Hyatt, and Erika McEntarfer. 2016. "Who Moves Up the Firm Productivity Ladder?" Unpublished draft, University of Maryland.

[23] Haltiwanger, John, Henry Hyatt, Erika McEntarfer, and Liliana Sousa. 2012. "Business Dynamics Statistics Briefing: Job Creation, Worker Churning, and Wages at Young Businesses." Kauffman Foundation Statistical Brief.

[24] Haltiwanger, John, Henry Hyatt, Erika McEntarfer, Liliana Sousa, and Stephen Tibbets. 2014. "Firm Age and Size in the Longitudinal Employer-Household Dynamics Data." U.S. Census Bureau Center for Economic Studies Working Paper #CES-14-16.

[25] Haltiwanger, John, Javier Miranda, and Ron Jarmin. 2013. "Who Creates Jobs? Small versus Large versus Young." *Review of Economics and Statistics* 95(2): 347-361.

[26] Henderson, Cody, and Henry Hyatt. 2012. "Estimation of Job-to-Job Flow Rates Under Partially Missing Geography." U.S. Census Bureau Center for Economic Studies Discussion Paper #CES-12-29.

[27] Hoynes, Hilary, Douglas Miller, and Jessamyn Schaller. 2012. "Who Suffers During Recessions?" *Journal of Economic Perspectives* 26(3): 27-47.

[28] Hyatt, Henry, and Erika McEntarfer. 2012a. "Job-to-Job Flows in the Great Recession." *American Economic Review* 102(3): 580-583.

[29] Hyatt, Henry, and Erika McEntarfer. 2012b. "Job-to-Job Flows and the Business Cycle." U.S. Census Bureau Center for Economic Studies Working Paper #CES-12-04.

[30] Hyatt, Henry, Erika McEntarfer, Kevin McKinney, Stephen Tibbets, and Douglas Walton. 2014. "Job-to-Job (J2J) Flows: New Labor Market Statistics from Linked Employer-Employee Data." *JSM Proceedings 2014*, Business and Economics Statistics Section: 231-245.

[31] Hyatt, Henry, and James Spletzer. 2013. "The Recent Decline in Employment Dynamics." *IZA Journal of Labor Economics* 2(3): 1-21.

[32] Hyatt, Henry, and James Spletzer. 2016. "The Recent Decline of Single Quarter Jobs." Forthcoming, *Labour Economics*.

[33] Jovanovic, B. 1982. "Selection and the evolution of industry." *Econometrica* 50(3): 649-670.

[34] Kahn, Lisa. 2010. "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy." *Labour Economics* 17(2): 303-316.

[35] Kahn, Lisa, and Erika McEntarfer. 2014. "Employment Cyclicality and Firm Quality." NBER Working Paper #20698.

[36] Keith, Kristen and Abigail McWilliams. 1999. "The Returns to Mobility and Job Search by Gender." *Industrial and Labor Relations Review* 52(3): 460-477.

[37] Lazear, Edward, and James Spletzer. 2012. "Hiring, Churn, and the Business Cycle." *American Economic Review* 102(3): 575-579.

[38] Moscarini, Giuseppe, and Fabien Postel-Vinay. 2009. "The Timing of Labor Market Expansions: New Facts and a New Hypothesis." In *NBER Macroeconomics Annual 2008*, Vol. 23, ed. Daron Acemoglu, Kenneth Rogoff, and Michael Woodford, 1-52. Chicago: University of Chicago Press.

[39] Moscarini, Giuseppe, and Fabien Postel-Vinay. 2012. "The Contribution of Large and Small Employers to Job Creation in Times of High and Low Unemployment." *American Economic Review* 102(6): 2509-39.

[40] Moscarini, Giuseppe, and Fabien Postel-Vinay. 2013. "Stochastic Search Equilibrium." *Review of Economic Studies* 80(4): 1545-1581.

[41] Moscarini, Giuseppe, and Fabien Postel-Vinay. 2016. "Did the Job Ladder Fail After the Great Recession?" *Journal of Labor Economics* 34(S1): S55-S93.

[42] Postel-Vinay, Fabien, and Jean-Marc Robin. 2002. "Equilibrium Wage Dispersion with Heterogeneous Workers and Firms." *Econometrica* 70(6): 1295-1350.

[43] Mortensen, Dale, and Christopher Pissarides. 1994. "Job Creation and Destruction in the Theory of Unemployment." *Review of Economic Studies* 61: 397-415.

[44] Mukoyama, Toshihiko. 2014. "The Cyclicality of Job-to-Job Transitions and Its Implications for Aggregate Productivity." *Journal of Economic Dynamics and Control* 1-17.

[45] Oreoploulos, Philip, Till von Wachter, and Andrew Heisz. 2012. "The Short- and Long-Term Career Effects of Graduating in a Recession." *American Economic Journal: Applied Economics* 4(1): 1-29.

[46] Schaal, Edouard. 2015. "Uncertainty and Unemployment." Unpublished draft, New York University.

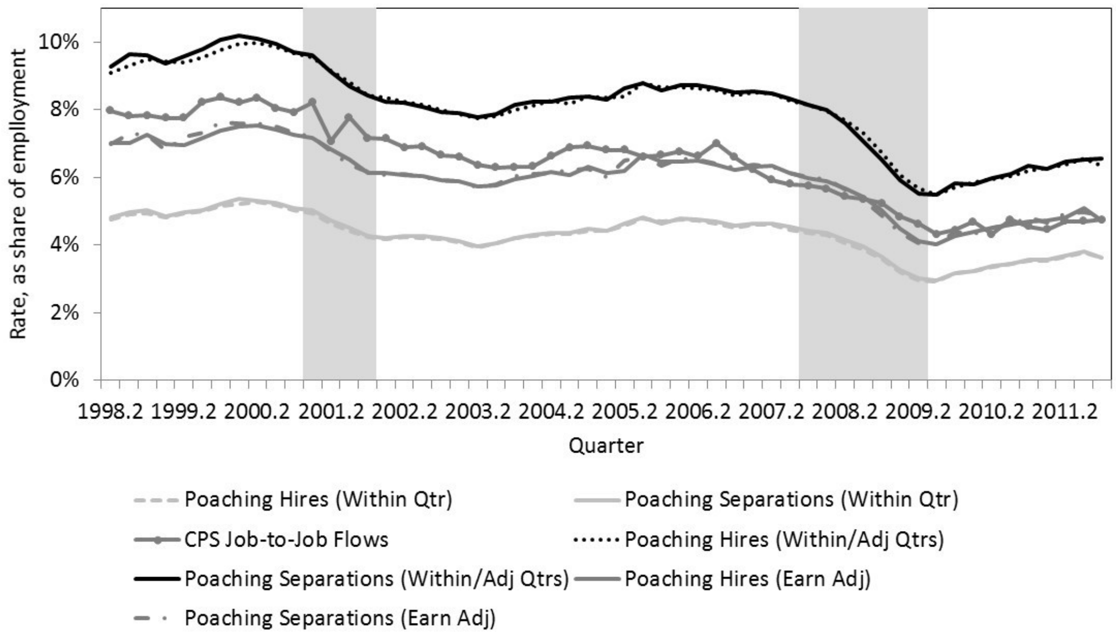
[47] Shimer, Robert. 2012. "Reassessing the ins and outs of unemployment." *Review of Economic Dynamics*, 127-148.

[48] Song, Jae, David Price, Fatih Guvenen, Nicholas Bloom, and Till von Wachter. 2015. "Firming Up Inequality." NBER Working Paper #21199.

[49] Sorkin, Isaac. 2016. "Ranking Firms Using Revealed Preference." Unpublished draft, Stanford University.

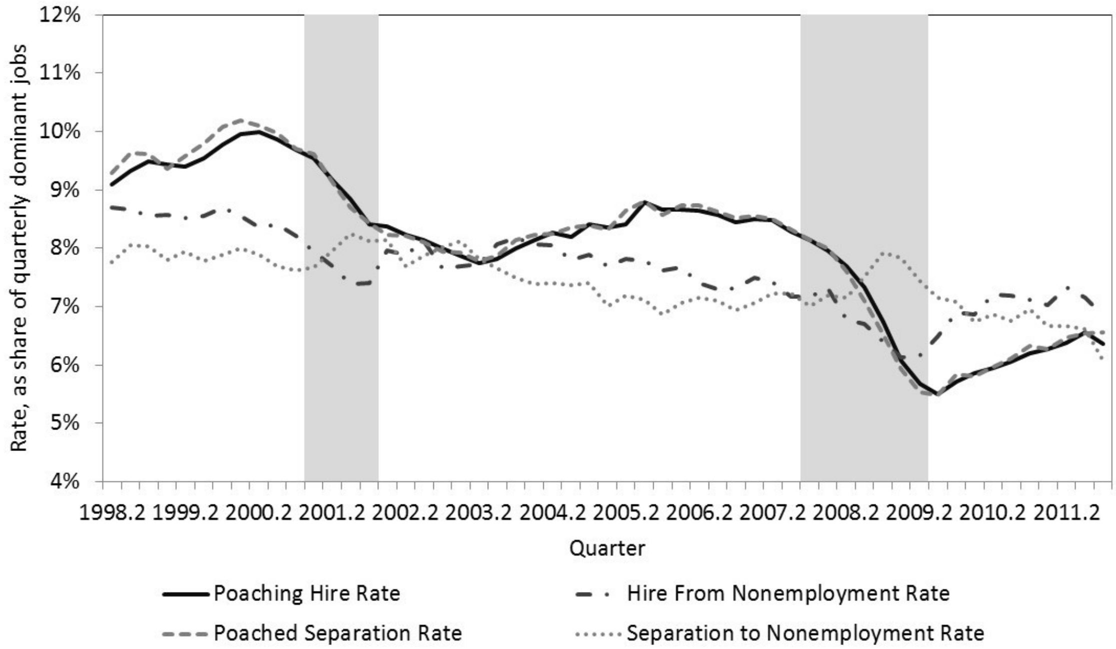
[50] Topel, Robert, and Michael Ward. 1992. "Job Mobility and the Careers of Young Men." *Quarterly Journal of Economics* 107(2): 439-479.

Figure 1: Comparisons of Alternative Job-to-Job Flow Series



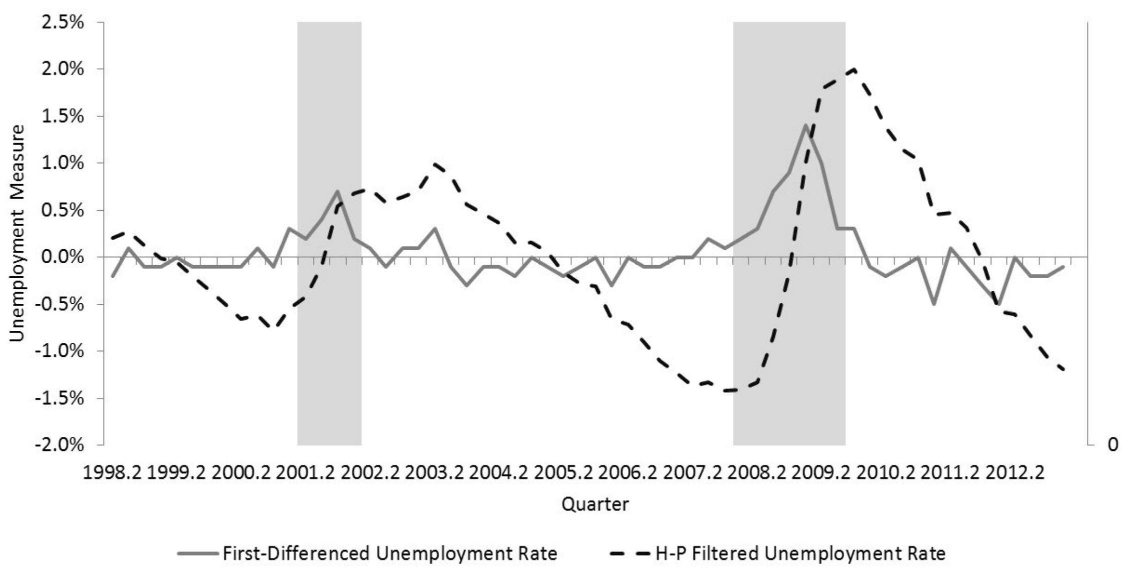
Notes: Shaded regions indicate NBER recession quarters. Data are seasonally adjusted using X-11.

Figure 2: Hires and Separations: Poaching vs. Flows to and from Non-Employment



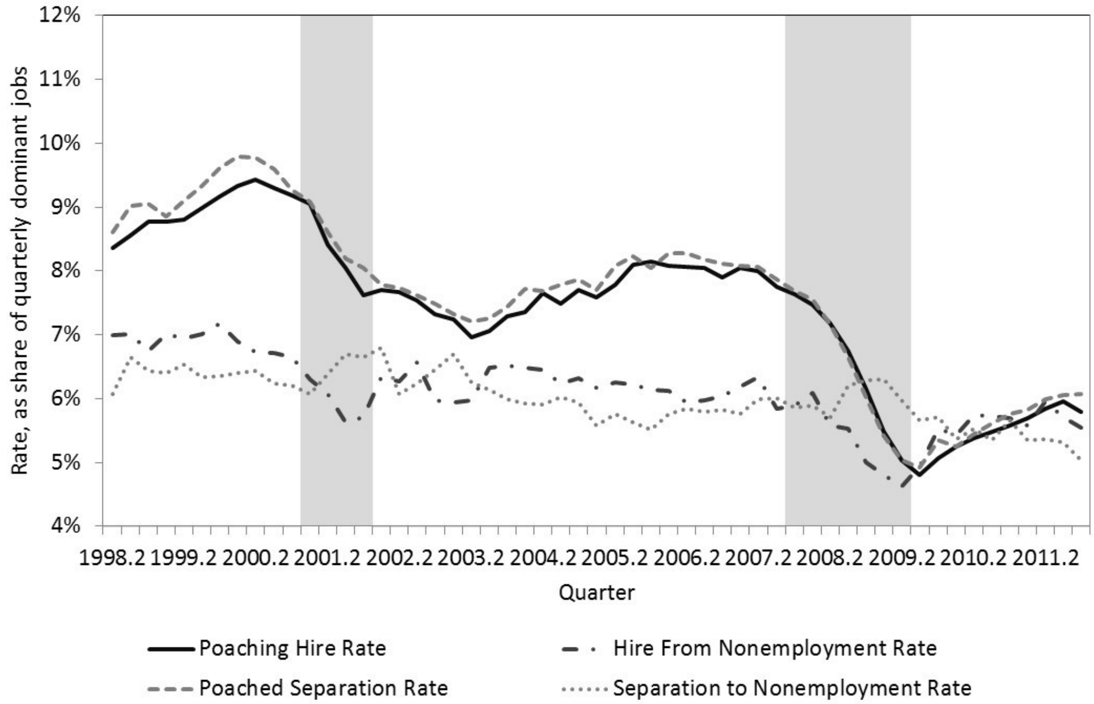
Notes: Shaded regions indicate NBER recession quarters. Data are seasonally adjusted using X-11.

Figure 3: Cyclical Indicators: HP-Filtered and First-Differenced Unemployment Rate

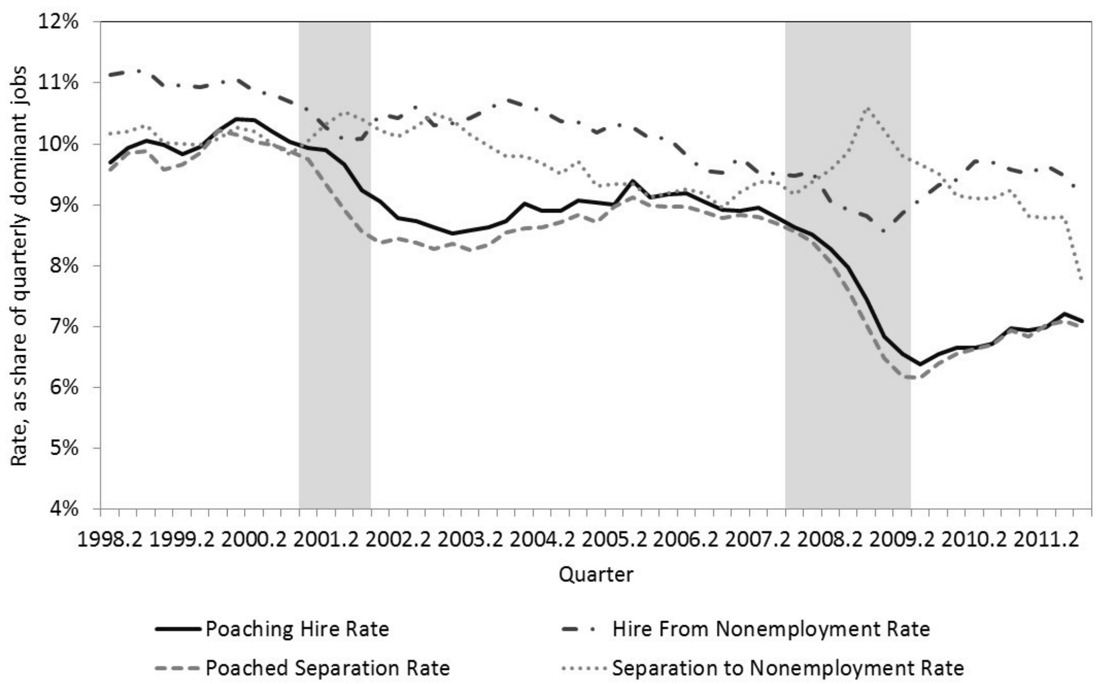


Notes: Shaded regions indicate NBER recession quarters. Data are seasonally adjusted using X-11.

Figure 4: Hires and Separations: Poaching vs. Flows to and from Non-Employment, by Size



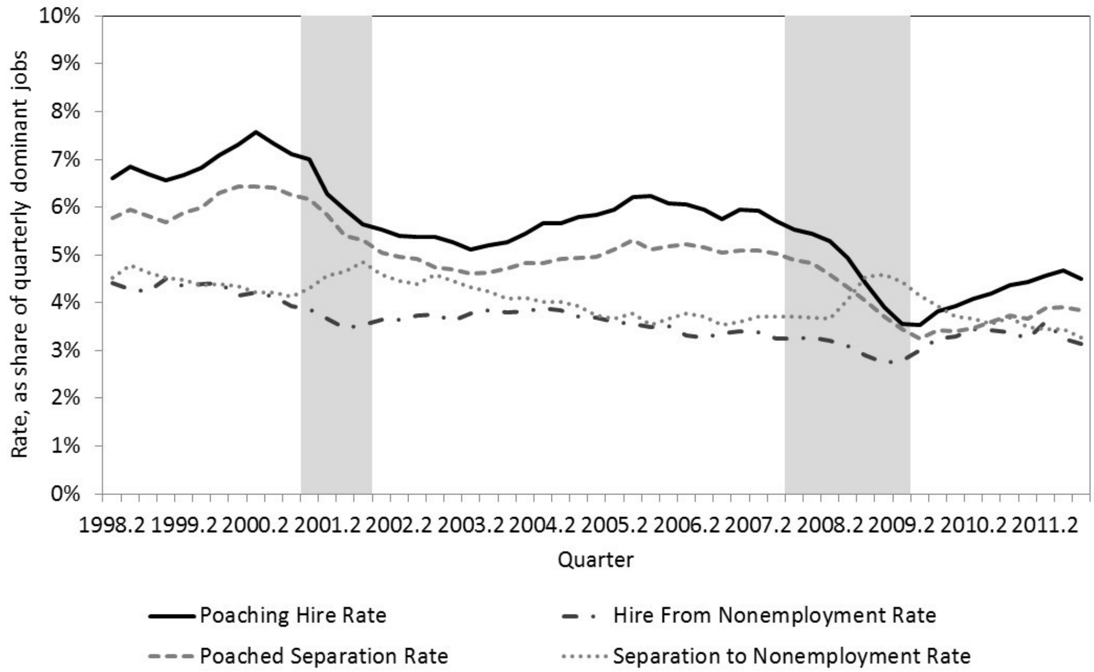
(a) Large Firms



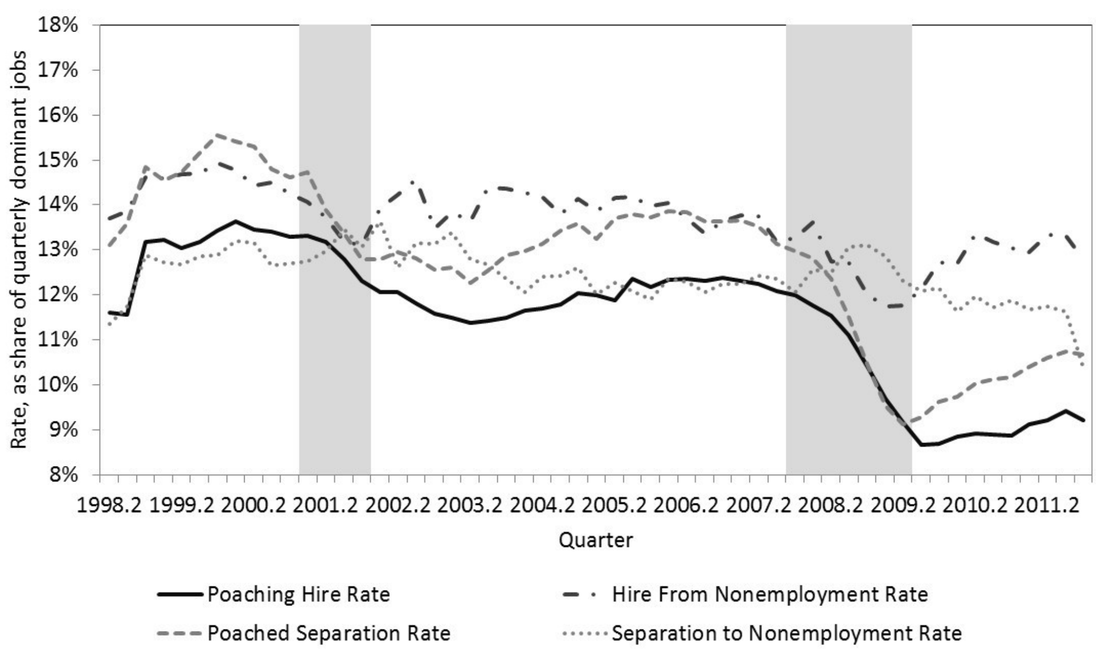
(b) Small Firms

Notes: Shaded regions indicate NBER recession quarters. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. Data are seasonally adjusted using X-11.

Figure 5: Hires and Separations: Poaching vs. Flows to and from Non-Employment, by Wage



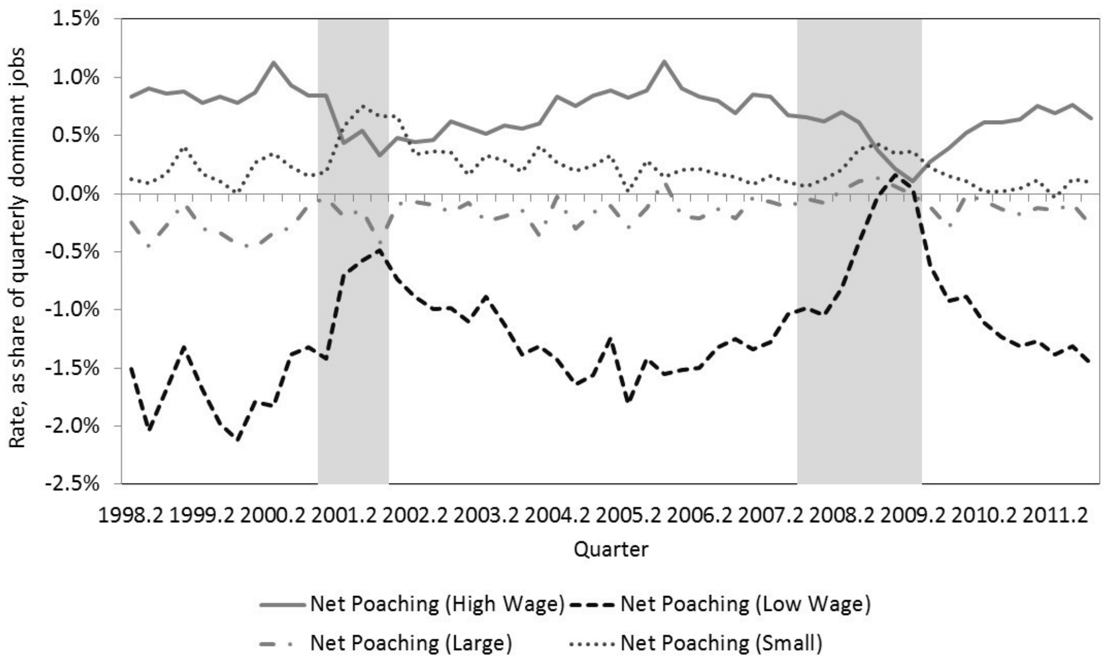
(a) High Wage Firms



(b) Low Wage Firms

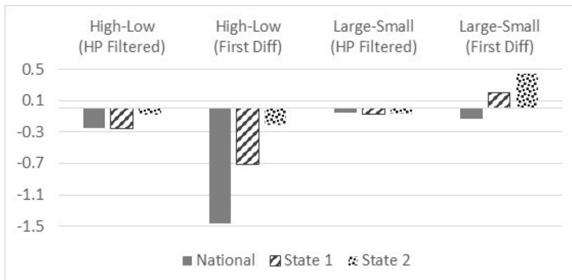
Notes: Shaded regions indicate NBER recession quarters. “High” indicates that the firm is in the top two quintiles of the wage distribution across firms. “Low” indicates that the firm is in the bottom quintile of the wage distribution across firms. Data are seasonally adjusted using X-11.

Figure 6: Net Poaching for Large vs. Small Firms and High vs. Low Wage Firms

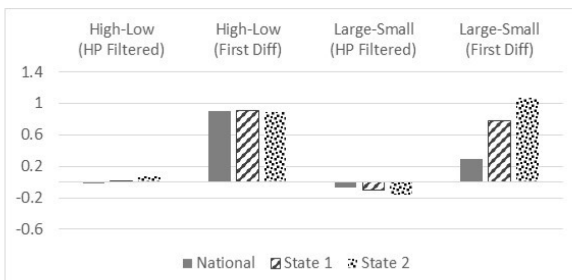


Notes: Shaded regions indicate NBER recession quarters. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. Data are seasonally adjusted using X-11.

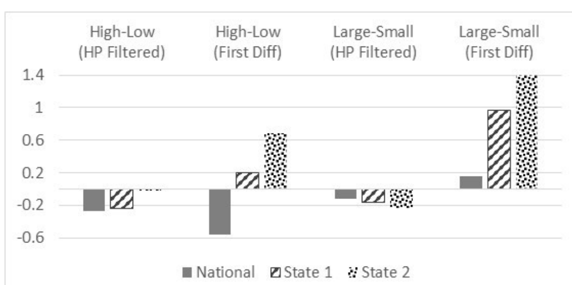
Figure 7: Cyclical Responses of Net Differentials by Firm Wage and Firm Size



(a) Net Poaching



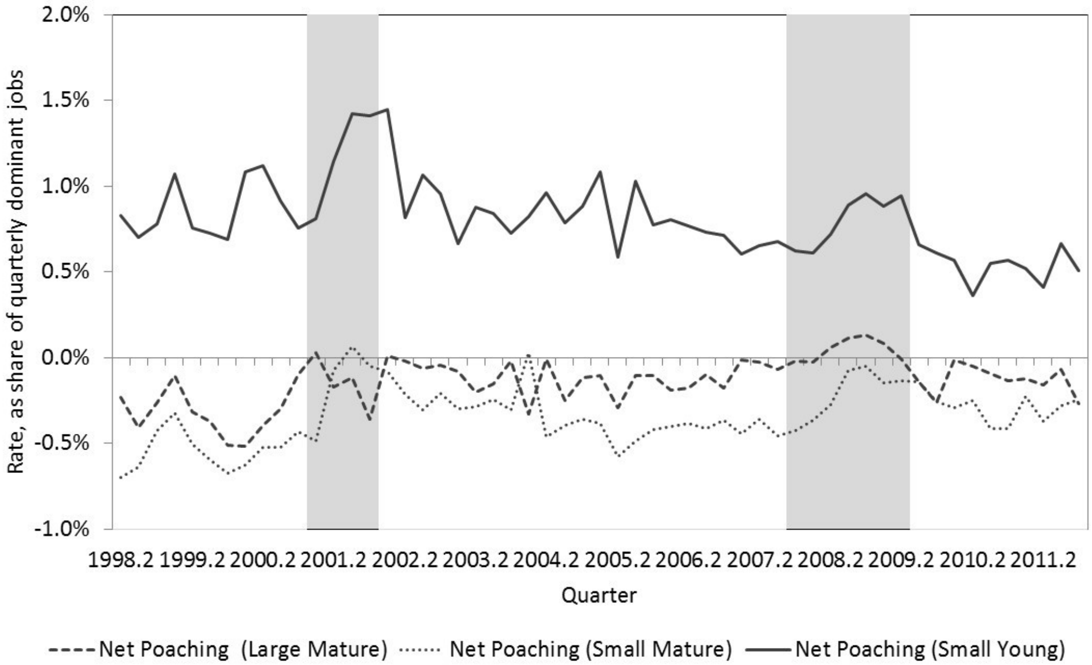
(b) Net Non-Employment



(c) Net Job Flows

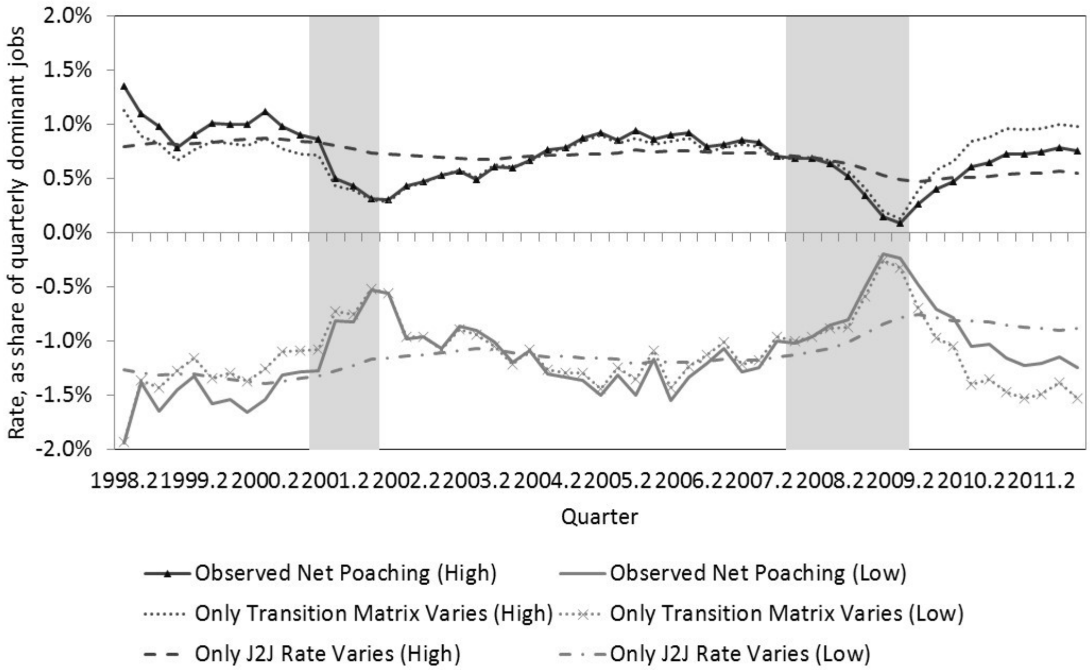
Notes: Point estimates are taken from Table 1.

Figure 8: Net Poaching by Firm Size and Firm Age



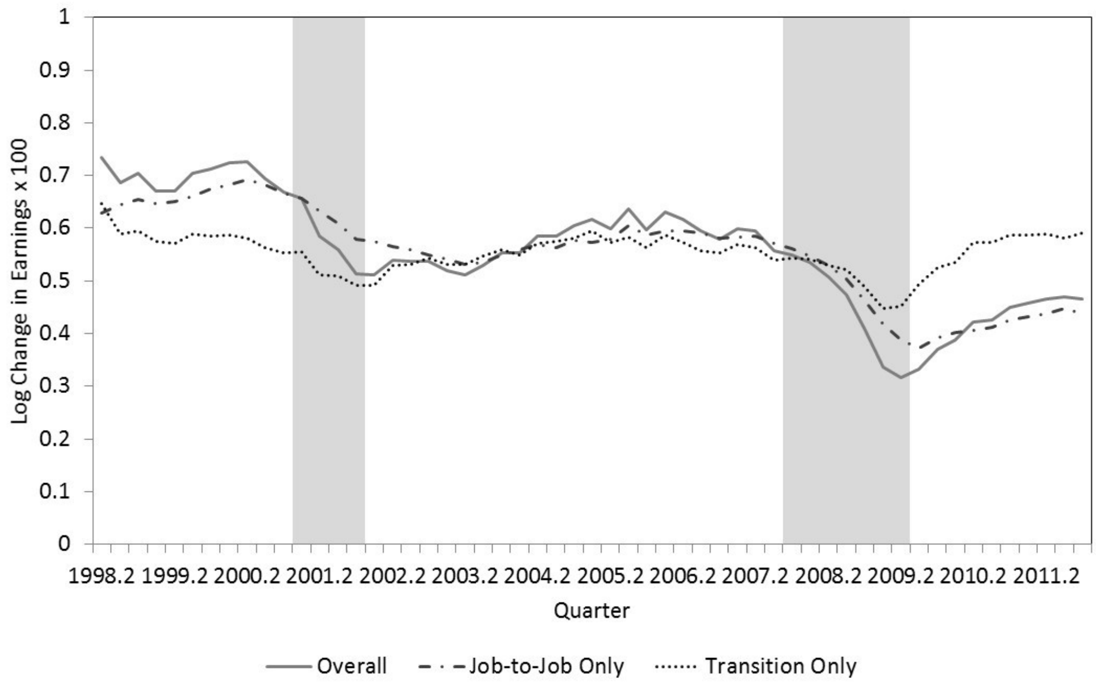
Notes: Shaded regions indicate NBER recession quarters. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "Mature" indicates that the firm is 11 or more years old. "Young" indicates that the firm is 10 or less years old. Data are seasonally adjusted using X-11.

Figure 9: Net Poaching: Observed versus Counterfactuals



Notes: Shaded regions indicate NBER recession quarters. Data are seasonally adjusted using X-11.

Figure 10: Decomposition of Earnings Changes from Movements Up and Down the Firm Wage Ladder



Notes: Shaded regions indicate NBER recession quarters. Data are seasonally adjusted using X-11.

Table 1: Differential Net Flows

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
			By Size: Large minus Small			
Net Job Flows	−0.116**	−0.169***	−0.228**	0.156	0.972***	1.535***
	(0.054)	(0.038)	(0.108)	(0.144)	(0.232)	(0.332)
Net Poaching Flows	−0.051*	−0.070***	−0.068	−0.132*	0.195**	0.448***
	(0.027)	(0.017)	(0.050)	(0.070)	(0.080)	(0.116)
Net Non-Employment Flows	−0.065	−0.099***	−0.160*	0.288***	0.777***	1.075***
	(0.041)	(0.027)	(0.080)	(0.103)	(0.158)	(0.226)
			By Wage: High Wage minus Low Wage			
Net Job Flows	−0.269***	−0.235***	−0.006	−0.557***	0.198	0.687***
	(0.073)	(0.035)	(0.140)	(0.198)	(0.162)	(0.240)
Net Poaching Flows	−0.253***	−0.251***	−0.080	−1.460***	−0.706***	−0.205**
	(0.093)	(0.031)	(0.077)	(0.157)	(0.080)	(0.094)
Net Non-Employment Flows	−0.016	0.016	0.074	0.903***	0.904***	0.891***
	(0.072)	(0.027)	(0.114)	(0.139)	(0.120)	(0.194)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.

Table 2: Differential Net Flows, Size-Age Interactions, State-Level Panel

Dependent Variable	**Deviation from HP Trend**	**First Difference**
	Large & Mature minus Small & Mature	
Net Job Flows	−0.190***	0.816***
	(0.037)	(0.238)
Net Poaching Flows	−0.099***	0.202**
	(0.021)	(0.079)
Net Non-Employment Flows	−0.091***	0.614***
	(0.027)	(0.165)
	Large & Mature minus Small & Young	
Net Job Flows	−0.159***	1.178***
	(0.041)	(0.227)
Net Poaching Flows	−0.041**	0.186**
	(0.016)	(0.083)
Net Non-Employment Flows	−0.118***	0.992***
	(0.029)	(0.1503)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "Mature" indicates that the firm is 11 or more years old. "Young" indicates that the firm is 10 or less years old. All specifications control for state effects, seasonal effects, and a linear time trend. Standard errors clustered at the state level.

Table 3: Differential Net Flows, Within-Industry Relative Size, State-Level Panel

Dependent Variable	**Deviation from HP Trend**	**First Difference**
	By Within-Industry Size: Large minus Small	
Net Job Flows	−0.179***	0.736***
	(0.038)	(0.190)
Net Poaching Flows	−0.078***	0.175**
	(0.019)	(0.067)
Net Non-Employment Flows	−0.101***	0.561***
	(0.025)	(0.129)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm is in the lowest tercile of the industry's firm size distribution, and "Large" indicates that a firm is in the upper tercile of the industry's firm size distribution. Industry terciles are defined at the NAICS sub-sector (3-digit) level. All specifications control for state effects, seasonal effects, and a linear time trend. Standard errors clustered at the state level.

Table 4: Transition Probabilities and Earnings Gains from Poaching Flows, by Firm Wage

Transition Probabilities:

		Destination Firm Wage		
		Low	Medium	High
	Low	22.1	14.1	5
Origin Firm Wage	Medium	11.8	15.7	8.4
	High	3.5	6.5	12.8

Log Earnings Changes from Job-to-Job Flows:

		Destination Firm Wage		
		Low	Medium	High
	Low	12.9	36.9	57.5
Origin Firm Wage	Medium	−11.7	9.8	26.5
	High	−34.4	−7.8	7.2

Notes: "Low" indicates that a firm is in bottom quintile of firm wage distribution, "Medium" indicates is in 2nd and third quintiles, and "High" indicates that firm is in top 4th and 5th quintiles of firm wage distribution. See equation (6) for definition of the transition probabilities.

Table 5: Decomposition Exercise

Allowing Only Transition Matrix to Vary		**Allowing Only Job-to-Job Flows to Vary**		**Allowing Only Employment Shares to Vary**	
High	Low	High	Low	High	Low
Correlation between observed and counterfactual					
0.8671	0.8875	0.6394	0.6225	0.3096	-0.4627
Regression of observed on counterfactual					
0.7158	0.7728	0.2751	0.3039	0.0137	-0.0429

Notes: Counterfactual exercises hold all components constant at their respective averages from 1998:Q2 to 2011:Q4. Regression estimates are the covariance of the observed value with its counterfactual, divided by the variance of the observed value.

Table A.1: Differential Net Flows, Using No Earnings Gap Approach

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
			By Size: Large minus Small			
Net Job Flows	−0.115**	−0.169***	−0.228**	0.162	0.972***	1.535***
	(0.055)	(0.038)	(0.108)	(0.146)	(0.232)	(0.332)
Net Poaching Flows	−0.013	0.0001	−0.013	−0.083	0.112**	0.236***
	(0.024)	(0.010)	(0.026)	(0.060)	(0.043)	(0.064)
Net Non-Employment Flows	−0.102**	−0.169***	−0.214**	0.245**	0.860***	1.287***
	(0.044)	(0.032)	(0.090)	(0.116)	(0.191)	(0.273)
			By Wage: High Wage minus Low Wage			
Net Job Flows	−0.268***	−0.235***	−0.006	−0.544***	0.198	0.687***
	(0.073)	(0.035)	(0.140)	(0.273)	(0.162)	(0.240)
Net Poaching Flows	−0.238***	−0.237***	−0.116*	−1.062***	−0.610***	−0.316***
	(0.070)	(0.024)	(0.067)	(0.135)	(0.054)	(0.070)
Net Non-Employment Flows	−0.030	0.002	0.110	0.518***	0.809***	1.003***
	(0.060)	(0.028)	(0.119)	(0.139)	(0.145)	(0.231)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.

Online Appendix. Appendix B. (Not intended for publication)

In this Appendix, we dig deeper into the findings of Table 1 in the text, which focused on net job flows, net poaching flows and net hires from non-employment. Here we investigate the patterns of the underlying hires and separations by firm size and firm wage over the business cycle.

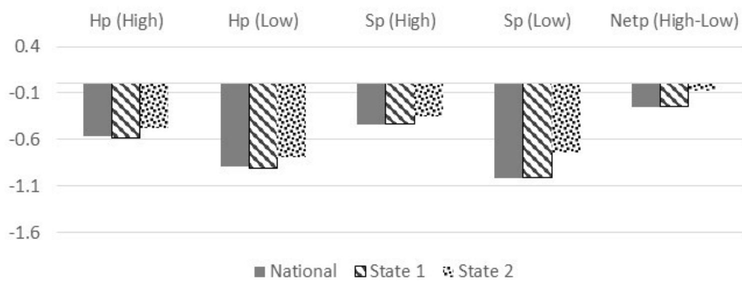
Figures B.1 and B.2 present the estimates for these margins, analogous to Figure 7 in the text. We examine the responsiveness of poaching hires and separations to each of the cyclical indicators in Figure B.1 for the high wage-low wage comparison (left) and the large firm-small firm comparison (right). We also include the cyclical net differential responses that have been discussed above for easy reference. Figure B.2 presents analogous figures for hires to and separations from non-employment. The full set of regression estimates are included in Tables B.1, B.2, B.3., and B.4.

Figure B.1 focuses on poaching hires and separations. A ubiquitous finding is that poaching hires and separations decline in economic slumps and times of high unemployment. This holds for high and low wage firms and large and small firms. However, the hypothesis of a directional job ladder towards high wage and large firms implies that we should observe poaching hires decline more at high wage and large firms while poaching separations decline more at low wage and small firms. For firm wage, this prediction holds up well for the most part. Poaching hires decline much more than poaching separations at high wage firms while poaching separations tend to decline more than poaching hires at low wage firms. These patterns are particularly pronounced during periods of economic contractions.

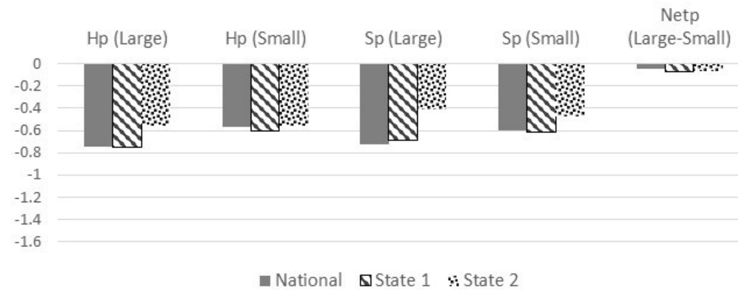
Patterns by firm size generally do not support this prediction. This is not surprising since we have already found little evidence of a procycical firm size job ladder. Figure B.1 helps us understand that finding with detail about the hires and separation adjustment margins. We find that both large and small firms exhibit broadly similar declines in poaching hires and separations during periods of economic contractions and high unemployment. These broadly similar patterns across firm type are what not one would expect if the firm characteristic defining type were not a good proxy for ranking of firms in terms of the job ladder. That is, consider any firm characteristic that is unrelated to the direction of the job ladder. For that characteristic, poaching hires and separations should decline in contractions and times of high unemployment given the general decline in job-to-job flows at such times. But there should not be a systematic pattern by that characteristic. That is what we find by firm size.

Figure B.2 shows the hires and separation responses for non-employment. It is apparent the non-employment margin is much more relevant during times of economic contractions than times of high unemployment. Focusing on the latter, the greater decline in net non-employment flows for low wage and small firms is driven both by a general tendency for greater declines in hires from non-employment and increases in separations to non-employment at such firms.

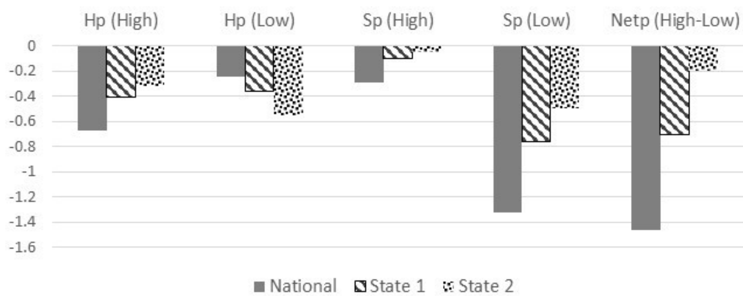
Figure B.1: Cyclical Responses of Poaching Hires and Separations by Firm Size and Firm Wage



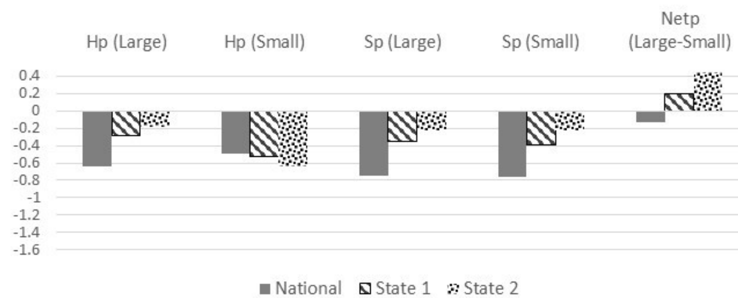
(a) Wage, HP Unemp.



(b) Size, HP Unemp.



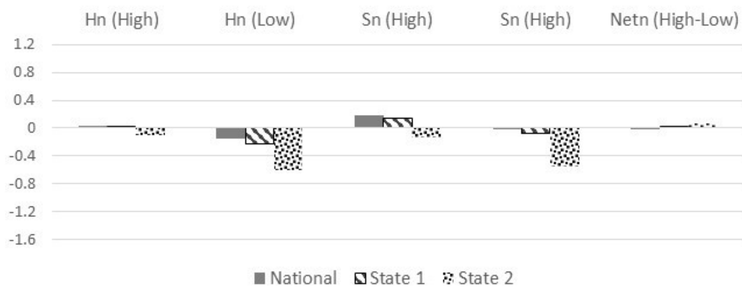
(c) Wage, FD Unemp.



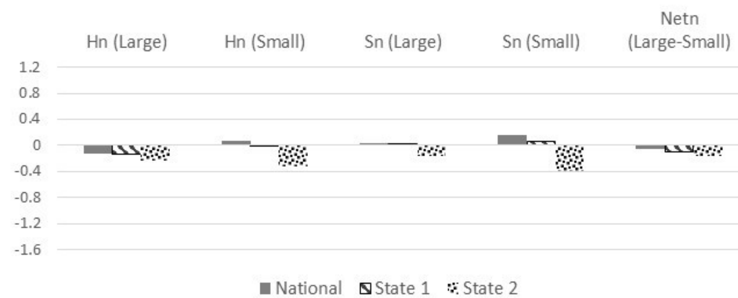
(d) Size, FD Unemp.

Notes: Hp are poaching hires and Sp are poaching separations. High refers to firms in the top two pay quintiles; low refers to firms in the bottom quintile. Large refers to firms employing 500 or more employees; small refers to firms employing 50 or fewer employees. Figures in the top panel report responsiveness to the HP-filtered unemployment rate (HP Unemp); the bottom panel reports responsiveness to the first-differenced unemployment rate (FD unemp). Point estimates from Appendix Tables B.1 and B.2.

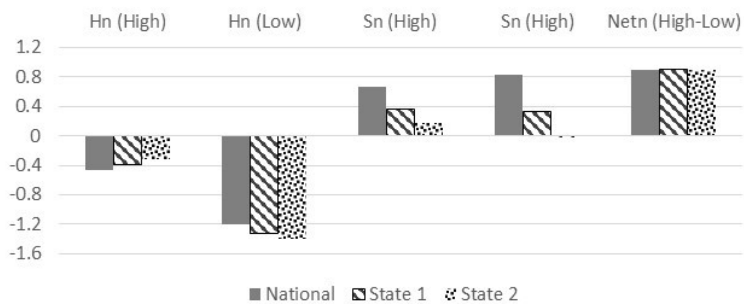
Figure B.2: Cyclical Responses of Non-Employment Hires and Separations by Firm Size and Firm Wage



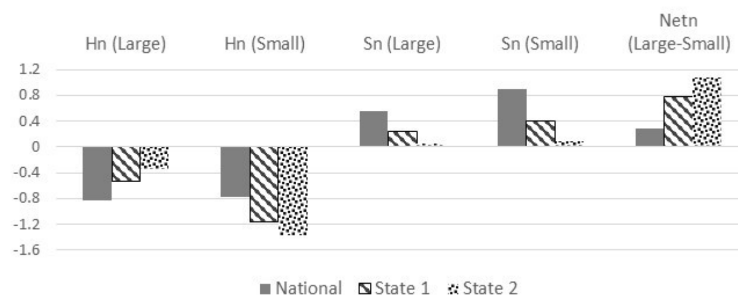
(a) Wage, HP Unemp.



(b) Size, HP Unemp.



(c) Wage, FD Unemp.



(d) Size, FD Unemp.

Notes: See Figure B.2. Hn are hires from non-employment and Sn are separations to non-employment. Point estimates from Appendix Tables B.3 and B.4.

Table B.1: Poaching Hires and Separations and Net Differential, by Wage

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
Poaching Hires: High Wage	−0.570*** (0.051)	−0.578*** (0.033)	−0.476*** (0.090)	−0.674*** (0.225)	−0.406*** (0.061)	−0.317*** (0.083)
Poaching Hires: Low Wage	−0.891*** (0.065)	−0.905*** (0.050)	−0.795*** (0.110)	−0.245 (0.395)	−0.366*** (0.080)	−0.555*** (0.116)
Poaching Sepatations: High Wage	−0.444*** (0.033)	−0.432*** (0.028)	−0.347*** (0.077)	0.297* (0.176)	−0.100** (0.040)	−0.050 (0.056)
Poaching Separations: Low Wage	−1.019*** (0.090)	−1.010*** (0.050)	−0.745*** (0.090)	−1.328*** (0.391)	−0.765*** (0.089)	−0.495*** (0.128)
Net Poaching: High Minus Low	−0.253*** (0.093)	−0.251*** (0.031)	−0.080 (0.077)	−1.460*** (0.157)	−0.706*** (0.080)	−0.205** (0.094)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.

Table B.2: Poaching Hires and Separations and Net Differential, by Size

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
Poaching Hires:	−0.743***	−0.748***	−0.563***	−0.636**	−0.291***	−0.191**
Large	(0.043)	(0.033)	(0.076)	(0.275)	(0.058)	(0.078)
Poaching Hires:	−0.569***	−0.609***	−0.557**	−0.489**	−0.524***	−0.635***
Small	(0.039)	(0.040)	(0.076)	(0.217)	(0.088)	(0.118)
Poaching Sepatations:	−0.724***	−0.689***	−0.415***	0.745***	−0.355***	−0.223***
Large	(0.051)	(0.027)	(0.058)	(0.223)	(0.048)	(0.068)
Poaching Separations:	−0.601***	−0.617***	−0.478***	−0.761***	−0.392***	−0.218***
Small	(0.046)	(0.037)	(0.057)	(0.272)	(0.058)	(0.077)
Net Poaching:	−0.051*	−0.070***	−0.068	−0.132*	0.195**	0.448***
Large Minus Small	(0.027)	(0.017)	(0.050)	(0.086)	(0.080)	(0.116)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.

Table B.3: Non-Employment Hires and Separations and Net Differential, by Wage

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
Non-Employment Hires: High Wage	0.026	0.007	−0.108***	−0.458***	−0.382***	−0.316***
	(0.035)	(0.020)	(0.035)	(0.066)	(0.047)	(0.078)
Non-Employment Hires:Low Wage	−0.157*	−0.233***	−0.606***	−1.202***	−1.325***	−1.400***
	(0.081)	(0.030)	(0.075)	(0.139)	(0.129)	(0.204)
Non-Employment Sepatations: High Wage	0.182***	0.142***	−0.133*	0.672***	0.365***	0.171***
	(0.038)	(0.028)	(0.070)	(0.073)	(0.044)	(0.060)
Non-Employment Separations:Low Wage	−0.017	−0.083*	−0.560***	0.831***	0.324***	−0.022
	(0.081)	(0.048)	(0.148)	(0.174)	(0.087)	(0.124)
Net Non-Emp.: High Minus Low	−0.016	0.016	0.074	0.903***	0.904***	0.891***
	(0.072)	(0.027)	(0.114)	(0.139)	(0.120)	(0.194)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.

Table B.4: Non-Employment Hires and Separations and Net Differential, by Size

Dependent Variable	**Deviation from HP Trend**			**First Difference**		
	National	State 1	State 2	National	State 1	State 2
Non-Employment	−0.128**	−0.144***	−0.238***	−0.824***	−0.534***	−0.342***
Hires: High Wage	(0.054)	(0.023)	(0.037)	(0.093)	(0.048)	(0.077)
Non-Employment	0.075	−0.007	−0.321***	−0.776***	−1.157***	−1.375***
Hires:Low Wage	(0.050)	(0.033)	(0.094)	(0.079)	(0.137)	(0.209)
Non-Employment	0.026	0.022	−0.160*	0.559***	0.242***	0.042
Sepatations: High Wage	(0.041)	(0.035)	(0.084)	(0.074)	(0.059)	(0.079)
Non-Employment	0.163**	0.060	−0.403***	0.895***	0.395***	0.084
Separations:Low Wage	(0.073)	(0.042)	(0.139)	(0.109)	(0.066)	(0.099)
Net Non-Emp.:	−0.065	−0.099***	−0.160*	0.288***	0.777***	1.075***
Large Minus Small	(0.041)	(0.027)	(0.080)	(0.103)	(0.158)	(0.226)

Notes: Coefficient on the cyclical variable with standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "Small" indicates that a firm has 0-50 employees, "Medium" indicates that a firm has 50-499 employees, and "Large" indicates that a business has 500+ employees. "High" indicates that the firm is in the top two quintiles of the wage distribution across firms. "Low" indicates that the firm is in the bottom quintile of the wage distribution across firms. National specification uses national-quarter level data (55 quarters from 1998:Q2-2011Q4), controls for a time trend and uses X-11 seasonal adjustments. State specifications use state-quarter level data (55 quarters and 28 states) and cluster standard errors at the state level. State 1 controls for seasonal dummies and a time trend. State 2 controls for a full set of time dummies for every quarter. Standard errors clustered at the state level.