Job-to-Job Flows:
New Statistics on Worker Reallocation and Job Turnover

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1 Introduction

Since 2015, the U.S. Census Bureau has provided statistics on job mobility constructed from data collected by the Longitudinal Employer-Household Dynamics Program. Job-to-Job Flows (J2J) show quarterly rates of job change, as well as transition rates into and out of employment, from 2000 Q2 onward.[2] In addition to job flow rates and counts, origin-destination J2J statistics show flows of workers across industries and labor markets, by characteristics of both the origin and destination job, as well as by worker age, education, and race/ethnicity. Newly updated

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[2] The latest available J2J quarter is typically three quarters prior to the current quarter.

statistics for 2017 also include new variables on earnings, metro-area level tabulations, as well as additional cross-tabulations of industry and worker demographics.

In this paper, we describe how the Job-to-Job Flows statistics are constructed from the Longitudinal Employer-Household Dynamics (LEHD) data at Census. We begin by briefly describing the LEHD data and explain how we identify employer transitions in the administrative record data. We then compare rates of job change in the J2J data to available statistics on quits, layoffs, and employer-to-employer flows tabulated from survey sources. In subsequent sections, we describe how the data is protected and our methodology for estimating national statistics when states are missing. Finally, we provide guidance to users on using and interpreting the data.

2 Identifying Flows of Workers between Jobs

Job-to-Job Flows are derived from the Longitudinal Employer-Household Dynamics (LEHD) data at the U.S. Census Bureau. The LEHD data consist of quarterly job-level earnings submitted by employers for the administration of state unemployment insurance (UI) benefit programs, linked to establishment-level data collected for the Quarterly Census of Employment and Wages (QCEW) program. As of this writing, 48 states, DC, Puerto Rico, and the Virgin Islands have active agreements in place to share QCEW and UI wage data with the LEHD program as part of the Local Employment Dynamics federal-state partnership.[3] The coverage of LEHD data is quite broad; state UI and QCEW data covers approximately 95% of private sector employment, as well as state and local government. Individual demographic and additional firm characteristics such as firm age and size are not part of the UI or QCEW data and instead come from survey, Census, and other administrative record sources.[4]

[3] Alaska and Wyoming both previously belonged to the Local Employment Dynamics data-sharing partnership, but at press time do not have a data-sharing agreement with Census. In such cases, we provide historical J2J data for the years data was provided. See Section 6.2 on how missing data of this type is handled.

[4] For a detailed description of the LEHD data, see Abowd et al. (2009); Abowd, Haltiwanger, and Lane (2004); Haltiwanger et al. (2014).

2.1 Microdata Definitions

2.1.1 Count Measures

Some notation is necessary to understand how we identify job-to-job transitions in the LEHD administrative data. Abowd et al. (2009) provide definitions for fundamental concepts in the LEHD administrative data, and which are used here as a starting point to develop additional definitions related to job-to-job transitions. First and foremost, we must clarify what we mean by a job, which in the LEHD data is identified from quarterly earnings data provided by firms to state governments for the administration of UI programs. We say that individual i is *employed* (has a job) at firm j in time t if the worker receives positive earnings w from that firm in quarter t. Formally [A.1] [5]:

$$m_{ijt} = \begin{cases} 1, \text{ if } w_{ijt} > 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-1}$$

An individual i is *beginning-of-quarter employed* at firm j in time t if the worker receives positive earnings from that employer in both t and $t-1$. Formally [A.2]:

$$b_{ijt} = \begin{cases} 1, \text{ if } w_{ijt} > 0 \text{ and } w_{ijt-1} > 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-2}$$

An individual i is *end-of-quarter employed* at firm j in time t if the worker receives positive earnings from that employer in both t and $t+1$. [6] Formally [A.3]:

$$e_{ijt} = \begin{cases} 1, \text{ if } w_{ijt} > 0 \text{ and } w_{ijt+1} > 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-3}$$

In a departure from the Quarterly Workforce Indicators (QWI), J2J is primarily concerned with beginning of period and end of period *dominant* jobs. This restriction is necessary because the precise timing of job starts and separations are not available in the LEHD data. Short LEHD jobs

[5] Where appropriate, we reference equivalent definitions from Abowd et al. (2009), Appendix A.2 as "[A.1]", etc.
[6] Without additional information, we cannot identify specific period(s) of job activity during a quarter. If an individual *i* receives positive earnings from employer *j* in quarter *t* and quarter *t*-1, we assume worker *i* is employed by firm *j* a minimum of both the first day of quarter *t* and the last day of quarter *t*-1 (this implies $b_{ijt} = e_{ijt-1}$).

that do not survive the quarter might be part of a job transition, or might instead be a secondary source of income that is concurrent with another job during the quarter. Because we cannot distinguish job transitions within the quarter from multiple job holding (nor can we determine which job is the origin or destination job in these cases), we focus instead on transitions between dominant (main) jobs held at the start and end of the quarter. Thus, a worker whose dominant (main) job is at firm 5 on January 1st and firm 10 on April 1st would be identified as having a job-to-job flow from employer 5 to 10, even if shorter transitory jobs were also held during that quarter. While necessary given the limitations of the data, this approach does have the obvious disadvantage of dropping legitimate transitions between short duration jobs and restricts each worker to only one job flow per quarter.[7]

The *dominant (or main) beginning-of-quarter* job $domb_{ijt}$ is the beginning-of-quarter job with the greatest combined earnings across quarters t and $t-1$, or:

$$domb_{ijt} = \begin{cases} 1, \text{if } b_{ijt} = 1 \text{ and } (w_{ijt} + w_{ijt-1}) > (w_{ilt} + w_{ilt-1}) \\ \quad \forall\, l \text{ where } b_{ilt} = 1 \text{ and } l \neq j \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-4}$$

The *dominant (or main) end-of-quarter* job $dome_{ijt}$ is the end-of-quarter job with the greatest combined earnings across quarters t and $t+1$, or:

$$dome_{ijt} = \begin{cases} 1, \text{if } e_{ijt} = 1 \text{ and } (w_{ijt} + w_{ijt+1}) > (w_{ilt} + w_{ilt+1}) \\ \quad \forall\, l \text{ where } e_{ilt} = 1 \text{ and } l \neq j \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-5}$$

We do not define a corresponding dominant job measure for m_{ijt}.

A separation from the main job active at the start of the quarter occurs during that quarter if no earnings for the main job are observed in the subsequent quarter. Specifically:

[7] A potential advantage of linking only main job-to-job transitions is that movements between very short duration jobs (which may not necessarily be economically interesting) do not dominate the J2J statistics. Bjelland, et al. (2011) found that treating all very short duration jobs in the LEHD data as job-to-job flows results in an extremely high job-to-job flow rate – several times the typical CPS quarterly job-to-job flow rate. They speculate that a good many of these short duration jobs are likely held simultaneously.

$$all\_doms2_{ijt} = \begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } m_{ijt+1} = 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-6}$$

Likewise, an accession to the main job active at the end of the quarter occurs during that quarter if no earnings for the main job are observed in the previous quarter:

$$all\_doma2_{ikt} = \begin{cases} 1, \text{if } domb_{ikt+1} = 1 \text{ and } m_{ikt-1} = 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-7}$$

If a main job held on the first day of the quarter ends and a new main job starts within the same quarter, we call this a within-quarter job-to-job flow from an origin dominant employer j to a destination dominant employer k $(k \neq j)$.

$$ee_{ijkt} = \begin{cases} 1, \text{if } all\_doms2_{ijt} = 1 \text{ and } all\_doma2_{ikt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-8}$$

The flow from employer j to employer k represents two economic events: the separation from the origin firm j

$$ee\_doms2_{ijt} = \begin{cases} 1, \text{if } \exists\ k \text{ such that } ee_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}. \quad \text{Eq 2-9}$$

and the accession to the destination firm k.

$$ee\_doma2_{ikt} = \begin{cases} 1, \text{if } \exists\ j \text{ such that } ee_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}. \quad \text{Eq 2-10}$$

We call a main job transition to a new main job in the next quarter an *adjacent-quarter* (aq) flow and they are identified as follows:

$$ee\_aq_{ijkt} = \begin{cases} 1, \text{if } all\_doms2_{ijt-1} = 1 \text{ and } all\_doma2_{ikt} = 1 \\ \quad \text{and } b_{ilt} = 0\ \forall\ l \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-11}$$

Thus, adjacent quarter job-to-job flows describe a job transition where individual i is beginning-of-quarter employed at the dominant firm j in quarter $t-1$, has no beginning-of-quarter employment in quarter t, and is end-of-quarter employed in t at the dominant firm k.[8]

Similarly to ee_{ijkt}, the adjacent-quarter flow ee_aq_{ijkt} represents two economic events: the separation from the origin firm j, which is recorded in period $t-1$

$$aq\_doms2_{ijt-1} = \begin{cases} 1, \text{if } \exists\ k \text{ such that } ee\_aq_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}, \qquad \text{Eq 2-12}$$

and the accession to the destination firm k, which is recorded in period t.

$$aq\_doma2_{ikt} = \begin{cases} 1, \text{if } \exists\ j \text{ such that } ee\_aq_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}. \qquad \text{Eq 2-13}$$

When a job-to-job flow occurs for individual i there may be a spell of reduced labor market activity between the end of one dominant job and the start of another. This spell of reduced activity may be a complete exit from the labor market for a period of up to three months for a within quarter transition and up to six months for an adjacent quarter transition or a period characterized by one or perhaps several active short duration jobs. A period of reduced labor market activity during the transition from one main job to another main job is not inconsistent with a voluntary move; workers may choose to take a break from their main job, an issue we discuss further in section 8.1.

Job separations to and accessions from spells of non-employment are defined as follows, respectively:

$$en\_doms2_{ijt} = \begin{cases} 1, if\ all\_doms2_{ijt} = 1 \text{ and } e_{ilt} = 0 \quad \forall\ l \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-14}$$

and

[8] Unlike within quarter flows (ee), the quarter of an adjacent-quarter flow can be assigned to either the separation or the accession. We choose to assign ee_aq to the quarter of the accession.

$$ne\_doma2_{ikt} = \begin{cases} 1, if\ all\_doma2_{ikt} = 1 \text{ and } b_{ilt} = 0\ \forall\ l \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-15}$$

Job separations to and accessions from *persistent* spells of non-employment are defined as follows, respectively:

$$en2\_doms2_{ijt} = \begin{cases} 1, \text{if } all\_doms2_{ijt} = 1 \text{ and } e_{ilt} = 0 \text{ and } e_{ilt+1} = 0\ \forall\ l \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-16}$$

and

$$ne2\_doma2_{ikt} = \begin{cases} 1, \text{if } all_{doma2_{ikt}} = 1 \text{ and } b_{ilt} = 0 \text{ and } b_{ilt-1} = 0\ \forall\ l \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-17}$$

Our definition of 'non-employment' allows an individual to hold short transitory jobs - the worker holds a job in t ($m_{ijt} = 1$) but is not observed as being employed at both the start and the end of the quarter - , but the overwhelming majority do not work at all during the quarter. Approximately 90% of transitions to/from persistent non-employment have zero earnings the quarter after separating or before starting their new job.

We use the concept of full-quarter employment as a basis for earnings calculations in section 2.1.3. An individual i is full-quarter employed at firm j in time t if the worker receives positive earnings from that employer in periods t, $t-1$, and $t+1$. Formally [A.6]:

$$f_{ijt} = \begin{cases} 1, \text{ if } w_{ijt-1} > 0 \text{ and } w_{ijt} > 0 \text{ and } w_{ijt+1} > 0 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-18}$$

A full-quarter to full-quarter employer to employer job transition can be written as

$$fee_{ijkt} = \begin{cases} 1, \text{if } all\_doms2_{ijt} = 1 \text{ and } all\_doma2_{ikt} = 1 \\ \quad \text{and } f_{ijt-1} = 1 \text{ and } f_{ikt+1} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-19}$$

2.1.2 Identities

There are several identities that impose relationships between J2J measures. Some of the identities are definitional in nature and show how certain measures can be calculated directly from other released measures. Other identities illustrate how employment flows can be used to calculate the overall change in dominant employment during a quarter.

First, we define a measure of job-to-job flows that includes both within-quarter and adjacent-quarter separations and accessions. As discussed in section 8.1, both within and adjacent-quarter flows appear to be consistent with the notion of a direct job flow. We define job-to-job separations and accessions as the sum of within-quarter and adjacent-quarter flows:

$$eeall\_doms2_{ijt} = ee\_doms2_{ijt} + aq\_doms2_{ijt} \quad \text{Eq 2-20}$$

$$eeall\_doma2_{ikt} = ee\_doma2_{ikt} + aq\_doma2_{ikt} \quad \text{Eq 2-21}$$

Flows to non-employment are the sum of adjacent-quarter flows and flows to persistent non-employment:

$$en\_doms2_{ijt} = en2\_doms2_{ijt} + aq\_doms2_{ijt} \quad \text{Eq 2-22}$$

Flows from non-employment consist of adjacent-quarter flows and flows from persistent non-employment:

$$ne\_doma2_{ikt} = ne2\_doma2_{ikt} + aq\_doma2_{ikt} \quad \text{Eq 2-23}$$

The above identities hold at both the individual and at higher levels of aggregation. At the individual level, the identities are arguably less interesting as a worker can contribute to at most one of the variables on the right hand side. For example, if $ee_{ijkt} = 1$ then $ee\_doms2_{ijt} = 1$ and $ee\_doma2_{ikt} = 1$, and by construction aq_doms2_{ijt}=0 and $aq\_doma2_{ikt} = 0$. A single worker either has a within quarter flow, an adjacent quarter flow, or no flow at all, but never both a within and adjacent flow in the same quarter. Similarly for transitions to non-employment, a worker either transitions to persistent non-employment, has an adjacent quarter flow, or no transition at all, but never a transition to both non-employment and an adjacent quarter flow. However, at

higher levels of aggregation these identities become more interesting as multiple workers transition to multiple firms and into/out of non-employment.

With these definitions, we can establish the aggregate dominant employment change identity. This identity states that the change in dominant employment between the beginning and the end of the quarter is equal to the difference between flows to and from non-employment. Formally:

$$dome_{it} - domb_{it} = ne\_doma2_{it} - en\_doms2_{it} \qquad \text{Eq 2-24}$$

It is important to note that the above employment change identity holds only at the national employment level; it does not necessarily hold at lower levels of aggregation, such as the state or industry sector level, nor for any particular firm, nor for worker age, which is time-variant. This is because some job changes do not involve flows to or from non-employment, such as workers moving directly between employers in the same quarter. These types of worker transitions do not affect employment at the national level, but they may, for example, affect state-level or industry-level employment totals if the origin and destination firm are not in the same state and/or industry.

Another interesting issue is the presence of multiple jobholders. As described in more detail in section 8.2, the dominant employer may change even without a separation or an accession, as a job that was not the highest earning job in one quarter becomes the highest earning job in the subsequent quarter. We define two measures for multiple jobholders that capture transitions from the old dominant job to the new dominant job.

The transition from the old dominant job is defined as a "main becomes secondary" transition:

$$mbs\_domb_{ijt} = \begin{cases} 1, if\ domb_{ijt} = 1 \text{ and } dome_{ijt} = 0\ and\ e_{ijt} = 1 \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-25}$$

In this transition, the main job at the beginning of the quarter is no longer the main job at the end of the quarter, but the individual is still employed in this job at the end of the quarter.

Similarly, the transition to the new dominant job is defined as a "secondary becomes main" transition:

$$sbm\_dome_{ikt} = \begin{cases} 1, if\ domb_{ikt} = 0 \text{ and } dome_{ikt} = 1\ and\ b_{ikt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-26}$$

In this transition, the secondary job in which the individual was employed at the beginning of the quarter is now the main job at the end of the quarter.

To capture all changes in main job employment, we define two final measures: "Main Job Ends" and "Main Job Starts." Formally:

$$mjobend_{ijt} = all\_doms2_{ijt} + mbs\_domb_{ijt} \quad \text{Eq 2-27}$$

$$mjobstart_{ikt} = all\_doma2_{ikt} + sbm\_dome_{ikt} \quad \text{Eq 2-28}$$

Equipped with these measures, we can now define the employment change identity that holds at all levels of aggregation:

$$dome_{ikt} - domb_{ijt} = mjobstart_{ikt} - mjobend_{ijt} \quad \text{Eq 2-29}$$

Once again, at the individual level this identity isn't particularly interesting, but at higher levels of aggregation it shows that the change in employment during the quarter is equal to the difference between the number of main jobs that start during the quarter and the number of main jobs that end during the quarter. We do not separately release the *sbm* and *mbs* transitions, but they can be derived from the public use statistics using the identity above.

2.1.3 Earnings Measures

Individuals often undergo changes in earnings when transitioning across employers. These individual earnings changes can be aggregated to detail the evolution of earnings changes across time and geographies. In accounting for earnings, we not only consider transitions between dominant job status across quarters (i.e. worker movements between employers, as well as into and from nonemployment) but also workers who did not change jobs, who we call "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. For a more complete description of the decomposition of earnings in the data that serves as a basis for these earnings concepts, see Hahn et al. (2017).

We restrict our attention to job transitions with a full-quarter of observed earnings for the origin job, destination job, or both. For workers not employed the entire quarter before and after a job transition, the weeks worked will likely differ between the old and the new job, distorting earnings comparisons.[9] For consistency, we also only use transitions from full quarter jobs to nonemployment and transitions from nonemployment to full quarter jobs. It is worth noting that this restriction yields slightly different counts than those presented in earlier sections. We denote these below.[10]

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 and end of the reference quarter t. Formally,

$$f4dombe_{ijt} = \begin{cases} 1, \text{ if } domb_{ijt} = 1 \text{ and } dome_{ijt} = 1 \\ \quad \text{and } f_{ijt-1} = 1 \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-30}$$

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

$$f4dombe\_jfqearn_{ijt} = \begin{cases} w_{ijt-1}, \text{if } f4dombe_{ijt} = 1 \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-31}$$

and the earnings contemporaneous with the reference quarter are

$$f4dombe\_kfqearn_{ijt} = \begin{cases} w_{ijt}, \text{if } f4dombe_{ijt} = 1 \\ 0, \text{otherwise} \end{cases} \qquad \text{Eq 2-32}$$

[9] This potential distortion could be removed if we had information on weeks worked and hours worked per week, but this information is not available for most states.

[10] We also augment our definitions of dominant (or main) beginning-of-quarter and end-of-quarter job definition to include a full-quarter of observed earnings. These are denoted fdomb_{ijt} and fdome_{ijt} and are formally defined in Table 1.

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 beginning 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 as defined by fee_{ijkt} defined in the previous section.

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.

$$fee\_jfqearn_{ijt} = \begin{cases} w_{ijt-1}, \text{if } fee_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-33}$$

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

$$fee\_kfqearn_{ijt} = \begin{cases} w_{ikt+1}, \text{if } fee_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-34}$$

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, in cases jobs start on the first day (or first weekday) of a given month. These adjacent-quarter job-to-job flows are defined:

$$fee\_aq_{ijkt} = \begin{cases} 1, if\ all\_doms2_{ijt-1} = 1\ and\ all\_doma2_{ikt} = 1 \\ \quad and\ b_{ilt} = 0\ \forall\ l\ and\ f_{ijt-2} = 1\ and\ f_{ikt+1} = 1 \\ 0, otherwise \end{cases} \quad \text{Eq 2-35}$$

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.

$$faq\_jfqearn_{ijt} = \begin{cases} w_{ijt-2}, \text{if } fee\_aq_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-36}$$

and the earnings contemporaneous with the reference quarter are

$$faq\_kfqearn_{ijt} = \begin{cases} w_{ikt+1}, \text{if } fee\_aq_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-37}$$

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 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

$$fen2\_doms2_{ijt} = \begin{cases} 1, if\ all\_doms2_{ijt} = 1\ and\ f_{ijt-1} = 1\ and\ e_{ilt} = 0 \\ \qquad\qquad and\ e_{ilt+1} = 0\ \forall\ l \\ 0, otherwise \end{cases} \quad \text{Eq 2-38}$$

and those earnings, taken from quarter t, are

$$fen2\_fqearn_{ijt} = \begin{cases} w_{ijt-1}, \text{if } fen2\_doms2_{ijt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-39}$$

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

$$fne2\_doma2_{ikt} = \begin{cases} 1, if\ all\_doma2_{ikt} = 1\ and\ f_{ikt+1} = 1\ and\ b_{ilt} = 0 \\ \qquad\qquad and\ b_{ilt-1} = 0\ \forall\ l \\ 0, otherwise \end{cases} \quad \text{Eq 2-40}$$

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

$$fne2\_fqearn_{ijt} = \begin{cases} w_{ikt+1}, \text{if } fne2\_doma2_{ikt} = 1 \\ 0, \text{otherwise} \end{cases} \quad \text{Eq 2-41}$$

For a complete set of measures and definitions, please see Tables 1 and 2.

2.2 Aggregation

2.2.1 Counts

For each microdata element we can produce an analogous count measure that is the sum of the instances of the event for sets of workers and firms with particular characteristics. Generically,

$$Measure_{IJKt} = \sum_{i \in I, j \in J, k \in K} measure_{ijkt} \quad \text{Eq 2-42}$$

The variable *I* represents a set of workers, *J* represents a set of origin firms, and *K* represents a set of destination firms. For some measures, the origin or destination firm may be unobserved or beyond the scope of the measure, and the subscript may be omitted. One additional notational concept is introduced here: some measures can be tabulated on only the origin or destination (e.g., accession to or separations from dominant jobs), and others can be tabulated on an origin-destination pair (e.g., an employer to employer flow). The latter measures can also be calculated across all origins or across all destinations. When aggregating over these margins, a period (.) is used in the appropriate subscript. Several examples follow - the complete list of released measures is available in Table 1, at the end of this document.

2.2.1.1 Selected Aggregate Measures

Main Beginning of Quarter Jobs

$$MainB_{IJt} = \sum_{i \in I, j \in J} \text{domb}_{ijt} \quad \text{Eq 2-43}$$

Main End of Quarter Jobs

$$MainE_{IKt} = \sum_{i \in I, k \in K} \text{dome}_{\text{ikt}} \quad \text{Eq 2-44}$$

Employer to Employer Flows – Origin *J*, Destination *K*

$$EE_{IJKt} = \sum_{i \in I, j \in J, k \in K} \text{ee}_{\text{ijkt}} \quad \text{Eq 2-45}$$

Employer to Employer Separations – Origin *J*, Any Destination

$$EESep_{IJt} = \sum_{i \in I, j \in J} \text{ee\_doms2}_{\text{ijt}} \quad \text{Eq 2-46}$$

Employer to Employer Accessions – Any Origin, Destination *K*

$$EEHire_{IKt} = \sum_{i \in I, k \in K} \text{ee\_doma2}_{\text{ikt}} \quad \text{Eq 2-47}$$

Employer to Employer Separations, Adjacent Quarter – Origin *J*, Any Destination

$$AQSep_{IJt} = \sum_{i \in I, j \in J} \text{aq\_doms2}_{\text{ijt}} \quad \text{Eq 2-48}$$

Employer to Employer Accessions, Adjacent Quarter – Any Origin, Destination *K*

$$AQHire_{IKt} = \sum_{i \in I, k \in K} \text{aq\_doma2}_{\text{ikt}} \quad \text{Eq 2-49}$$

Job-to-Job Separations, Origin *J*, Any Destination

$$J2JSep_{IJt} = EESep_{IJt} + AQSep_{IJt} \quad \text{Eq 2-50}$$

Job-to-Job Accessions, Any Origin, Destination *K*

$$J2JHire_{IKt} = EEHire_{IKt} + AQHire_{IKt} \quad \text{Eq 2-51}$$

Separation to Non-employment – Origin *J*

$$ENSep_{IJt} = \sum_{i \in I, j \in J} \text{en\_doms2}_{\text{ijt}} \quad \text{Eq 2-52}$$

Accession from Persistent Non-employment – Destination *K*

$$NEHire_{IKt} = \sum_{i \in I, k \in K} \text{ne\_doma2}_{\text{ikt}} \quad \text{Eq 2-53}$$

Separation to Persistent Non-employment – Origin *J*

$$ENPersist_{IJt} = \sum_{i \in I, j \in J} \text{en2\_doms2}_{\text{ijt}} \quad \text{Eq 2-54}$$

Accession from Persistent Non-employment – Destination *K*

$$NEPersist_{IKt} = \sum_{i \in I, k \in K} \text{ne2\_doma2}_{\text{ikt}} \quad \text{Eq 2-55}$$

2.2.1.2 Disclosure Protection

All released count measures aggregate from noise-infused components. For more information, see section 4.

2.2.2 Rates

Rates are calculated for all flow variables, using average dominant beginning and ending quarter employment in the cell as the denominator. Average dominant employment, $\overline{MainE_{IJt}}$, is calculated as

$$\overline{MainE_{IJt}} = \frac{\left(MainB_{IJt} + MainE_{IJt}\right)}{2} \quad \text{Eq 2-56}$$

The naming convention for rate variables appends an "R" to the end of the count variable name. For example, the *Employer to Employer Separation Rate* is computed as

$$EESepR_{IJt} = \frac{EESep_{IJt}}{\overline{MainE_{IJt}}}, \quad \text{Eq 2-57}$$

and the *Employer to Employer Accession Rate* is computed as

$$EEHireR_{IKt} = \frac{EEHire_{IKt}}{\overline{MainE_{IKt}}}. \quad \text{Eq 2-58}$$

Other selected rates follow:

Separation to Non-employment Rate

$$ENSepR_{IJt} = \frac{ENSep_{IJt}}{\overline{MainE_{IJt}}}. \quad \text{Eq 2-59}$$

Accession from Non-employment Rate

$$NEHireR_{IKt} = \frac{NEHire_{IKt}}{MainE_{IKt}}. \quad \text{Eq 2-60}$$

Separation to Persistent Non-employment Rate

$$ENPersistR_{IJt} = \frac{ENPersist_{IJt}}{MainE_{IJt}}. \quad \text{Eq 2-61}$$

Accession from Persistent Non-employment Rate

$$NEPersistR_{IKt} = \frac{NEPersist_{IKt}}{MainE_{IKt}}. \quad \text{Eq 2-62}$$

Job-to-Job Separation Rate

$$J2JSepR_{IJt} = \frac{J2JSep_{IJt}}{MainE_{IJt}}. \quad \text{Eq 2-63}$$

Job-to-Job Hire Rate

$$J2JHireR_{IKt} = \frac{J2JHire_{IKt}}{MainE_{IKt}}. \quad \text{Eq 2-64}$$

2.2.2.1 Disclosure Protection

All released rate measures are calculated from post-publication counts in both the numerator and the denominator, and no additional disclosure protection measures beyond those already applied to the counts (see section 4) are applied.

2.2.2.2 Deviations Between Released Count and Rate Series

The not seasonally adjusted national rate series are directly calculable from the corresponding released count series. However, the seasonal adjustment process for counts and rates at both the state and national level is done separately for each series. This will likely result in seasonally adjusted rate series that differ from a direct calculation of the rates using the corresponding seasonally adjusted count series.

2.2.3 Earnings

Average earnings are calculated in the counts and origin-destination tables for several types of earnings transitions. Average earnings are defined as the sum of earnings in the appropriate reference quarter for all transitions of a particular type, divided by the count of those transitions.

Examples of these calculations follow. As in the count data, summations are performed over $i \in I$, $j \in J$, and $k \in K$.

2.2.3.1 Selected Earnings Calculations

Average Earnings in the Origin Job Prior to a Full-Quarter Employer to Employer Transition

$$EESEarn\_orig_{IJKt} = \frac{\sum_{ijk} fee\_jfqearn_{ijkt}}{\sum_{ijk} fee_{ijkt}} \quad \text{Eq 2-65}$$

Average Earnings in the Destination Job Following a Full-Quarter Employer to Employer Transition

$$EESEarn\_dest_{IJKt} = \frac{\sum_{ijk} fee\_kfqearn_{ijkt}}{\sum_{ijk} fee_{ijkt}} \quad \text{Eq 2-66}$$

2.2.3.2 Disclosure Protection

Average earnings measures aggregate from noise-infused components. For more information, see section 4.

3 Imputation of National J2J Series

All fifty states provided data to Census only for a limited number of quarters. In the most recent quarters, any state with an expired data-sharing agreement with Census is missing in the microdata.[11] In the historical series, states can be missing because different states joined the data sharing partnership at different times. We release the national time-series beginning 2000 Q2. In this initial quarter, LEHD data is available for 41 states.[12] As shown in Figure 5, additional states become available in subsequent quarters. The largest missing data state, Michigan, enters first, followed shortly by an almost equal sized cluster of three geographically dispersed states. Another five states appear over the next four years and by 2005Q2 the data is virtually complete except for Massachusetts which does not appear in the data for another five years. By 2010Q2 the data is complete, with all 50 states and the District of Columbia regularly reporting to LEHD. Wyoming

[11] At press time, both Wyoming and Alaska have expired data sharing agreements with Census. If these agreements are subsequently renewed, the states would begin sending data again, including those quarters the agreements were expired.

[12] These 41 states account for 87% of QCEW 2012Q2 Month 1 private sector employment.

stops sending Census data in 2015, and the last quarter of the complete data period at press time is 2014 Q4.

Similar to Abowd and Vilhuber (2011), we develop two missing data models, the first covers the period prior to 2005Q2 (10 states missing) and the second model covers the later missing data period (1 state missing). We also use the same alternative reference series (the QCEW), to calculate rates (J2J measure/QCEW employment) for the complete data states. For the missing data states, we impute each rate value by sampling from the adjusted complete data states' rates. An estimate of the counts is constructed by taking a weighted average of the sampled rates for each missing data state multiplied by the corresponding missing data state's QCEW employment value. Although this method is similar to Abowd and Vilhuber (2011), we implement several adjustments to both reduce the small sample variance of the estimates and address a fundamental difference between the calculation of the J2J and the QWI statistics.

For the QWI, statistics are unbiased at the state level when other states are missing; however, this is not the case for J2J. The J2J uses the concept of national dominant beginning and ending quarter jobs for each worker; if data for a state is missing, a non-dominant job in a reporting state may be incorrectly classified as a dominant job. In addition, workers that transition to a job in a missing data state will be incorrectly classified as transitioning to non-employment. To address the resulting bias in the observed or reporting data states' rates during the incomplete data period, we adjust the rates using information from the complete data period (2010Q2 – 2014Q4).

The average rate for the missing data states differs noticeably from the average rate for the reporting data states. Although this finding may seem like a violation of the missing at random assumption, it is more likely a feature of the Bayesian bootstrap methodology when the set of states is small and the number of missing data states differs substantially from the number of complete data states. For example, assume the missing and complete data states' rates are drawn from the same population distribution. As long as this distribution is not degenerate, the sampled rates will differ across states. For any two samples of states drawn at random, the average rate in the two samples will differ by some amount, but this difference is likely to be smallest when the number of missing and complete data states is about the same. In the two missing data periods or "regimes," there are 10 missing and 41 reported data states in the first regime and 1 missing data state and 50 reported data states in the second regime. Due to both the small number of missing

data states and the large difference in the number of missing and reporting data states in both regimes, the average of the reporting data states is likely to be much closer to the overall average than the average of the missing data states.

To adjust for both the difference in the average rates between the missing and the reporting states and reduce the variance in our estimates we implement a modification to the Abowd and Vilhuber (2011) methodology. Using the complete data period where the rates are observed for each missing-reporting state pair, we estimate a correction model at the NAICS sector level. We then sample from the correction model PPD(s), generating adjusted rates for each sampled state pair. Assuming the differences in state labor market dynamics are relatively stable over time, this methodology accounts for unobserved differences between the missing data states and the sampled reporting data states.

With the data completed, the national rate estimates are formed using the customary Rubin (1987) combining formulas, properly accounting for the additional uncertainty due to both the missing state data as well as the rate adjustment process.[13]

4 Disclosure Protection

To ensure the confidentiality of the released data, a variety of confidentiality protection measures are applied to the J2J data. In an extension of the existing noise infusion procedure used for the QWI, each item in the J2J data receives a multiplicative fuzz factor (Abowd et al., 2009). However, unlike the QWI, where an item is uniquely related to a single establishment with a unique fuzz factor, a particular feature of the J2J data is that many indicators involve flows between jobs. For transitions between employers, the noise infusion mechanism must consider whether to assign the fuzz factor associated with the origin establishment or the destination establishment. The methodology used here (Abowd and McKinney, 2014) is based on the notion of an "edge" in graph theory and is designed to draw a single fuzz factor from the two available establishment fuzz factors, designating the chosen establishment fuzz factor as the fuzz factor for that edge. The new edge fuzz factor is used in all subsequent statistics and tabulations to multiplicatively modify any

[13] Standard errors computed according to the Rubin (1987) methodology are also obtained. These may be released in the future.

employment transition between the same two establishments. Note that no new fuzz factors are created.

In addition to noise infusion, additional protection is provided by synthesizing values for small cells. First, cells that do not have any positive weight ("true zeros") are removed and do not pass through the synthesizer. These cells are released as is, with no distortion. To synthesize the values in the remaining small cells, we take a Bayesian approach by sampling from a multinomial Posterior Predictive Distribution (PPD). Every quarter for each release table, we count the number of fuzzed counts (the confidential value multiplied by the fuzz factor) that are zeros (n0), ones (n1), twos (n2), and threes (n3). We use a uniform prior of size U, and add the fuzzed counts to this prior, resulting in parameters for the Dirichlet posterior of (n0+U/4, n1+U/4, n2+U/4, n3+U/4). To complete the table, we sample from the multinomial PPD once for each candidate suppressed cell, replacing what would have been a suppression with a synthesized value. The share of "true zeros" and small cells is quite large in some tables and this approach preserves the general pattern of job-to-job flows, while at the same time enabling the public release of complete tables.

To maintain consistency across releases, the synthetic values drawn from the PPD are carried forward into all subsequent releases. In particular, each suppressed cell receives a single synthetic value. That same synthetic value is used in all future releases in which the cell is suppressed.

5 Seasonally Adjusted J2J series

Many of the J2J series exhibit significant seasonal variation; quarter-to-quarter changes in hires and separations are large and can make analysis of longer trends in the data difficult. Because of the strong seasonality, we will release seasonally adjusted data whenever possible, as well as the non-seasonally adjusted series. The initial release of national rates and counts include both the seasonally adjusted and the non-seasonally adjusted series. For count and rate measures, the data are adjusted using the X-12-ARIMA methodology developed by the U.S. Census Bureau, with a separate adjustment for each series.

Seasonal adjustment of average earnings poses additional challenges beyond the basic methodology. Our research has found that quarterly earnings in administrative data exhibit significant irregular variation that does not follow seasonal patterns. Some of this is due to so-

called “trading day” effects, as quarterly earnings vary by the number of pay periods in each quarter. However, a significant amount of variation is unexplained by trading day or other seasonal patterns. We continue to explore alternative methods to smooth quarterly earnings series.

5.1 Pretreatment of Seasonally-Adjusted State-Level Data

When examining the state-by-industry level beta J2J, unusual spikes in the separations and hires from persistent non-employment series can be observed in several time series. Further examination of the data led us to the conclusion that these spikes were principally the result of reporting errors in the administrative data. A typical scenario would be an employer failing to report UI earnings for one quarter, causing the administrative data to reflect an unusually large number of workers in the industry moving from employment to non-employment and then back to employment again. To address this issue, prior to seasonal adjustment, we pretreat the state-level tabulations by detecting additive outliers and replacing them with forecasted values from the time series, using the X-11-ARIMA method. We then seasonally adjust the pretreated data with outliers removed. Outliers are not removed from the not seasonally adjusted data. In the longer term, we plan to impute wage records for these cases in the microdata.

6 Job-to-Job Flows – Released Data

6.1 National Measures of Job Change

The national job-to-job flows rates file contains national main job hire and separation rates, by whether or not the worker is moving to/from a recent employment spell. Figure 1 shows the job-to-job separation rate $J2JSepR_{IJt}$ (Eq 2-63) and job-to-job hire rate $J2JHireR_{IKt}$ (Eq 2-64) for the United States for the period 2000-2016. Job separation rates to persistent non-employment $ENPersistR_{IJt}$ (Eq 2-61) and accession rates from persistent non-employment $NEPersistR_{IKt}$ (Eq 2-62) are also shown. This decomposition shows several interesting trends in labor market flows during the last decade. First, as noted by Hyatt and McEntarfer (2012a, 2012b) and Lazear and Spletzer (2012), there is a marked decline in the rate of job change over this period, particularly pronounced in the last two recessions. While there is also a slight downward trend in hires to and

separations from non-employment, the recent decline in job separations and hires is largely driven by this decline in worker reallocation.[14]

In the national aggregate flows shown in Figure 1, job separations and hires from employment cancel each other out, and net employment flows are entirely due to flows to and from non-employment. However, this will not be the case when decomposing net employment growth at the industry or state-level. At the sub-national level, employment growth can occur because a state is 'poaching' employed workers from other states; industry growth can occur when an expanding industry poaches workers away from other industries.

Additional release tables describe job transitions and flows to and from non-employment at the national, state-level, and sub-state geography, by industry sector and sub-sector, firm age and size, worker age, sex, education, and race/ethnicity.[15]

6.2 State Measures of Job Change and Criteria for Release

In addition to the rates series shown in Figure 1, state-level files with the same set of job-to-job statistics are also available. The length of the time series will vary by state, depending on availability of data. However, in contrast to the QWI, the lack of data for one state may impact state-level data for other states. Some states will have suppressed J2J series because there are a large number of labor flows between that state and a state (or states) with missing data. For example, LEHD has complete data for Massachusetts starting in 2010. All other New England states – Connecticut, Rhode Island, Vermont, New Hampshire, and Maine – have large cross-state job-to-job flows with Massachusetts. The absence of Massachusetts creates significant bias in the rates of flows to and from employment for these other states. Therefore, state-level data for all of New England is suppressed until Massachusetts data becomes available in 2010. A similar problem affects the Washington, DC region, as District of Columbia data is not available before 2006.[16]

[14]Hyatt and Spletzer (2013) investigate several possible causes of the decline in employment dynamics during this period and find that relatively little of the decline can be explained by changes in worker demographics or industry composition over this period. Most of the decline in job change remains unexplained.

[15] The J2J beta releases will only contain a subset of these tables. The final specifications for official J2J data releases have not yet been fixed.

[16] In the case of both Massachusetts and the District of Columbia, data is available before these dates but did not meet standards for publication in the Quarterly Workforce Indicators. Future research will examine whether this data meets a standard that would allow neighboring state-level J2J statistics to be released in earlier years.

State interrelatedness is established by analyzing patterns of within-quarter employer-to-employer flows. These transitions are summarized by origin and destination states for an eight-quarter window during which all states are available, 2011-2012. From this, we calculate the mean share of accessions in a reference state coming from each linked state (including itself), as well as the mean share of separations from the reference state going to each linked state. For every reference state-linked state pair, the two rates are averaged together across quarters, resulting in an index L_{ab} representing the overall impact of the linked state *b* on the reference state *a*. Formally, the index *L* is calculated between reference state *a* and linked state *b*, using *N* quarters in *T*. We reference the measures for the margins across all person characteristics, so a period (.) replaces the usual *I* subscript. The denominators in the calculation sum over the set of all destination or origin states *S*, which includes the reference state *a*.

$$L_{ab} = \sum_{t \in T} \left(\frac{EE_{.abt}}{\sum_{s \in S} EE_{.ast}} + \frac{EE_{.bat}}{\sum_{s \in S} EE_{.sat}} \right) / 2N \qquad \text{Eq 6-1}$$

Using the L_{ab} index created above, the aggregate release index RL_{at} is calculated between reference state *a* and the set M_t of all missing linked states *b* in time period *t*.

$$RL_{at} = \sum_{b \in M_t} L_{ab} \qquad \text{Eq 6-2}$$

This aggregate index RL_{at} is used to determine if statistics for state *a* can be released in quarter *t*. If RL_{at} is 2.5% or greater, the absence of the linked state will by itself result in suppression of the reference state. If multiple linked states are missing, RL_{at} measures the aggregate impact of missing states on the reference state, with the same 2.5% benchmark as the upper limit for release of the reference state. During quality assurance review, some additional suppressions may be applied to marginal cases. For example, RL_{at} for Ohio drops from 3.3% to a marginal 2.4% when Michigan enters in the fourth quarter of 2000, but drops strongly to 0.5% when Kentucky enters in the second quarter of 2001, suggesting that the latter quarter is a more appropriate start date for the Ohio series.

6.2.1 Release of Metro Area Series

Job-to-job statistics are also provided for metropolitan regions. The same rules regarding state missingness are used to determine if data for a metropolitan region is releasable. Note, metropolitan regions may cross state boundaries, and all states that contain part of the metro region must be available for the metro region to be released. It is possible that a metro region is released in quarters that a state in which it is contained is not. For example, if data is not available for state A, adjoining state B might be suppressed, but a metro area within state B, relatively distant from state A, might be less affected and could be released.

6.3 Job-to-Job Flows – Origin and Destination Data on Flows of Workers between Jobs

A separate tabulation file provides origin and destination statistics for flows from one job to another. Specifically, for job transitions that take place either within the quarter or within adjacent quarters, we tabulate characteristics of the origin and destination jobs – industry, geography, ownership, firm age, and firm size. This allows a further decomposition of the data and a new set of statistics on labor market adjustment. For example, when decomposing the net employment decline of an industry into separations to employment and non-employment, the separations to employment can further be stratified by destination industries and geographies. The data can therefore be used to measure the extent to which workers exiting a declining regional industry migrate somewhere else in the U.S. and, in addition, measure the earnings losses or gains associated with such transitions.

7 Comparability to Other Data

With any new data series, it is often instructive to compare it where we can with similar data. With regard to J2J flows to and from employment, the most comparable statistic is the employer-to-employer flows series constructed from the Current Population Survey (CPS) by Fallick and Fleischman (2004). Fallick and Fleishman exploit the dependent interviewing technique adopted in the 1994 CPS redesign to identify workers who changed employers from one month to another. Since the Fallick and Fleischman CPS data is monthly, we sum the monthly data to obtain the quarterly rates, following Hyatt and Spletzer (2013). Note that individuals can have multiple

employment transitions per quarter in the monthly Fallick and Fleishman series, while the LEHD J2J series limits workers to one job transition per quarter.

In Figure 2, we show a quarterly version of the CPS monthly rate of job-to-job flows along with three LEHD J2J series for job-to-job flows rates: job-to-job separation rate (*J2JSepR*, Eq 2-63), job-to-job hire rate (*J2JHireR*, Eq 2-64), and within-quarter job-to-job hire rate (*EEHireR*, Eq 2-58). While there is a level difference in the rates, the trends between the two series track each other well until about 2006. The pre-recession collapse in the CPS job-to-job flows series in 2006 coincides with a change in the dependent interviewing procedure for the CPS. The result of this change was a substantial increase in the missingness rate in the CPS on questions related to whether the respondent is still with the same employer as of the last interview. Although both the CPS and J2J series show a fall in the rate of job change in the Great Recession, there is no corresponding recovery in the CPS employer-to-employer transition rate. As we discuss further below, the recovery in the J2J job-to-job flows rate from 2010 forward is also reflected in JOLTS. Thus it is the CPS employer-to-employer flows series that appears to be inconsistent with the recovery in job mobility shown in the other two series.

Figure 3 compares the Fallick and Fleischman (2004) non-employment inflows and outflows series to J2J flows to non-employment (*ENSepR*, *ENPersistR*) and from non-employment (*NEHireR*, *NEPersistR*). Again, the CPS rates are higher than those derived from the LEHD data. The CPS and LEHD data sources show small trends which diverge somewhat, especially during the expansion period between the two recessions. Compared to the job-to-job series, these two are much less like, with more cyclicality and a downward trend in hires and separations in the J2J series that is not evident in the CPS series.

Figure 4 compares J2J separations to employment (*J2JSepR*, Eq 2-63) and persistent non-employment (*ENPersistR*, Eq 2-61) to the quits and layoffs series in the Job Openings and Labor Turnover Survey (JOLTS). The correlation between JOLTS quits and job-to-job flows in J2J is quite high, at 0.99, and the correlation between JOLTS layoffs and J2J separations to persistent non-employment is 0.62. There is, however, a substantial level difference, with separations to persistent non-employment being much higher in the J2J series. Davis, Faberman, Haltiwanger, and Rucker (2010) create a synthetic JOLTS layoff series adjusting for higher non-response rates in JOLTS from declining establishments; this adjusted layoffs series is higher than the J2J

separations to persistent non-employment rate, suggesting that the gap between the two series is largely due to establishments with larger employment declines being underrepresented in JOLTS.

8 Some Considerations When Using the J2J Data

8.1 Identifying Voluntary Job Change in the J2J Data

An obvious question for analysts using these new statistics is discerning which job-to-job movements are voluntary vs. involuntary moves. Unfortunately, the administrative data do not allow us to observe the reason for a particular job change. However, much of the research leading to the development of the J2J data examined whether certain types of job-to-job movements had other characteristics associated with voluntary job changes. Much of this evidence suggests that within-quarter job-to-job flows (and many adjacent-quarter job-to-job flows) are predominantly voluntary job changes. First, separations to a new job in the same quarter job are procyclical, unlike separations to persistent non-employment, which are counter-cyclical. Also, earnings changes associated with job separations to a new job in the same quarter are positive, with the median within-quarter job changer experiencing about 8% earnings increase (Hyatt and McEntarfer, 2012b). Job tenure, on average, is also longer at the destination job than the origin job (Bjelland et al., 2011).

There is greater ambiguity as to whether the smaller category of adjacent-quarter job transitions are more correctly classed as voluntary or involuntary job-to-job flows. Clearly, the potential for a longer non-employment spell between jobs is greater within this group. However, like within-quarter flows they are also associated with positive earnings changes at the median – albeit, smaller earnings increases (Hyatt and McEntarfer, 2012b). They are also pro-cyclical, like within-quarter job-to-job flows, and unlike flows to persistent non-employment.

Here we use a simple earnings test to gauge what share of job flows might be voluntary job movements. Aggregating total earnings across all jobs in the quarters surrounding the job transition, we compare earnings in the transition quarters to earnings in the quarters surrounding the transition. We then choose one month as the maximum time a worker might voluntarily choose

to remain nonemployed between jobs.[17] For within-quarter flows, we flag job transitions where total earnings in the transition quarter are less than two-thirds of the average earnings in surrounding quarters. For adjacent quarter flows, the job transition takes place over two quarters, so the transition is flagged if the sum of total earnings in those quarters is less than 5/6 of the sum of earnings in the two quarters before and after the job transition.[18] Applying this simple test, 85% of workers changing jobs within the quarter met the earnings threshold consistent with a voluntary job transition, while only half of adjacent-quarter job transitions met this threshold.

While we tabulate within and adjacent quarter job-to-job flows separately and leave this decision to the individual analyst, our preference is to classify adjacent-quarter flows with within-quarter job-to-job flows as predominantly voluntary job transitions. Census is currently researching whether we can use earnings histories to better identify voluntary and involuntary job-to-job flows in future releases of the data.

8.2 Dual Jobholders Switching Main Source of Employment

Not every change in a worker's main job involves leaving an old job and starting a new job. Some workers hold two or more jobs, switching back and forth over time which job is the primary source of earnings. Workers also hold jobs that are primarily a secondary source of earnings but become a primary job when the worker separates from the former main job.

To account for primary employment changes at the industry or state level, these main job changes must also be included. Thus we separately tabulate 'main job accessions' and 'main job starts'. Main job accessions include only new main jobs where the worker was hired by the firm during that quarter. Main job starts denote all jobs that are newly the main source of earnings, a measure that includes both new hires and jobs that were formerly secondary sources of earnings in the last quarter.

[17] In addition to allowing time off between jobs as part of a voluntary job transition, we also want to allow for earnings gaps caused by workers not yet paid in their new job. Earnings reported to states for unemployment insurance program administration are paid earnings, not earned earnings. Differences between payroll processing at the two jobs could create a gap in earnings even when there is no gap in employment.

[18] This is identical to the approach used to earnings adjust job-to-job flows in Haltiwanger, Hyatt, and McEntarfer (2014).

8.3 Main Jobs vs. Employment

When comparing employment counts in the J2J data to other sources such as the QCEW and the QWI, keep in mind that employment in J2J is *main* job employment, not total employment, and thus you should expect that employment counts in J2J should be lower than in QCEW or QWI, which count all jobs.

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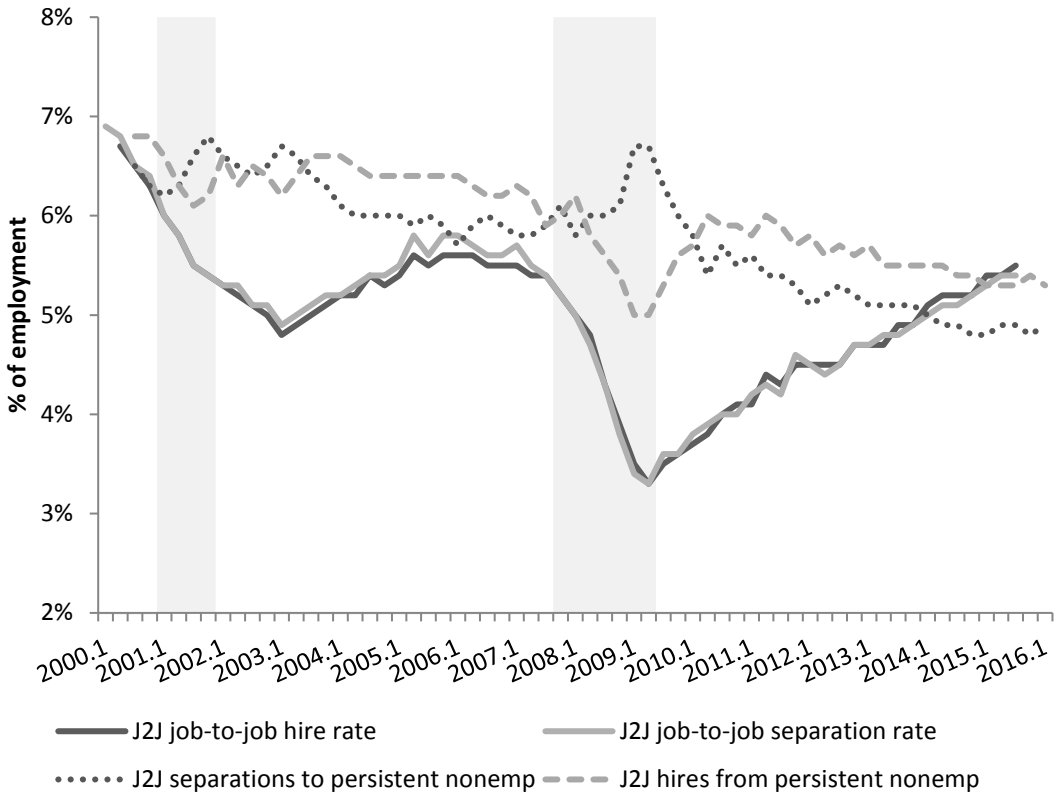
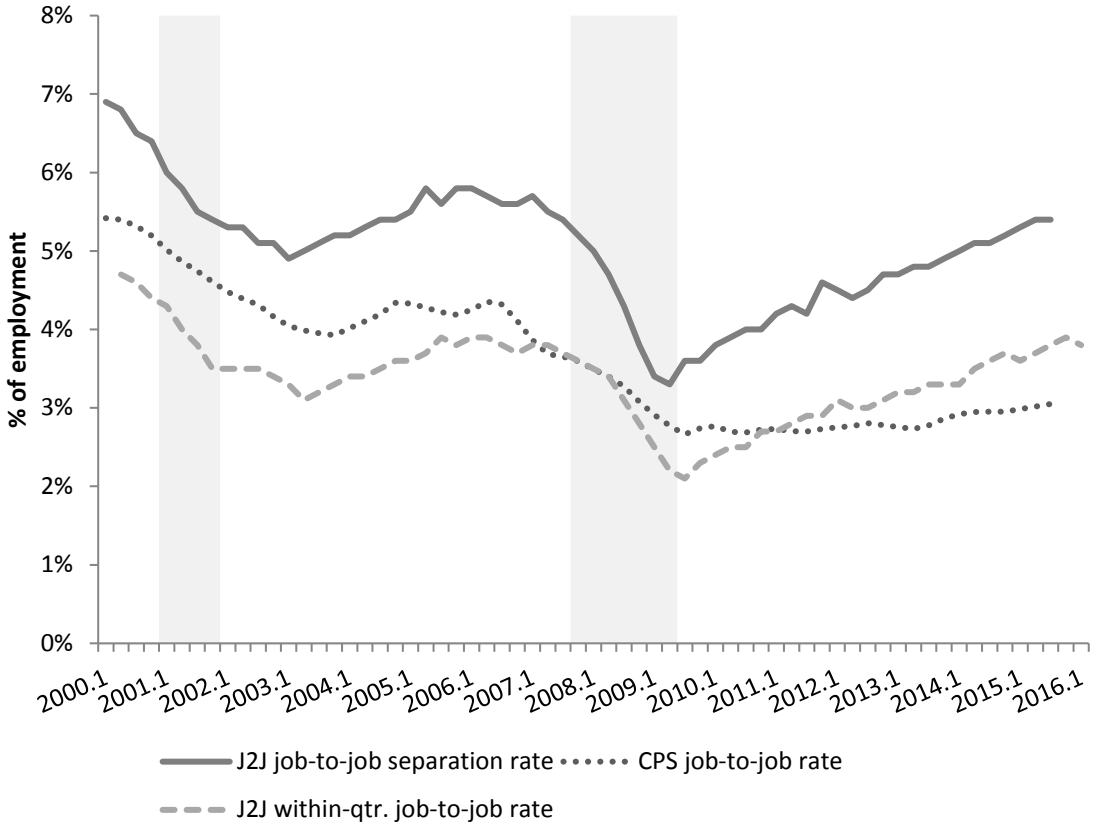
Figures

Figure 1: National Job-to-Job Flows: Hires and Separations due to Job Change vs. Flows In and Out of Employment, 2000-2016



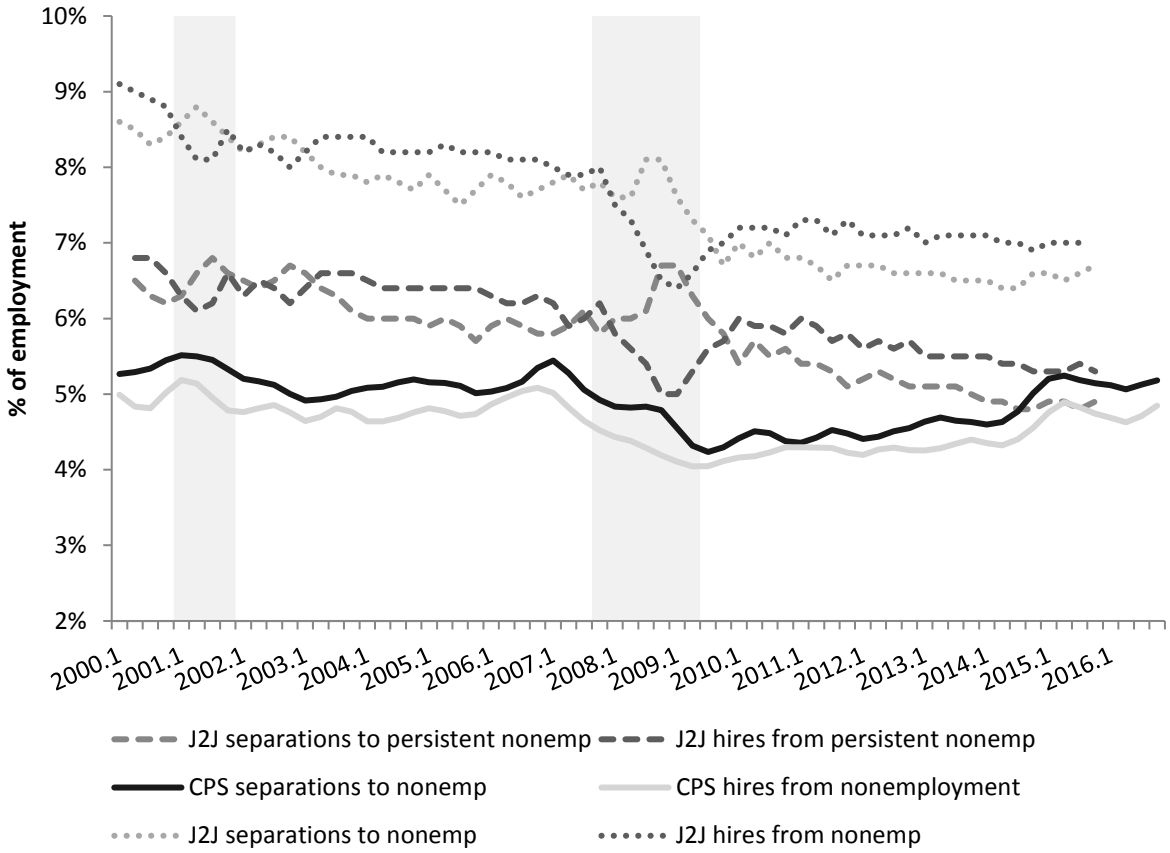
Note: Source: U.S. Census Bureau, Job-to-Job Flow statistics, national-level, seasonally-adjusted rates, R2017Q1. Shaded regions indicate NBER recession quarters. J2J job-to-job hires are new job starts where the separation from the previous main job occurred in either this quarter or the previous quarter (separations are similarly to a new job this quarter or next quarter). Almost all (90%) workers who separate to a persistent non-employment spell are not employed at all in the quarter following their job separation (similar for accessions).

Figure 2: Rates of Job Change: J2J vs. Employer-to-Employer Flows from CPS



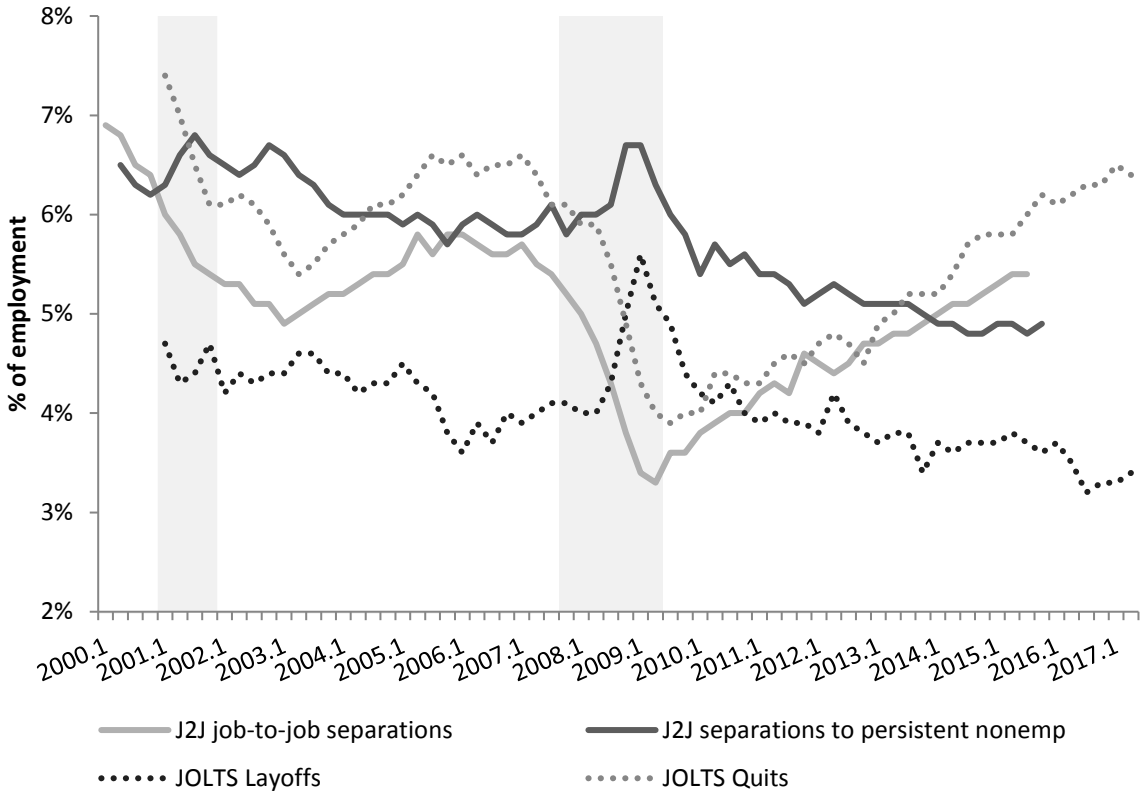
Note: Sources: U.S. Census Bureau, Job-to-Job Flow statistics, national-level, seasonally adjusted rates, R2017Q1, and employer-to-employer flows series calculated from the CPS by Fallick and Fleischman (2004), provided on their website. Shaded regions indicate NBER recession quarters. The collapse in the Fallick and Fleischman CPS series in 2006 appears to be driven by changes in the CPS dependent interviewing procedures. The CPS series fails to capture the recovery in quits and job-to-job change since 2010 observed both J2J and JOLTS.

Figure 3: Flows In and Out of Employment: J2J vs. CPS



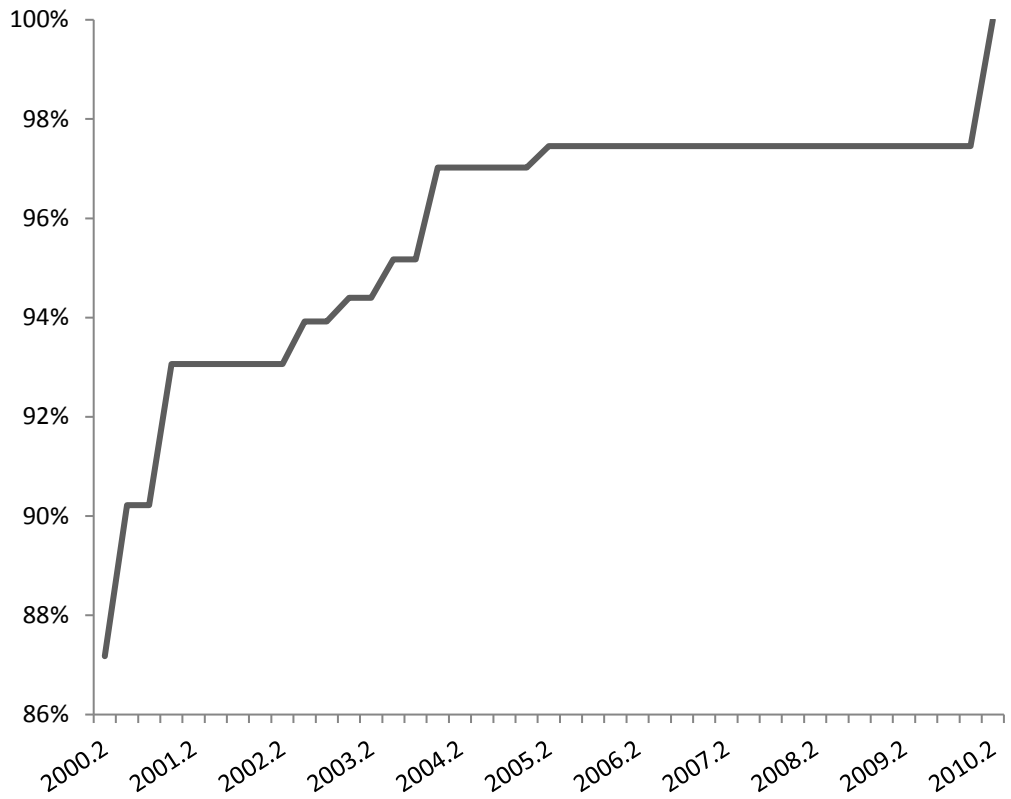
Note: Sources: U.S. Census Bureau, Job-to-Job Flow statistics, national-level, seasonally adjusted rates, R2017Q1, CPS flows are downloaded from Fallick and Fleischman (2004) website. Shaded regions indicate NBER recession quarters. Both Job-to-Job Flows series show pronounced spikes in separations from employment (and sharp declines in flows out of non-employment) in the Great Recession as well as a general decline in gross flows overall during this period. None of these features are present in the CPS series.

Figure 4: Separations in J2J vs. Quits and Layoffs in JOLTS



Note: Sources: U.S. Census Bureau, Job-to-Job Flow statistics, seasonally adjusted rates, R2017Q1, Bureau of Labor Statistics, Job Openings and Labor Turnover Survey (JOLTS) data. JOLTS data are released monthly; we estimate quarterly rates by summing the monthly rates for the relevant quarter. Shaded regions indicate NBER recession quarters. The J2J separation rate to new jobs and the JOLTS quit rate move very closely together, especially since 2010. Davis, Faberman, Haltiwanger, and Rucker (2010) estimate that the JOLTS layoff rate biased downward due to the sampling frame for JOLTS, which excludes new and very young establishments. They provide an adjusted layoff rate that accounts for this bias; that rate is higher than the J2J separations to nonemployment rate.

Figure 5: Proportion of Private Sector Employment in LEHD states: 2000.2-2010.2



Note: Shares of QCEW private sector employment totals for April of 2012 as downloaded from the BLS website. Coverage reflects the number of states with data that has passed quality assurance thresholds for release in the QWI.

Tables

List of Count Variable Definitions[19]

Table 1

Microdata Variable	Short Description	Definition	Aggregate Variable (sum)
Job Counts			
$\mathbf{b_{ijt}}$	Beginning of Quarter Job	$\begin{cases} 1, \text{if } w_{ijt} > 0 \text{ and } w_{ijt-1} > 0 \\ 0, \text{otherwise} \end{cases}$	
$\mathbf{e_{ijt}}$	End of Quarter Job	$\begin{cases} 1, \text{if } w_{ijt} > 0 \text{ and } w_{ijt+1} > 0 \\ 0, \text{otherwise} \end{cases}$	
$\mathbf{domb_{ijt}}$	Main Beginning of Quarter Job	$\begin{cases} 1, \text{if } b_{ijt} = 1 \text{ and } (w_{ijt} + w_{ijt-1}) > (w_{ilt} + w_{ilt-1}) \\ \quad \forall\, l \text{ where } b_{ilt} = 1 \text{ and } l \neq j \\ 0, \text{otherwise} \end{cases}$	MainB
$\mathbf{dome_{ijt}}$	Main End of Quarter Job	$\begin{cases} 1, \text{if } e_{ijt} = 1 \text{ and } (w_{ijt} + w_{ijt+1}) > (w_{ilt} + w_{ilt+1}) \\ \quad \forall\, l \text{ where } e_{ilt} = 1 \text{ and } l \neq j \\ 0, \text{otherwise} \end{cases}$	MainE
$\mathbf{dombe_{ijt}}$	Main Beginning and End of Quarter Job	$\begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } dome_{ijt} = 1 \\ 0, \text{otherwise} \end{cases}$	
$\mathbf{f_{ijt}}$	Full-Quarter (Stable) Job	$\begin{cases} 1, \text{if } w_{ijt-1} > 0 \text{ and } w_{ijt} > 0 \text{ and } w_{ijt+1} > 0 \\ 0, \text{otherwise} \end{cases}$	
$\mathbf{fdomb_{ijt}}$	Dominant Beginning of Quarter Job, Stable	$\begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } f_{ijt-1} = 1 \\ 0, \text{otherwise} \end{cases}$	MainBS
$\mathbf{fdome_{ijt}}$	Dominant End of Quarter Job, Stable	$\begin{cases} 1, \text{if } dome_{ijt} = 1 \text{ and } f_{ijt+1} = 1 \\ 0, \text{otherwise} \end{cases}$	MainES
$\mathbf{f4dombe_{ijt}}$	Dominant Beginning and End of Quarter Job, 4-quarter stayer	$\begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } dome_{ijt} = 1 \\ \quad \text{and } f_{ijt-1} = 1 \\ 0, \text{otherwise} \end{cases}$	JobStayS
$\mathbf{fdombe_{ijt}}$	Dominant Beginning and End of Quarter Job, 5-quarter stayer	$\begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } dome_{ijt} = 1 \\ \quad \text{and } f_{ijt-1} = 1 \text{ and } f_{ijt+1} = 1 \\ 0, \text{otherwise} \end{cases}$	
Transitions from and to Dominant Jobs			
$\mathbf{all\_doms2_{ijt}}$	Separation from Main Job	$\begin{cases} 1, \text{if } domb_{ijt} = 1 \text{ and } m_{ijt+1} = 0 \\ 0, \text{otherwise} \end{cases}$	MSep
$\mathbf{all\_doma2_{ikt}}$	Accession to Main Job	$\begin{cases} 1, \text{if } dome_{ikt} = 1 \text{ and } m_{ijt-1} = 0 \\ 0, \text{otherwise} \end{cases}$	MHire

[19] Note on Rates: The denominator for rates is the average employment over the quarter, or the average of main jobs held at the start and end of the quarter (MainB and MainE). Rates corresponding to the variables listed above have the same name but end with an R (for example, the rate corresponding to job-to-job hires (J2JHire) is the job-to-job hiring rate J2JHireR).

Microdata Variable	Short Description	Definition	Aggregate Variable (sum)
en2_doms2$_{ijt}$	Separation to Persistent Non-employment	$\begin{cases} 1, \text{if all\_doms2}_{ijt} = 1 \text{ and } e_{ilt} = 0 \text{ and } e_{ilt+1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	ENPersist
fen2_doms2$_{ijt}$	Separation from Stable Job to Persistent Non-employment	$\begin{cases} 1, \text{if all\_doms2}_{ijt} = 1 \text{ and } f_{ijt-1} = 1 \text{ and } e_{ilt} = 0 \\ \qquad \text{and } e_{ilt+1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	ENPersistS
ne2_doma2$_{ikt}$	Accession from Persistent Non-employment	$\begin{cases} 1, \text{if all\_doma2}_{ikt} = 1 \text{ and } b_{ilt} = 0 \text{ and } b_{ilt-1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	NEPersist
fne2_doma2$_{ikt}$	Accession to Stable Job from Persistent Non-employment	$\begin{cases} 1, \text{if all\_doma2}_{ikt} = 1 \text{ and } f_{ikt+1} = 1 \text{ and } b_{ilt} = 0 \\ \qquad \text{and } b_{ilt-1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	NEPersistS
en2p_doms2$_{ijt}$	Separation to Full-Quarter Non-employment	$\begin{cases} 1, \text{if all\_doms2}_{ijt} = 1 \text{ and } m_{ilt+1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	ENFullQ
ne2p_doma2$_{ikt}$	Accession from Full-Quarter Non-employment	$\begin{cases} 1, \text{if all\_doma2}_{ikt} = 1 \text{ and } m_{ilt-1} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	NEFullQ
en_doms2$_{ijt}$	Separation to Non-employment	$\begin{cases} 1, \text{if all\_doms2}_{ijt} = 1 \text{ and } e_{ilt} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	ENSep
ne_doma2$_{ikt}$	Accession from Non-employment	$\begin{cases} 1, \text{if all\_doma2}_{ikt} = 1 \text{ and } b_{ilt} = 0 \ \forall \ l \\ 0, \text{otherwise} \end{cases}$	NEHire
mbs_domb$_{ijt}$	Main Job Becomes Secondary	$\begin{cases} 1, \text{if domb}_{ijt} = 1 \text{ and dome}_{ijt} = 0 \text{ and } e_{ijt} = 1 \\ 0, \text{otherwise} \end{cases}$	
sbm_dome$_{ikt}$	Secondary Job Becomes Main	$\begin{cases} 1, \text{if dome}_{ikt} = 1 \text{ and } b_{ikt} = 1 \text{ and domb}_{ikt} = 0 \\ 0, \text{otherwise} \end{cases}$	
last_domb$_{ijt}$	Main Job End	$\begin{cases} 1, \text{if mbs\_domb}_{ijt} = 1 \text{ or all\_doms2}_{ijt} = 1 \\ 0, \text{otherwise} \end{cases}$	MJobEnd
first_dome$_{ikt}$	Main Job Start	$\begin{cases} 1, \text{if sbm\_dome}_{ikt} = 1 \text{ or all\_doma2}_{ikt} = 1 \\ 0, \text{otherwise} \end{cases}$	MJobStart
Employer to Employer Transitions			
ee$_{ijkt}$	Employer-to-Employer Flow	$\begin{cases} 1, \text{if all\_doms2}_{ijt} = 1 \text{ and all\_doma2}_{ikt} = 1 \\ 0, \text{otherwise} \end{cases}$	EE
fee$_{ijkt}$	Stable Employer-to-Employer Flow		EES
ee_doms2$_{ijt}$	Separation in Employer-to-Employer Flow	$\begin{cases} 1, \text{if } \exists \text{ k such that ee}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	EESep
ee_doma2$_{ikt}$	Accession in Employer-to-Employer Flow	$\begin{cases} 1, \text{if } \exists \text{ j such that ee}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	EEHire
fee_doms2$_{ijt}$	Separation in Stable Employer-to-Employer Flow	$\begin{cases} 1, \text{if } \exists \text{ k such that fee}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	EESepS
fee_doma2$_{ikt}$	Accession in Stable Employer-to-Employer Flow	$\begin{cases} 1, \text{if } \exists \text{ j such that fee}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	EEHireS

Microdata Variable	Short Description	Definition	Aggregate Variable (sum)
ee_aq$_{ijkt}$	Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if all\_doms2}_{ijt-1} = 1 \text{ and all\_doma2}_{ikt} = 1 \text{ and } b_{ilt} = 0 \\ 0, \text{otherwise} \end{cases}$	AQHire
fee_aq$_{ijkt}$	Stable Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if all\_doms2}_{ijt-1} = 1 \text{ and all\_doma2}_{ikt} = 1 \\ \quad \text{and } b_{ilt} = 0 \ \forall \ l \text{ and } f_{ijt-2} = 1 \text{ and } f_{ikt+1} = 1 \\ 0, \text{otherwise} \end{cases}$	AQHireS
aq_doms2$_{ijt}$	Separation in Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if } \exists \text{ k such that ee\_aq}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	AQSep
aq_doma2$_{ikt}$	Accession in Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if } \exists \text{ j such that ee\_aq}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	AQHire
faq_doms2$_{ijt}$	Separation in Stable Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if } \exists \text{ k such that fee\_aq}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	AQSepS
faq_doma2$_{ikt}$	Accession in Stable Employer-to-Employer Flow, Adjacent Quarter	$\begin{cases} 1, \text{if } \exists \text{ j such that fee\_aq}_{ijkt} = 1 \\ 0, \text{otherwise} \end{cases}$	AQHireS
eeall_doms2$_{ijt}$	Job-to-Job Separation	$\begin{cases} 1, \text{if ee\_doms2}_{ijt} = 1 \text{ or aq\_doms2}_{ijt} = 1 \\ 0, \text{otherwise} \end{cases}$	J2JSep
eeall_doma2$_{ikt}$	Job-to-Job Accession	$\begin{cases} 1, \text{if ee\_doma2}_{ikt} = 1 \text{ or aq\_doma2}_{ikt} = 1 \\ 0, \text{otherwise} \end{cases}$	J2JHire

Earnings Variable Definitions

Table 2

Microdata Variable	Short Description	Definition	Aggegation Calculation $i \in I, j \in J, k \in K$	Aggregate Variable (mean)
f4dombe_jfqearn$_{ijt}$	Earnings in Origin Time Period, Full-Quarter Job Stayer	w_{ijt-1}, where f4dombe$_{ijt}$=1	$\frac{\sum_{ij} \text{fdombe\_jfqearn}_{ijt}}{\sum_{ij} \text{f4dombe}_{ijt}}$	JobStaySEarn_Orig
f4dombe_kfqearn$_{ijt}$	Earnings in Destination Time Period, Full-Quarter Job Stayer	w_{ijt}, where f4dombe$_{ijt}$=1	$\frac{\sum_{ij} \text{fdombe\_kfqearn}_{ijt}}{\sum_{ij} \text{f4dombe}_{ijt}}$	JobStaySEarn_Dest
fne2_kfqearn$_{ikt}$	Earnings in Destination Job, Full-Quarter Flow from Persistent Nonemployment	w_{ikt+1}, where fne2_doma2$_{ikt}$=1	$\frac{\sum_{ik} \text{fne2\_kfqearn}_{ikt}}{\sum_{ik}(\text{fne2\_doma2}_{ikt})}$	NEHireSEarn_Dest
fen2_jfqearn$_{ijt}$	Earnings in Origin Job, Full-Quarter Flow to Persistent Nonemployment	w_{ijt-1}, where fen2_doms2$_{ijt}$=1	$\frac{\sum_{ij} \text{fen2\_jfqearn}_{ijt}}{\sum_{ij}(\text{fen2\_doms2}_{ijt})}$	ENSepSEarn_Orig
fee_jfqearn$_{ijkt}$	Earnings in Origin Job, Full-Quarter Employer-to-Employer Flow	w_{ijt-1}, where fee$_{ijkt}$=1	$\frac{\sum_{ijk} \text{fee\_jfqearn}_{ijkt}}{\sum_{ijk} \text{fee}_{ijkt}}$	EESEarn_Orig
fee_kfqearn$_{ijkt}$	Earnings in Destination Job, Full-Quarter Employer-to-Employer Flow	w_{ikt+1}, where fee$_{ijkt}$=1	$\frac{\sum_{ijk} \text{fee\_kfqearn}_{ijkt}}{\sum_{ijk} \text{fee}_{ijkt}}$	EESEarn_Dest
faq_jfqearn$_{ijkt}$	Earnings in Origin Job, Full-Quarter Adjacent-Quarter Flow	w_{ijt-2}, where fee_aq$_{ijkt}$=1	$\frac{\sum_{ijk} \text{faq\_jfqearn}_{ijkt}}{\sum_{ijk} \text{faq\_aq}_{ijkt}}$	AQHireSEarn_Orig
faq_kfqearn$_{ijkt}$	Earnings in Destination Job, Full-Quarter Adjacent-Quarter Flow	w_{ikt+1}, where fee_aq$_{ijkt}$=1	$\frac{\sum_{ijk} \text{faq\_kfqearn}_{ijkt}}{\sum_{ijk} \text{faq\_aq}_{ijkt}}$	AQHireSEarn_Dest