Job-to-Job Flows and Earnings Growth[*]

By Joyce K. Hahn, Henry R. Hyatt, Hubert P. Janicki, and Stephen R. Tibbets[†]

Recent studies have noted that the U.S. workforce has had little change in real wages, income, or earnings since the year 2000. However, even when there is little change in the average rate at which workers are compensated, individual workers experienced a distribution of wage and earnings changes over this time period. Since individual employment spells involve job changes, transitions to and from nonemployment, and the accumulation of experience at particular jobs, we would like to describe the how earnings evolve at these different circumstances. How does the earnings level, that is, the amount of wage and salary payments that employees receive from their employers, evolve over time? How much comes from on-the-job earnings growth, and how much comes from transitions between employers?

In this paper, we demonstrate how earnings evolve in the U.S. economy in the years 2002-2013 on a forthcoming dataset of public-use data on earnings for stayers and transitioners. Specifically, we implement a variant of the Hahn, Hyatt, and Janicki (2016) earnings decomposition on the core earnings measures for forthcoming public-use data of the U.S. Census Bureau's Job-to-Job Flows data product. We provide an overview of the new measures and how they can be used to account for the role of on-the-job earnings growth, job-to-job flows, and nonemployment in the growth of U.S. earnings.

I. Data on Job-to-Job Flows and Earnings

We use forthcoming earnings data for U.S. Census Bureau's Job-to-Job Flows.[1] The main definitions are described in Hyatt et al. (2014), see Web Appendix A for a description of the new measures. The underlying microdata come from unemployment insurance wage records provided by U.S. states to the U.S. Census Bureau as part of the Local Employment Dynamics federal-state partnership, see Abowd et al. (2009).

The Job-to-Job Flows data measure the universe of transitions between jobs that are dominant among consecutive quarter jobs. The addition of earnings to these job-to-job flows involves associating "full-quarter" earnings with jobs, whenever it is available: start and end dates are not available for the earnings records. Full-quarter earnings are defined as earnings in a quarter in which a job existed in the quarter before and the quarter after. Because there is an employer-employee relationship that spans three consecutive quarters, the earnings that the employee received during the middle quarter can serve as a proxy for the quarterly rate at which that worker was compensated.

Note that the Job-to-Job Flows earnings data are distinct from wages. There is a natural relationship between wages and earnings, in that earnings are the product of an employee's hourly wage rate and the number of hours that employee worked. However, only a small set of states collect hours data as part of their unemployment insurance program. For an analysis of how that hours data allows for separate consideration of hours and wages, see Hahn, Hyatt, and Janicki (2016).

II. Earnings Growth Concepts

Recent work by Hahn, Hyatt, and Janicki (2016) propose a novel method of decomposing earnings growth into the components that come from job-to-job flows (i.e., employer-to-employer transitions), entry and exit from nonemployment, and on-the-job earnings growth. This earnings decomposition begins with the insight of Topel and Ward (1992), that one can measure the earnings changes around job-to-job flows, and compare that with the overall amount of earnings growth for an individual to recover the amount of earnings growth that can be attributed to job-to-job transitions.

The Job-to-Job Flow measures can be used to account for how earnings evolves over time, from some previous P level quarter $t-1$ to a subsequent S level in quarter t. Earnings then evolve from a P level in quarter t to a S level in $t+1$, etc., and in practice more than

[1] Released Job-to-Job Flows data are available for download at `http://lehd.ces.census.gov/data/j2j_beta.html`. Note that, at the time of this writing, earnings data are not yet available for download.

90% of all earnings items in the forthcoming Job-to-Job Flows earnings data are released as both P and S.[2] We use the publication variables to construct average earnings in each quarter, viewed from each so-defined P and S perspective. Job stayers and job-to-job flows evolve from P to S. Nonemployment transitions only contribute to only one side, by construction: separations to nonemployment only contribute to P and hires from nonemployment contribute only to S. The following is an outline of how the forthcoming data release can be transformed to account for changes in the level of average earnings, for a full list of steps involved, see Web Appendix B.

It is possible to express earnings either prospective P or subsequent S earnings. We will consider growth in subsequent S earnings, which evolve according to

$$\Delta \bar{w}_t^S = \bar{w}_t^S - \bar{w}_{t-1}^S = (\bar{w}_t^S - \bar{w}_{t-1}^P) - (\bar{w}_{t-1}^S - \bar{w}_{t-1}^P).$$

We develop a term that denotes the amount of earnings changes that can be associated with job-stayers JS, as well as earnings changes that can be associated with job-to-job flows JJ and transitions into nonemployment EN and transitions out of nonemployment NE. For $C \in \{JS, JJ, EN, NE\}$, we write

$$\bar{w}_t^S - \bar{w}_{t-1}^P = \sum_C \bar{w}_t^{S,C} D_t^{S,C} - \bar{w}_{t-1}^{P,C} D_{t-1}^{P,C}.$$

where $D_t^{L,C}$ indicates the share of the workforce that is in transition category C from lookup L. For the components for job-stayers and job-to-job flows, that is, $C \in \{JS, JJ\}$ we further distinguish:

$$\bar{w}_t^{S,C} D_t^{S,C} - \bar{w}_{t-1}^{P,C} D_{t-1}^{P,C} =$$
$$\underbrace{(D_t^{S,C} - D_{t-1}^{P,C})(\frac{\bar{w}_t^{S,C} + \bar{w}_{t-1}^{P,C}}{2})}_{\text{extensive margin}} +$$
$$\underbrace{(\bar{w}_t^{S,C} - \bar{w}_{t-1}^{P,C})(\frac{D_t^{S,C} + D_{t-1}^{P,C}}{2})}_{\text{intensive margin}}.$$

In the spirit of Daly and Hobijn (2016), we group several terms associated with the net entry of workers from nonemployment: the $(D_t^{S,C} - D_{t-1}^{P,C})$ "extensive

margin" terms with nonemployment's direct contribution to average earnings, $\bar{w}_t^{S,NE} D_t^{S,NE} - \bar{w}_{t-1}^{P,EN} D_{t-1}^{P,EN}$.

The residual $\bar{w}_{t-1}^S - \bar{w}_{t-1}^P$ is the combination of several factors, which we list here.[3] Changes in the earnings level due to job-to-job transitions that do not involve both a hire and separation, as well as job-to-job transitions in which only employment at the previous or subsequent quarter lasts a full quarter. Differences also exist because all tabulations are done on the population in the age range of 14-99, so the entry of very young and very old workers are not treated as flows across employment, but job stayers whose work in earlier quarters was not tabulated (in the case of the youngest workers), and workers whose work is not tabulated in subsequent quarters (in the case of the oldest workers). Finally, confidentiality protection in the released data includes noise infusion, which also can make cross-quarter identities that hold in the underlying microdata no longer hold in the released data.

III. Accounting for Earnings Growth

We now conduct an empirical analysis of earnings growth, distinguishing between the different components of earnings growth. We have five categories for earnings growth: the overall change in average earnings, the contributions that can be attributed to job stayers, job-to-job flows, net effects of worker entry from and exit to nonemployment, and the residual that captures the difference in average earnings measured prospectively or retrospectively, defined above.

We make adjustments to our data that are prudent when analyzing employer-reported earnings amounts that are available at a quarterly frequency. First, we account for seasonality, which is common in analysis of data that is available at higher-than-annual frequencies. We also found it useful to account for what are called "trading day" effects, that is, changes in the number of days of some economic event in a quarter. In the case of earnings, the number of pay periods (that is, paychecks that a worker receives) in a quarter can affect the amount of earnings, as noted by Kurmann, McEntarfer, and Spletzer (2016). Some workers are paid on a weekly basis, while others are paid on a bi-weekly or monthly basis. We are not interested in variation in the earnings level that comes from these calendar effects, so we perform an adjustment to remove them.

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[2]E.g. if a full-quarter job stayer transitions into a different job that does not last a full quarter, then there may be S earnings associated with the stayer, but the full quarter earnings that would contribute to P earnings are not released because earnings are not released for job-to-job flows unless they are full-quarter to full-quarter.

[3]We conduct our analysis in this paper either at the national level, or for all available states as data permit. Conducting this decomposition exercise for published subpopulations can also be influenced by worker movements across locations, industry sectors, and time-variant demographic categories, and so these differences would also be absorbed a residual as defined in this paper.

Table 1—: Linear Regression to Account for Earnings Growth and Its Components

	Earnings Growth	Job Stayer	Job-to-Job	Nonemp.	Residual
Winter (Quarter 1)	-1120***	-1006***	-10	-79***	-13
	(214)	(209)	(7)	(14)	(20)
Spring (Quarter 2)	-2182***	-2253***	26***	55***	24**
	(116)	(113)	(4)	(8)	(11)
Summer (Quarter 3)	-1666***	-1598***	9**	-30***	20
	(136)	(133)	(5)	(9)	(13)
Sundays	110	76	7*	0	-6
	(118)	(116)	(4)	(8)	(11)
Mondays	224*	210*	11**	-1	-2
	(118)	(116)	(4)	(8)	(11)
Tuesdays	113	91	6	7	-1
	(116)	(115)	(4)	(8)	(11)
Wednesdays	228*	197*	5	6	2
	(116)	(112)	(4)	(8)	(11)
Thursdays	415***	381***	8*	14	20
	(137)	(136)	(5)	(9)	(13)
Fridays	510***	477***	14***	22***	-1
	(117)	(115)	(4)	(8)	(11)
Saturdays	-14	33	2	-7	1
	(129)	(124)	(4)	(9)	(12)
Unemployment	-14	-25	-3***	17***	-9***
First Difference	(25)	(25)	(1)	(2)	(2)

Notes: Regressions also include controls for a linear time trend and a fixed effect corresponding to the quarter of entry of each state. "Earnings Growth" indicates the change in earnings from one quarter to the next. "Job Stayer" indicates the intensive margin of earnings growth attributable to job stayers who remain at their jobs at least four quarters. "Job-to-Job" indicates the intensive margin of earnings growth attributable to workers involved in a job-to-job flow from one employer to another, separating from the former, being hired at the latter, and both jobs last at least three quarters. Nonemployment ("Nonemp.") is the sum of the components attributable to the earnings of nonemployment entrants and exiters and their respective shares, as well as the extensive margin of earnings growth attributable to job stayers and workers in job-to-job flows. Residual is the difference in earnings viewed as previous vs. subsequent. See text and Web Appendix B for additional details.

To do so, we run a seasonal model along with a term that accounts for how the number of Fridays in a quarter changes over time. While the typical quarter has 13 Fridays (as there are thirteen weeks in a quarter), some quarters have only 12 Fridays, while others have 14. The number of Fridays in a quarter therefore changes by zero, one, or two. Different states enter the administrative records data at different times and, at the time of this writing, an imputation to correct for the omission of different states is not available.[4] Therefore, we include a linear effect that captures the quarters in which different states first enter the Job-to-Job Flows data.[5]

In Table 1, we show selected coefficients from a regression of each measure on season dummies, a linear

time trend, the number of each day of the week in the calendar quarter, and the unemployment rate. There is substantial seasonality in the components of earnings growth. The phenomenon of year-end bonuses seems present in the data: overall earnings level is the highest in the fourth quarter (Fall) relative to other quarters. This difference is driven by job stayers: for other components of earnings growth, the earnings in the fourth quarter are not always higher than earnings in every other calendar quarter.

The number of days of the week in a calendar quarter also has some effect on earnings changes, although this varies in magnitude depending on the measure and particular day of the week under consideration. The largest effects of the number of days of the week in a calendar quarter are found for the number of Thursdays and Fridays for overall earnings growth and job stayers: an additional Friday in a calendar quarter increases overall (job stayer) earnings growth by $510 ($477), while an additional Thursday increases overall (job stayer) earnings growth by $415 ($381). An addi-

[4]Many of the economic measures produced as part of the Job-to-Job Flows data product do have national measures that are regularly produced. National earnings measures are under development but not in regular production.

[5]Specifically, we have dummy variables whenever one or more states are included in the data for the first time. These quarters are 2001Q1 (AL, KY, and WY), 2002Q3 (AR), 2003Q1 (NH), 2003Q3 (MI), 2004Q1 (AZ), 2005Q2 (DC), and 2010Q1 (MA).

Figure 1. : Contribution to Average Earnings: Earnings Growth vs. Dilution through Employment Growth
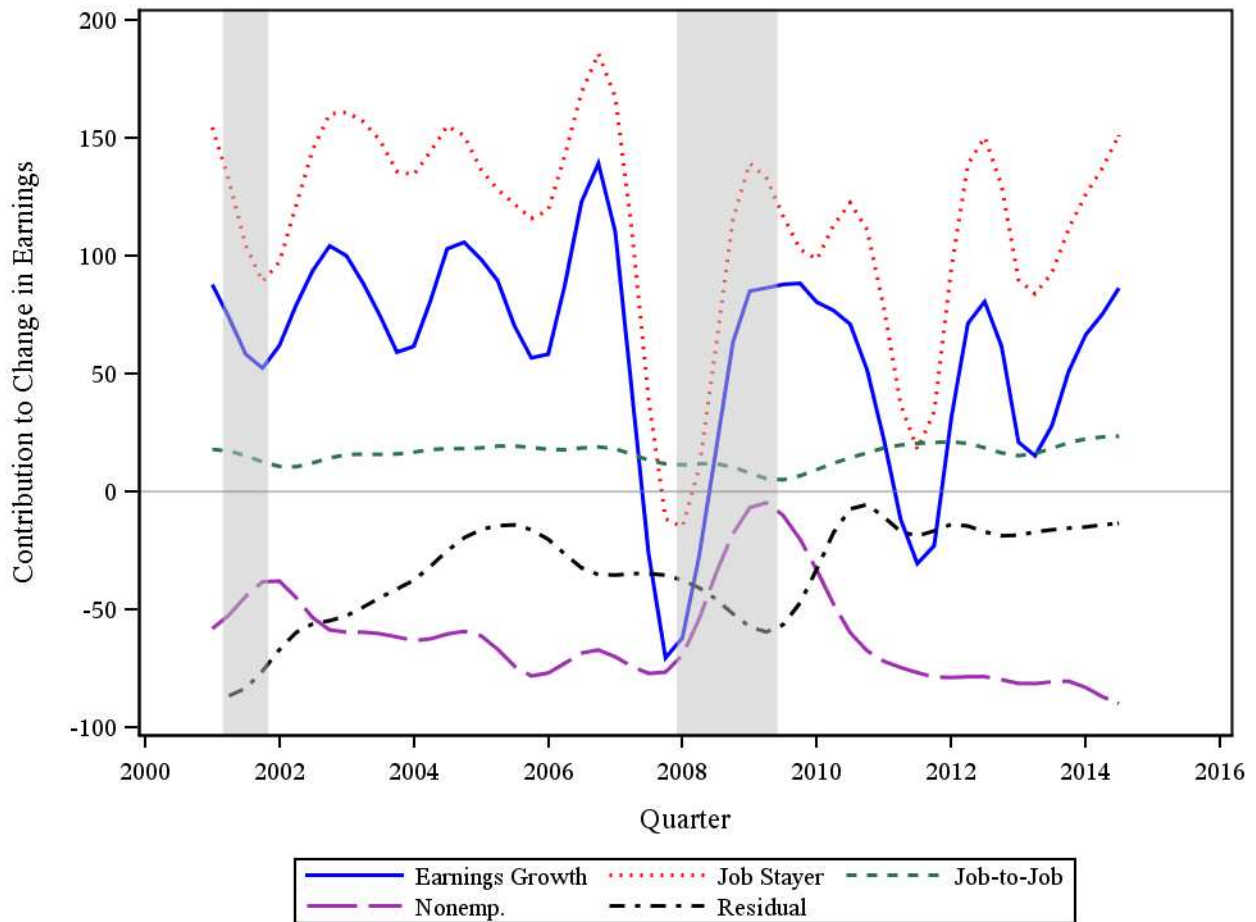
Notes: All data are presented in 2014 constant dollars. Data pre-treated for trading day effects and the quarter of entry of different U.S. states into the Job-to-Job Flows data via linear regression, and are then seasonally-adjusted and Henderson-filtered using x12 with a moving average of 9 quarters. Shaded areas indicate recessions. "Earnings Growth" indicates the total change in earnings within a quarter. "Job Stayer" indicates the intensive margin of earnings growth attributable to job stayers who remain at their jobs at least four quarters. "Job-to-Job" indicates the intensive margin of earnings growth attributable workers involved in a job-to-job flow from one employer to another, separating from the former, being hired at the latter, and both jobs last at least three quarters. Nonemployment ("Nonemp.") is the sum of the component attributable to the earnings of nonemployment entrants and exiters and their respective shares, as well as the extensive margin of earnings growth attributable to job stayers and workers in job-to-job flows as above. Residual is the difference in earnings viewed as previous vs. subsequent. See text and Web Appendix B for additional details.

tional Monday or Wednesday has an effect that is about half as large, and other days have marginal effects that are smaller and rarely significantly different from zero.

The relationship between unemployment and earnings growth varies across components. This relationship is of interest because the degree to which wages can adjust downward when there is less demand for labor can affect the unemployment rate. Models of wage rigidity propose that if employers are unable to adjust wages in response to shocks, employers may respond to negative shocks by cutting employment rather than wages.[6] When the unemployment rate is one per-

[6]While our regression of earnings changes on the first difference in

centage point higher, the regression estimate implies that overall earnings growth will be lower by $14, although this estimate is not distinguishable from zero. Job stayers have a regression estimate that implies that they contribute $25 less to earnings growth when the unemployment rate is one percentage point higher, al-

unemployment resembles estimates from the literature that follows Bils (1985), we note two important differences. First, we do not control for worker-level observable characteristics such as age and job tenure. Second, we consider changes in total earnings, not wages (earnings per hour). For estimates on the underlying microdata that control for observable characteristics, as well as estimates of the relationship between the unemployment rate and earnings per employer-reported hours paid, see Hahn, Hyatt, and Janicki (2016).

though, again, the estimate is imprecise and we cannot reject zero. More precise estimates are found for the contribution of job-to-job flows, nonemployment, and the residual. The job-to-job flow contribution to earnings growth is procyclical, and contributes about $3 less to earnings for every percentage point increase in the unemployment rate. Nonemployment contributes to earnings growth countercyclically, with a one percentage point increase in the unemployment rate contributes $17 to earnings growth. The residual is also cyclical, and contributes $9 less for every percentage point increase in the unemployment rate.

The time trends of the underlying components can help with the interpretation of the regression estimates, and we plot these time trends in Figure 1. Earnings growth overall, as well as that which is associated with job stayers, varies more than the other measures, which is consistent with the large standard errors of the regression estimates.[7] The contribution of job-to-job flows to earnings is modest and procyclical.[8] The nonemployment effect is driven by the fact that workers who are leaving nonemployment into employment tend to earn less than those exiting to nonemployment, and also earn much less than incumbent workers, hence the contribution of the nonemployment margin is generally negative. During expansions, the number of workers entering employment substantially exceeds the number of workers exiting employment, lowering the average earnings level. However, during recessions, fewer workers move into employment from nonemployment, and so this negative effect is lower in magnitude. The residual is also negative, as earnings viewed as subsequent to a transition are greater than earnings viewed as previous to a transition. However, it is countercyclical and falls during the 2007-2009 recession.

IV.   Conclusion

We have demonstrated how to use the new earnings data associated with the U.S. Census Bureau's Job-to-Job Flows data product to account for how earnings evolve in the U.S. economy. We proposed aggregations

of the forthcoming release that permit an understanding of the role of on-the-job earnings growth, as well as job-to-job flows, nonemployment, characterized some properties of the residual that the released measures do not account for. Consistent with previous evidence, job stayers move the earnings level by more than the other components. Nonemployment flows have a negative effect on the earnings level, which declines in magnitude during recessions. Job-to-job flows have a more modest positive effect on earnings, because of the outsized returns to moving, which also declines during recessions. Analysis of the full set of released data will allow consideration of different industries, locations, worker demographic characteristics, and firm characteristics in the evolution of earnings in the U.S. economy.

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[7]The substantial volatility in these series is at least in part due to the universe-level nature of the earnings data, which includes many very high earners with volatile earnings. In Hahn, Hyatt, and Janicki (2016), similarly constructed results using data that winsorize the top 1% of earnings exhibit substantially less volatility, as are results using log earnings relative to levels (as in this paper).

[8]There is a substantial difference in the contribution of earnings in logs relative to levels (this paper uses the latter), explored in Hahn, Hyatt, and Janicki (2016). Because workers undergoing job-to-job transitions earn substantially less (about half as much) as job stayers, their large proportionate earnings increases are captured in a decomposition of log earnings, as are the relatively small proportionate increases in job stayers.

Appendices

A. Job-to-Job Flow Definitions (Web Only)

This appendix provides the formal definitions of the job-to-job flow concepts used in the forthcoming earnings tabulation. Definitions follow the notational conventions established by Abowd et al. (2009), augmented to include job-to-job flows by Hyatt et al. (2014). The starting point is earnings for individual i from employer j in quarter t, denoted w_{ijt}. If an individual has no earnings from an employer in a given quarter, then the worker did not receive unemployment insurance taxable income from that employer during that quarter, otherwise, if the worker did receive positive earnings from that employer ($w_{ijt} > 0$), then the worker worked for the employer.

The job-to-job flow definitions used for published tabulations, as listed in Hyatt et al. (2014), consider the subset of jobs that span two consecutive quarters (often called "consecutive quarter" or "beginning of quarter" jobs). Such consecutive quarter jobs have the desirable property that, for most such employment relationships, the employee was employed by the employer at the time of transition between the quarters, which allows this employment measure to reasonably be interpreted as indicative of point-in-time employment (recall that these administrative records lack start and end dates). Formally, these are

$$b_{ijt} = \begin{cases} 1, & \text{if } w_{ijt-1} > 0 \text{ and } w_{ijt} > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Before we define the earnings measures formally, it is useful to introduce one more term, that for full quarter jobs. Such jobs span three consecutive quarters, in other words,

$$f_{ijt} = \begin{cases} 1, & \text{if } w_{ijt-1} > 0 \text{ and } w_{ijt} > 0 \text{ and } w_{ijt+1} > 0 \\ 0, & \text{otherwise.} \end{cases}$$

For any two-quarter pair, job-to-job flows are calculated only using jobs that are maximal earning among all such consecutive quarter jobs, referenced from the "beginning" of quarter t. Formally, this is defined as:

$$domb_{ijt} = \begin{cases} 1, & \text{if } b_{ijt} = 1 \text{ and} \\ & w_{ijt} + w_{ijt-1} > w_{ikt} + w_{ikt-1} \forall k \\ & \text{s.t. } b_{ikt} = 1 \text{ and } j \neq k \\ 0, & \text{otherwise.} \end{cases}$$

The Job-to-Job Flows data product records transitions between dominant job status across quarters. These are worker movements between employers, as well as into and from nonemployment. In accounting for earnings, we also consider workers who did not change jobs, who are called "job stayers." This leads to five earnings concepts, each with one or two earnings observations attached: workers transitioning into and out of nonemployment can get only one earnings observation because there are no earnings associated with nonemployment (by definition). In contrast, job stayers and each of two types of job-to-job flows each get two earnings observations, in order to assign earnings changes to these employment statuses.

These job stayers that contribute to earnings tabulations have at least four quarters of consecutive earnings: this is the minimum number of quarters necessary to compare a given job stayer's full quarter earnings in a given quarter to full-quarter earnings in the previous quarter. Additionally, such workers must be dominant among consecutive quarter jobs at the beginning of the reference quarter t, as well as at the beginning of the next quarter $t+1$. Formally,

$$fdombe_{ijt} = \begin{cases} 1, & \text{if } domb_{ijt} = 1 \text{ and } domb_{ijt+1} = 1 \\ & \text{and } f_{ijt-1} = 1 \\ 0, & \text{otherwise.} \end{cases}$$

For these so-defined job-stayers, we can compare earnings from quarter $t-1$ to earnings in quarter t. The earnings for the quarter preceding the reference quarter are

$$fdombe\_jfqearn_{ijt} = \begin{cases} w_{ijt-1}, & \text{if } fdombe_{ijt} = 1 \\ 0, & \text{otherwise,} \end{cases}$$

and the earnings contemporaneous with the reference quarter are

$$fdombe\_kfqearn_{ijt} = \begin{cases} w_{ijt}, & \text{if } fdombe_{ijt} = 1 \\ 0, & \text{otherwise.} \end{cases}$$

Two types of job-to-job transitions are also tabulated: those in which there is earnings from the previous employer j and subsequent employer k in the same calendar quarter (called "within-quarter" job-to-job flows) and in which the earnings from the subsequent employer begins in the following quarter (called "adjacent-quarter" job-to-job flows).

The first type of job-to-job flow involves the case in which a worker had a different employer at the be-

ginning of a quarter than its end (i.e., the beginning of the next quarter), from employer j to employer k. The worker must separate from the previous employer j and be hired at employer k in quarter t.

$$
fee_{ijkt} = \begin{cases} 1, & \text{if } domb_{ijt} = 1 \text{ and } domb_{ikt+1} = 1 \\ & \text{and } f_{ijt-1} = 1 \text{ and } f_{ikt+1} = 1 \\ & \text{and } w_{ijt+1} = 0 \text{ and } w_{ikt-1} = 0 \\ & \text{and } j \neq k \\ 0, & \text{otherwise.} \end{cases}
$$

Earnings are taken from the last available full-quarter earnings observation from the previous employer j and the first available full-quarter earnings observation from the subsequent employer k.

$$
fee\_jfqearn_{ijt} = \begin{cases} w_{ijt-1}, & \text{if } fee_{ijkt} = 1 \\ 0, & \text{otherwise,} \end{cases}
$$

and the earnings at the next employer are taken from the quarter immediately after the reference quarter, i.e. quarter $t+1$.

$$
fee\_kfqearn_{ijt} = \begin{cases} w_{ijt+1}, & \text{if } fee_{ijkt} = 1 \\ 0, & \text{otherwise.} \end{cases}
$$

There is a second type of job-to-job flow definition that captures employment at a job that ends in the quarter before the subsequent employment begins at the worker's next employer. Note that workers in a quarter t who have no employer j such that $b_{ijt} = 1$ could be said to be nonemployed at the beginning of quarter t. However, it is well known that in some cases jobs start on the first day (or first weekday) of a given month. These adjacent-quarter job-to-job flows that have earnings attached

$$
faq_{ijkt} = \begin{cases} 1, & \text{if } domb_{ijt-1} = 1 \text{ and } domb_{ikt+1} = 1 \\ & \text{and } f_{ijt-1} = 1 \text{ and } f_{ikt+1} = 1 \\ & \text{and } domb_{ilt} \neq 1 \forall l \text{ and } j \neq k \\ 0, & \text{otherwise.} \end{cases}
$$

Earnings are taken from the last available full-quarter earnings observation from the previous employer j and the first available full-quarter earnings observation from the subsequent employer k.

$$
faq\_jfqearn_{ijt} = \begin{cases} w_{ijt-2}, & \text{if } faq_{ijkt} = 1 \\ 0, & \text{otherwise,} \end{cases}
$$

and the earnings contemporaneous with the reference quarter are

$$
faq\_kfqearn_{ijt} = \begin{cases} w_{ijt+1}, & \text{if } faq_{ijkt} = 1 \\ 0, & \text{otherwise.} \end{cases}
$$

We also assign earnings to transitions involving movements into and out of "persistent" nonemployment, that is, a worker has no consecutive quarter job at the beginning of quarter t or quarter $t+1$. If the worker was employed at the beginning of the previous quarters and t quarter but is not employed at the beginning of quarters $t+1$ and $t+2$, then the worker transitioned from employment to nonemployment, otherwise if the worker was not employed at the beginning of quarters $t-1$ and t, but is employed at the beginning of quarter $t+1$, then the worker is said to have transitioned from nonemployment into employment during quarter t.

Flows into persistent nonemployment in quarter t have full-quarter earnings when

$$
fen2\_doms2_{ijt} = \begin{cases} 1, & \text{if } domb_{ijt} = 1 \text{ and } f_{ijt-1} = 1 \\ & \text{and } domb_{ilt+1} \neq 1 \forall l \\ & \text{and } domb_{imt+2} \neq 1 \forall m \\ 0, & \text{otherwise,} \end{cases}
$$

and those earnings, taken from quarter $t-1$, are

$$
fen2\_fqearn_{ijt} = \begin{cases} w_{ijt-1}, & \text{if } fen2\_doms2_{ijt} = 1 \\ 0, & \text{otherwise} \end{cases}.
$$

Flows from persistent nonemployment into employment in quarter t have full quarter earnings when

$$
fne2\_doma2_{ikt} = \begin{cases} 1, & \text{if } domb_{ikt+1} = 1 \text{ and } f_{ikt+1} = 1 \\ & \text{and } domb_{ilt} \neq 1 \forall l \\ & \text{and } domb_{imt-1} \neq 1 \forall m \\ 0, & \text{otherwise,} \end{cases}
$$

and those earnings, taken from quarter $t+1$ are defined as:

$$
fne2\_fqearn_{ijt} = \begin{cases} w_{ijt+1}, & \text{if } fne2\_doma2_{ikt} = 1 \\ 0, & \text{otherwise.} \end{cases}
$$

B. Decomposition Transformations (Web Only)

The decomposition exercise accounts for the different mechanisms by which earnings from one quarter to the next, in other words, quarter $t-1$ to quar-

ter t. We transform twelve of the measures defined in Appendix A into five aggregates: one for overall earnings growth, as well as the contribution of job stayers, job-to-job flows, transitions into and out of nonemployment, and a residual. Earnings in each quarter can be viewed prospectively P or subsequently S. Each quarter t for which data is available has job stayers and job-to-job flows contribute once to earnings viewed prospectively, and once when viewed subsequently. For example, for the job stayer $fdombe_{ijt}$, the earnings $fdombe\_kfqearn_{ijt}$ come from quarter t and are hence viewed subsequently, while the earnings $fdombe\_jfqearn_{ijt}$ come from quarter $t-1$ and hence are viewed previously. We can, for any quarter t, express average earnings as the weighted sum of earnings for each job-to-job flow measure. By contrast, transitions into and out of nonemployment only contribute once: employment-to-nonemployment flows only contribute to earnings when viewed subsequently, and nonemployment-to-employment flows only contribute to earnings only when viewed prospectively. We specify how to measure earnings when measured subsequently.

The decomposition will express earnings change associated with changes in the shares of the workforce that are stayers and each type of transitioner, as well as changes in those shares, and changes in earnings. We will turn twelve of the measures defined in Appendix A into six average earnings measures and six share of employment measures (the fact that both sum to twelve is purely coincidental).

Call the total number of earnings observations $totemp_t^P$ when viewed prospectively and $totemp_t^S$, when viewed subsequently. This can be calculated as

$$totemp_t^P = \begin{aligned} &\Sigma_i fdombe_{ijt+1}+ \\ &\Sigma_i fee_{ijt+1}+ \\ &\Sigma_i faq_{ijt+2}+ \\ &\Sigma_i fen2_{ijt+1}. \end{aligned}$$

Note that all observations that contribute to quarter t's earnings come from transitions referencing quarter $t+1$ with the exception of adjacent-quarter flows, because the earnings from which earnings are taken lag the reference quarter by one relative to the other transition types.

Earnings for a given quarter, viewed from the subsequent perspective draw from the transition reference quarter $t-1$ with the exception of job stayers, which reference quarter t:

$$totemp_t^S = \begin{aligned} &\Sigma_i fdombe_{ijt}+ \\ &\Sigma_i fee_{ijt-1}+ \\ &\Sigma_i faq_{ijt-1}+ \\ &\Sigma_i fne2_{ijt-1}. \end{aligned}$$

Now, we can define the shares associated with job-stayers JS, job-to-job flows JJ, and flows into nonemployment EN and flows out of nonemployment NE viewed from both the previous and subsequent perspectives, as follows.

We now define six share measures. The share of all earnings observations viewed from the previous perspective that are associated with job stayers is

$$D_t^{P,JS} = \frac{\Sigma_i fdombe_{ijt+1}}{totemp_t^P}.$$

The share of earnings observations viewed from the previous perspective that are associated with job-to-job flows is

$$D_t^{P,JJ} = \frac{\Sigma_i fee_{ijt+1} + \Sigma_i faq_{ijt+2}}{totemp_t^P}.$$

The share of earnings observations viewed from the previous perspective associated with flows into nonemployment is

$$D_t^{P,EN} = \frac{\Sigma_i fen2_{ijt+1}}{totemp_t^P}.$$

The share of all earnings observations viewed from the subsequent perspective that are associated with job stayers is

$$D_t^{S,JS} = \frac{\Sigma_i fdombe_{ikt}}{totemp_t^S}.$$

The share of earnings observations viewed from the subsequent perspective that are associated with job-to-job flows is

$$D_t^{S,JJ} = \frac{\Sigma_i fee_{ikt-1} + \Sigma_i faq_{ikt-1}}{totemp_t^S}.$$

The share of earnings observations viewed from the subsequent perspective associated with flows into nonemployment is

$$D_t^{S,EN} = \frac{\Sigma_i fne2_{ijk-1}}{totemp_t^S}.$$

We now define six average earnings measures. The average earnings associated with earnings observations viewed from the previous perspective that is associated with job stayers is

$$\bar{w}_t^{P,JS} = \frac{\sum_i fdombe\_jfqearn_{ijt+1}}{\sum_i fdombe_{ijt+1}}.$$

The share of earnings observations viewed from the previous perspective that are associated with job-to-job flows is

$$\bar{w}_t^{P,JJ} = \frac{\sum_i fee\_jfqearn_{ijt+1} + \sum_i faq\_jfqearn_{ijt+2}}{\sum_i fee_{ijt+1} + \sum_i faq_{ijt+2}}.$$

The share of earnings observations viewed from the previous perspective associated with flows into nonemployment is

$$\bar{w}_t^{P,EN} = \frac{\sum_i fen2\_fqearn_{ijt+1}}{\sum_i fen_{ijt+1}}.$$

The share of all earnings observations viewed from the subsequent perspective that are associated with job stayers is

$$\bar{w}_t^{S,JS} = \frac{\sum_i fdombe\_kfqearn_{ikt}}{\sum_i fdombe_{ikt}}.$$

The share of earnings observations viewed from the subsequent perspective that are associated with job-to-job flows is

$$\bar{w}_t^{S,JJ} = \frac{\sum_i fee\_kfqearn_{ikt-1} + \sum_i faq\_kfqearn_{ikt-1}}{\sum_i fee_{ikt-1} + \sum_i faq_{ikt-1}}.$$

The share of earnings observations viewed from the subsequent perspective associated with flows into nonemployment is

$$\bar{w}_t^{S,EN} = \frac{\sum_i fne2\_fqearn_{ijk-1}}{\sum_i fne2_{ijk-1}}.$$

Armed with these 6 shares and 6 earnings definitions, we can decompose average earnings into different components: job stayers, job-to-job flows, and nonemployment, as well as a residual. To do so, we use a convenient substitution.

$$\Delta\bar{w}_t = \bar{w}_t^S - \bar{w}_{t-1}^S = \underbrace{(\bar{w}_t^S - \bar{w}_{t-1}^P)}_{=JS+JJ+N} - \underbrace{(\bar{w}_{t-1}^S - \bar{w}_{t-1}^P)}_{residual}.$$

The residual $\bar{w}_{t-1}^S - \bar{w}_{t-1}^P$ indicates the difference that quarter $t-1$ earnings are when viewed from the previous vs. subsequent perspective. We do additional transformations of $\bar{w}_t^S - \bar{w}_{t-1}^P$. First, note that

$$\bar{w}_t^S - \bar{w}_t^P = \sum_C \bar{w}_t^{S,C} D_t^{S,C} - \bar{w}_{t-1}^{P,C} D_{t-1}^{P,C}.$$

For the components for job-stayers and job-to-job flows, that is, $C \in \{JS, JJ\}$ we further distinguish:

$$\bar{w}_t^{S,C} D_t^{S,C} - \bar{w}_{t-1}^{P,C} D_{t-1}^{P,C} =$$
$$\underbrace{(D_t^{S,C} - D_{t-1}^{P,C})(\frac{\bar{w}_t^{S,C} + \bar{w}_{t-1}^{P,C}}{2})}_{extensive\ margin} +$$
$$\underbrace{(\bar{w}_t^{S,C} - \bar{w}_{t-1}^{P,C})(\frac{D_t^{S,C} + D_{t-1}^{P,C}}{2})}_{intensive\ margin}.$$

In the spirit of Daly and Hobijn (2016), we group the terms associated with the "dilution" of employment by the net entry of workers from nonemployment. In other words, we group the $(D_t^{S,C} - D_{t-1}^{P,C})$ "extensive margin" terms with nonemployment's other component, $\bar{w}_t^{S,NE} D_t^{S,NE} - \bar{w}_{t-1}^{P,EN} D_{t-1}^{P,EN}$.

Now, for any quarter t, we can define the components of our decomposition.

Job stayers contribute

$$JS_t = (\bar{w}_t^{S,JS} - \bar{w}_{t-1}^{P,JS})(\frac{D_t^{S,JS} + D_{t-1}^{P,JS}}{2}),$$

job-to-job flows contribute

$$JJ_t = (\bar{w}_t^{S,JJ} - \bar{w}_{t-1}^{P,JJ})(\frac{D_t^{S,JJ} + D_{t-1}^{P,JJ}}{2}),$$

and nonemployment contributes

$$N_t = (D_t^{S,JS} - D_{t-1}^{P,JS})(\frac{\bar{w}_t^{S,JS} + \bar{w}_{t-1}^{P,JS}}{2}) +$$
$$(D_t^{S,JJ} - D_{t-1}^{P,JJ})(\frac{\bar{w}_t^{S,C} + \bar{w}_{t-1}^{P,JJ}}{2}) +$$
$$\bar{w}_t^{S,NE} D_t^{S,NE} - \bar{w}_{t-1}^{P,EN} D_{t-1}^{P,EN}.$$

Released data are converted to 2014 constant dollars. Overall earnings growth in time t is, by construction, equal to the sum of $JS_t + JJ_t + N_t$ and the residual from time t. Overall earnings growth, JS_t, JJ_t, N_t, and the residual are the dependent variables for each column in Table 1, respectively, and are presented, after adjustment for trading day effects, changes in the composition of U.S. states, seasonally adjustment, and Henderson filtering, in Figure 1.

Figure C1. : Share of Employment
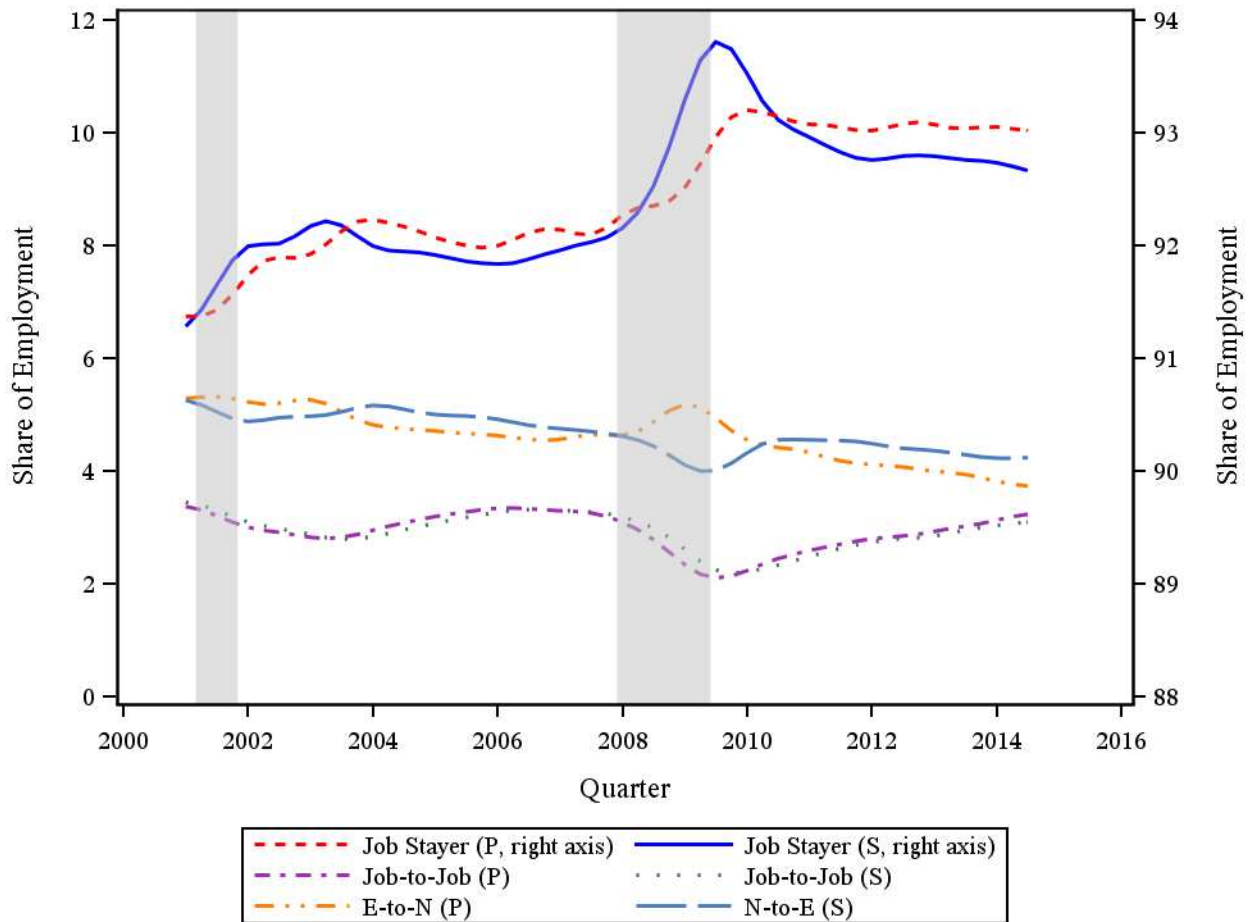
Notes: All data are seasonally-adjusted using x12. Shaded areas indicate recessions. "Job Stayers (Previous)" indicates the freqency in previous quarter for job stayers who remain at their jobs at least four quarters. "Job Stayers (Subsequent)" indicates the frequency in the current quarter for job stayers who remain at their jobs at least four quarters. "Job-to-Job Flows (P)" indicates the frequency of a job-to-job flow from one employer to another, separating from the former, being hired at the latter, in the previous quarter. Both jobs last at least three quarters. "Job-to-Job Flows (S)" indicates the frequency of a job-to-job flow from one employer to another, separating from the former, being hired at the latter, in the current quarter. Both jobs last at least three quarters. "Flows to Nonemployment (P)" indicates the frequency of nonemployment entrants in the previous quarter. "Flows from Nonemployment (S)" indicates the frequency of nonemployment exiters in the current quarter.

C.   Descriptive Figures (Web Only)

In this section, we describe the relative frequency of job stayers, job-to-job flows, and nonemployment entrants and exiters, as well as the average earnigns associated with each group. All results are seasonally adjusted using x12. All results reference time t and present the contemporaneous value (subsequent S, containing earnings from time t) as well as the value corresponding to the quarter before (previous P, containing earnings from time $t-1$). In terms of the definitions from Appendix B, for each component C, we plot $D_t^{S,C}$ and $D_{t-1}^{S,C}$

Figure C.1 plots the relative frequency of job stay-

ers, job-to-job flows, and nonemployment entrants and exiters. In every quarter, most workers are job stayers (plotted on the right axis), who constitute at least 91% of employment in each quarter. The share of employment that job stayers constitute increases procyclically, and is at its highest in the late stages of recoveries. Job-to-job flows are procyclical and reach a series low at the end of the 2007-2009 recession. Job-to-job flows constitute 2% to 4% of employment. Nonemployment flows are more frequent than job-to-job flows throughout the time series and account for 4% to 6% of employment. Flows out of nonemployment are procyclical and generally exceed flows out of employment and into nonemployment, which are countercyclial.

Figure C2. : Average Earnings
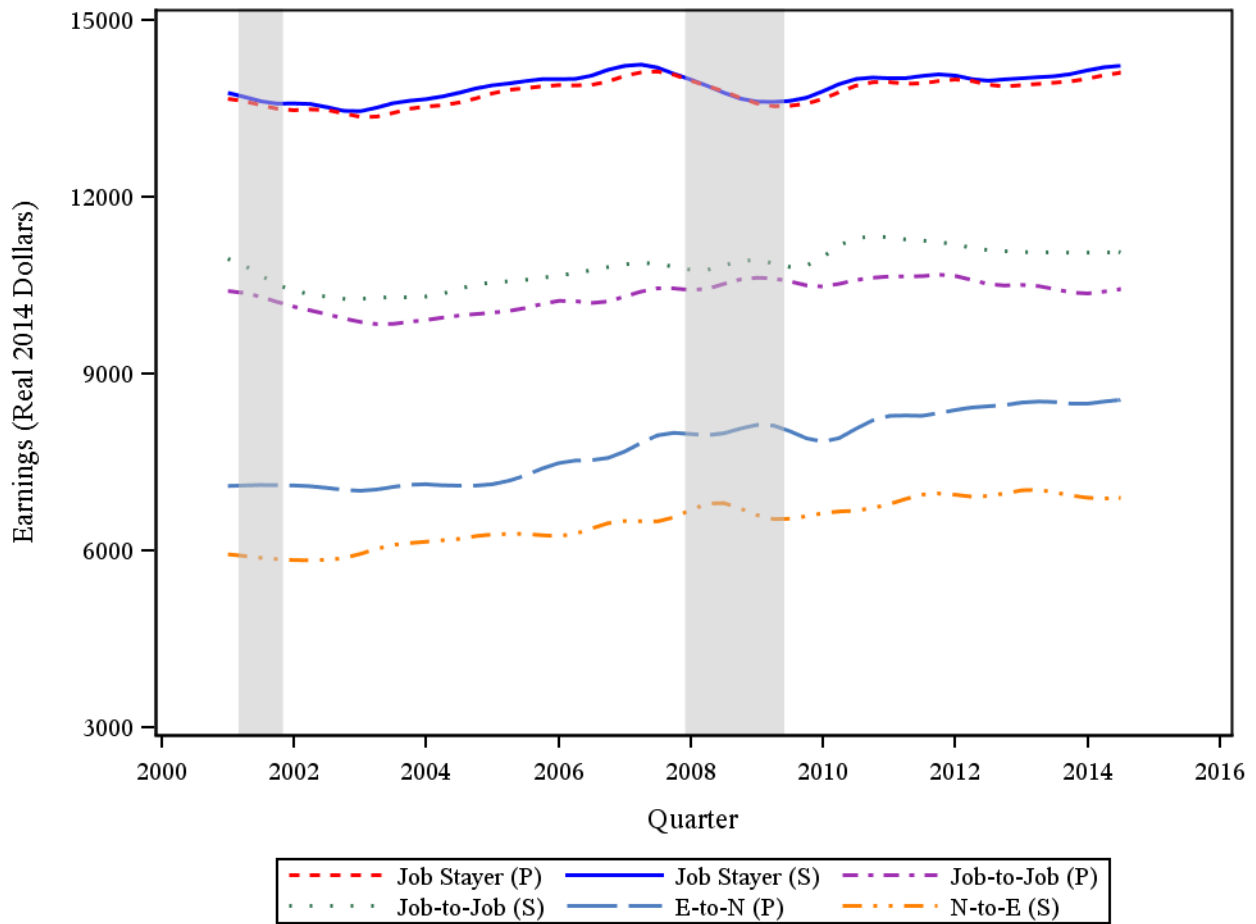
Notes: All data are presented in 2014 constant dollars and are seasonally-adjusted using x12. Shaded areas indicate recessions. "Job Stayers (Previous)" indicates average earnings in the previous quarter for job stayers who remain at their jobs at least four quarters. "Job Stayers (Subsequent)" indicates average earnings in the current quarter for job stayers who remain at their jobs at least four quarters. "Job-to-Job Flows (P)" indicates average earnings in the previous quarter for workers involved in a job-to-job flow from one employer to another, separating from the former, being hired at the latter. Both jobs last at least three quarters. "Job-to-Job Flows (S)" indicates average earnings in the current quarter for workers involved in a job-to-job flow from one employer to another, separating from the former, being hired at the latter. Both jobs last at least three quarters. "E-to-N (P)" indicates average earnings in the previous quarter for nonemployment entrants. "N-to-E (S)" indicates average earnings in the previous quarter for nonemployment exiters.

These figures also distinguish whether the earlier (previous *P*) or later (subsequent *S*) are used. Recall that the number of job stayers in each quarter *t* is the same whether measured as part of *P* or *S*, all that is different is the denominator. Differences in the share of emplyoment that job stayers constitute is driven by the difference in the share of emplyoment of workers exiting and entering nonemplyoment. During and shortly after economic contractions, more workers enter nonemployment than leave it, which leads the share of employment cosntituted by job stayers to be greater measured as part of *S* relative to *P*. Similarly, during economic expansions, job stayers contribute less to *S* than to *P*. A similar intituion holds for the fluctuations

in job-to-job flows measured from *P* or *S*.

Figure C.2 plots the average earnings of job stayers, job-to-job flows, and nonemployment entrants and exiters in 2014 constant dollars. Job stayers have the highest earnings, and its average is in the range of $13,400 and $14,200. The average earnings of job stayers is procyclical, growing gradually during the middle to late stages of economic expansions, and falling during and after economic contractions. Workers going through job-to-job flows earn less than job stayers. Workers who recently moved to another employer tend to earn more ($10,200 to $11,400) than workers who recently left an employer for another (such workers have average earnings in

the range of $9,800 to $10,700), and this difference is greatest in the late stages of economic expansions, during which it can exceed $600. Workers entering and exiting nonemployment have lower earnings ($7,000 to $8,600), and new entrants to employment have the lowest earnings $5,800 to $7,100). This diffence in the earnings of workers entering vs. exiting nonemployment is almost certainly in part due to the fact that all workers who are initially entering the labor market without previous work experience are part of nonemployment-to-employment flows, and that some share of employment-to-nonemployment flows are workers who are voluntarily retiring.

These two figures provide additional intution for one of the main results in the body of the paper. Becuase workers entering emplyoment from nonemployment tend to earn much less than workers who are continiously employed, and the number of such workers increases during expansions and declines during contractions, nonemployment flows induce earnings to be lower during expansions, but this effect lessens during and after economic downturns.