WORKING PAPERS

RESEARCH DEPARTMENT

WORKING PAPER NO. 07-5

**THE CYCLICALITY OF WORKER FLOWS:
NEW EVIDENCE FROM THE SIPP**

Shigeru Fujita
Federal Reserve Bank of Philadelphia

Christopher J. Nekarda
University of California, San Diego

Garey Ramey
University of California, San Diego

February 2007

RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA

The Cyclicality of Worker Flows:
New Evidence from the SIPP[*]

Shigeru Fujita[†], Christopher J. Nekarda[‡] and Garey Ramey[§]

January 29, 2007

Abstract

Drawing on CPS data, Fujita and Ramey (2006) show that total monthly job loss and hiring among U.S. workers, as well as job loss hazard rates, are strongly countercyclical, while job finding hazard rates are strongly procyclical. They also find that total job loss and job loss hazard rates lead the business cycle, while total hiring and job finding rates trail the cycle. In the current paper we use information from the Survey on Income and Program Participation (SIPP) to reevaluate these findings. SIPP data are used to construct new longitudinally consistent gross flow series for U.S. workers, covering 1983-2003. The results strongly validate the Fujita-Ramey findings, with two important exceptions: (1) total hiring leads the cycle in the SIPP data, and (2) the job loss rate is substantially more volatile than the job finding rate at business cycle frequencies.

JEL codes: J63, J64

Keywords: Job loss, Hiring, SIPP worker flows

[†]Federal Reserve Bank of Philadelphia; e-mail: shigeru.fujita@phil.frb.org.

[‡]University of California, San Diego; e-mail: cnekarda@ucsd.edu.

[§]University of California, San Diego; e-mail: gramey@ucsd.edu.

1   Introduction

Drawing on Current Population Survey (CPS) gross flow data for the period 1976–2005, Fujita and Ramey (2006), henceforth referred to as FR, construct new monthly data series on U.S. total job loss and hiring, along with job loss and job finding hazard rates faced by individual workers. These series are adjusted for margin error and time aggregation error, and Baxter and King (1999)'s band-pass filter is used to extract business cycle components. They show that the following characteristics hold for aggregate worker flows between employment and unemployment:

1. Total job loss, total hiring, and the job loss hazard rate rise sharply during all four NBER recessions in the sample period, while the job finding hazard rate falls sharply.

2. The cyclical components of total job loss, total hiring, and the job loss rate exhibit strong negative correlations with the cyclical component of the industrial production index, and the cyclical component of the job finding rate exhibits strong positive correlation.

3. Both total job loss and the job loss rate lead the cycle by three months, while total hiring and the job finding rate trail the cycle by one to two months.

4. Total job loss is more volatile than total hiring at business cycle frequencies, while the job finding rate is more volatile than the job loss rate.

5. All four variables are highly volatile relative to industrial production.

These findings support a "separation-driven" view of employment adjustment, whereby cyclical downturns are associated with initial waves of job loss, followed by increased hiring activity as the economy recovers.[1]

In this paper we reevaluate these findings using gross flow information derived from a separate data set, the Survey of Income and Program Participation (SIPP). The SIPP,

---

[1]Other papers have used various data sets and methods to reach broadly consistent conclusions. For recent work, see Elsby et al. (2007), Fujita and Ramey (2007), and Yashiv (2006a,b).

administered by the Census Bureau since 1983, collects longitudinal data on the labor force status of individuals, along with other data. For the sake of brevity, we omit the analysis of demographic factors and not-in-labor-force flows that is contained in FR and focus on transitions between employment and unemployment among all workers. We also extend the FR analysis by considering the unemployment rate as a cyclical indicator.[2]

The SIPP data derive from panels having various starting dates, sample periods, and survey methodologies. We develop consistent cross-panel data definitions and aggregation procedures in order to obtain a longitudinally consistent aggregation of the SIPP panels. This new data set covers the period September 1983–September 2003. From these data we construct "synthetic" CPS gross flow series at monthly frequency, that is, monthly gross flow series that are measured from the SIPP data set according to the concepts used in the CPS. This allows us to make a direct comparison between CPS- and SIPP-based findings.[3]

The SIPP data validate the first two FR findings. Steep increases in total flows and the job loss rate and steep declines in the job finding rate are associated with both NBER recessions in the SIPP sample period. Furthermore, the cyclical components of total flows and the job loss rate are strongly negatively correlated with the cyclical component of industrial production and strongly positively correlated with the cyclical component of unemployment.[4] Notably, all three variables have peak correlations with industrial industrial production of around −0.80 at lags of four to five months. Peak correlations with unemployment are 0.80 at similar lags. This means that these variables are strongly countercyclical.

The job finding rate exhibits significant positive comovement with industrial production and negative comovement with unemployment, in agreement with the finding of

---

[2]Nagypál (2004) draws on the SIPP to study the extent to which the cyclical behavior of job-to-job transitions is driven by quits versus other types of separations.

[3]Gottschalk and Moffitt (1999) also look at monthly hazard rates calculated from the SIPP. Their analysis, however, focuses on secular movements in the time-averaged series, rather than cyclical adjustment.

[4]As noted in FR, the cyclical components of the quarterly time-averaged industrial production index and real GDP are highly correlated, even though the industrial production index captures production activities in goods-producing industries only.

Shimer (2005a) and FR. The peak correlation with industrial production, however, is only 0.55 in the SIPP data, significantly smaller than the value 0.80 found in the CPS data. Thus, the cyclical comovement of the job finding rate is somewhat less pronounced in the SIPP.

As for the third FR finding, the SIPP data indicate that both total job loss and the job loss rate lead the cycle, supporting FR's conclusions. A noteworthy difference from FR, however, is that total hiring in the SIPP data leads the cycle by four to five months, while in the CPS data it trails the cycle by one to two months. Thus, the two data sets do not provide a clear picture of the comovement of total hiring.

As for the fourth FR finding, total job loss in the SIPP is significantly more volatile than total hiring at business cycle frequencies. Specifically, in the SIPP data the standard deviation of the cyclical component of total job loss is 31 percent greater than that of total hiring, versus 39 percent greater in FR.

An important difference emerges with respect to the relative volatilities of the transition hazard rates. In the SIPP data the standard deviation of the cyclical component of the job loss rate is 60 percent greater than that of the job finding rate. In the CPS data, on the other hand, the cyclical component of the job finding rate has a standard deviation that is 32 percent greater. Thus, the two data sets disagree as to the relative volatilities of job loss and job finding rates.

Finally, the standard deviations of the cyclical components of both total flow variables and both hazard rate variables are large in comparison to that of aggregate output, as measured by the industrial production index, in agreement with the fifth FR finding.

The paper proceeds as follows. Section 2 discusses our construction of the SIPP data set, Section 3 analyzes business cycle comovement and volatility of total flows and transition hazard rates, and Section 4 concludes. The Appendix provides further details about the data construction.

2 SIPP-Based Gross Flow Measures

2.1 Overview

The SIPP is designed to provide comprehensive information about the dynamics of income, labor force status, and government program participation of individuals in the United States. The SIPP is organized into 13 multi-year panels, each comprised of between 30,000 to 90,000 persons. At the start of each panel a nationally representative sample of individuals aged 15 years and older is drawn from the civilian noninstitutional population. These sampled individuals, along with others who subsequently live with them, are interviewed every four months over the duration of the panel. Each panel is subdivided into four rotation groups, one of which is interviewed in each month. Members of the original sample who move are interviewed at their new addresses.[5]

By following sample members who move, the SIPP design maximizes the longitudinal information collected for each person. This design differs fundamentally from that of the CPS, which collects data on the current occupants of a sample of addresses; respondents who move from a sample address are not followed. In addition, the SIPP surveys the same individuals for a longer period than does the CPS. Thus, the SIPP provides a longer set of observations for each individual from which labor force transitions may be measured. Moreover, labor force status is recorded on a weekly basis.

Several new challenges must be overcome in constructing CPS-comparable aggregate gross flow measures from SIPP data. First, microdata from the panels before 1996 are published in both longitudinal (full panel) and wave-specific (core wave) files. These files must be merged in order to combine longitudinally edited demographic information from the full panel files with the calendar date, labor force status, and sampling weight information necessary to create an aggregate time series.

Second, after merging the full panel and core wave files, we obtain a set of observations for each person that includes labor force for each week that the individual is in the panel. Because the SIPP labor force classification is fundamentally different from that in the

---

[5]See Westat (2001) for a detailed description of the SIPP survey design.

CPS, we must recode the SIPP labor force information to create CPS-consistent monthly measures. This produces a "synthetic" CPS monthly labor force classification for each individual.

Finally, the data from the different panels must be aggregated to create a continuous time series. This aggregation is complicated by rotation group effects and gaps in panel coverage. To avoid small-sample bias for months when the entire panel is not interviewed, we drop observations for the first and last three months of each panel. Additional details of the data construction are provided in the Appendix.

2.2   Data adjustment issues

Because of gaps between the administration of panels, there are several months missing from the SIPP-based series, notably a seven-month gap between March 2000 and October 2000. We handle the missing month issue by utilizing a standard maximum likelihood interpolation procedure; see the Appendix for details.

FR adjust their data to correct for margin error in the CPS, building on the method developed by Abowd and Zellner (1985). Margin error refers to inconsistency in the stock-flow identities. In the CPS, labor market transition information can be computed for at most 75 percent of all the individuals in the stock calculations. Further, it is known that the missing individuals, amounting to at least 25 percent of the sample size, create systematic biases in the flow calculations.[6] In contrast, this problem does not arise in the SIPP because all respondents provide retrospective information about labor force behavior in the preceding four months. In addition, the SIPP data have very few missing observations. For these reasons, SIPP-based gross flow series do not require margin error adjustments.

Measures of gross flows and average transition rates may be derived from observed month-over-month transitions into and out of employed status. As pointed out by Shimer

---

[6]If the information is missing at random, because the sample size is large, the missing observations should not per se cause important inconsistencies. However, FR statistically test this missing-at-random model and strongly reject it. The rejection of the missing at random model may pertain to the so-called rotation group bias in the CPS. See Solon (1986) for an explanation of rotation group bias.

(2005a), these measures may miss transitions that are reversed within the month, leading to potential time aggregation bias. This problem may be addressed by linking the measurements to an underlying continuous-time adjustment framework. To this end, we apply the time aggregation adjustment used by Shimer (2005a) and FR to the SIPP series constructed here.

3   Cyclical Behavior of Worker Flows

Our SIPP-based adjusted gross flow series measure aggregate monthly worker transitions between employment and unemployment. The time aggregation procedure implies that these series capture *all* worker transitions occurring over the course of the month, including those that are reversed within the month. The procedure also yields estimates of monthly job loss and job finding transition hazard rates.

3.1   Comovement

Figure 1 presents the estimated monthly total flow and hazard rate series derived from the SIPP. The figure also shows the net job flows and average transition rates obtained from data that are not adjusted for time aggregation error. We report 12-month backward moving averages in order to screen out high-frequency movements including seasonal variations. Vertical reference bands indicate NBER recession dates.

Steep increases in total job loss and hiring as well as in the job loss hazard rate occur during both of the recessions in the sample period. Moreover, the recessions are accompanied by sharp declines in the job finding hazard rate. These findings are consistent with the results in FR obtained using the CPS. Note further that the time aggregation adjustment has little effect on the cyclical behavior of the four variables.

Cyclical components of the four series are shown in Figure 2. These are obtained using the Baxter-King filter with a cycle range of 15–96 months.[7] Sharp increases in total job

---

[7]Note that the Baxter-King filter is a symmetric moving average filter. In our application, we have set the moving-average window to 36 months. Thus, the estimated cyclical components cover the September 1986–September 2000 period, as seen in Figure 2.

loss and hiring flows and in the job loss rate may be observed in the months leading up to the 1990–91 recession. The job finding rate, in contrast, experiences its decline during and after the recession. Because the Baxter-King filter necessarily shortens the period for which the cyclical components can be computed, Figure 2 does not cover the most recent recession, which started in March 2001. The figure clearly shows, however, that the cyclical components of total job loss, total hiring, and the job loss rate have already bottomed out sharply by late 1999.

A more systematic assessment of business cycle comovement may be obtained by considering the cross correlations between the cyclical components of the four variables and the cyclical component of business cycle indicator variables. Here we consider the Federal Reserve Board's monthly index of industrial production and the official monthly CPS unemployment rate as cyclical indicators.

The cross correlations with industrial production are reported in Figure 3. Observe that in the SIPP data, the two total flow series and the job loss rate exhibit high negative correlation with the industrial production index. This indicates that these variables are strongly countercyclical. Notably, total job loss and hiring and the job loss hazard rate have peak correlations with industrial production of around −0.80 at a lag of five months. The job finding rate, on the other hand, exhibits somewhat weaker comovement, with a peak correlation of about 0.55 at leads of between zero and 16 months.

Figure 3 also reports the cross correlations obtained by FR using the CPS-based series. Peak correlations of total flows and the job loss hazard rate are essentially identical to those obtained from the SIPP data. For the job finding rate, the peak correlation is 0.80 in the CPS, which is somewhat higher than the value determined by the SIPP.

Cross correlations with unemployment are shown in Figure 4. Peak correlations for all four variables are similar in sign and magnitude across both data sets. Thus, the results strongly confirm the second FR finding.

Figures 3 and 4 show further that total job loss and the job loss hazard rate in the SIPP data exhibit peak correlations at five month lags, roughly similar to the lags obtained in the FR data. This reinforces the conclusion that job loss activity leads the business cycle.

Moreover, the evidence indicates that the job finding rate trails the cycle: across both data sets and cyclical indicators, peak correlations occur at leads of between zero and 15 months.

Important differences emerge with respect to total hiring. Whereas total hiring leads the cycle by about five months in the SIPP-based series, it lags the cycle by zero to two months in the CPS-based series. The two data sets do not therefore provide a clear picture of the the cyclical behavior of total hiring.

3.2 Volatility

Standard deviations of the cyclical components of total flows and hazard rates are reported in Table 1. Whereas the volatility of the job finding hazard rate is essentially equal in the two data sets, the other three variables display significantly greater volatility in the SIPP data. Table 1 also shows that total job loss is significantly more volatile than total hiring in both data sets. In particular, the standard deviation of the cyclical component of total job loss is 31 percent greater than that of total hiring in SIPP and 39 percent greater in the CPS. Thus, the SIPP data corroborate this FR finding.

In the SIPP data the standard deviation of the job loss hazard rate is 60 percent greater than that of the job finding rate rate. In the CPS, however, the standard deviation of the job finding rate is 32 percent greater. Thus, the two data sets disagree as to the relative volatilities of job loss and job finding rates.

Note finally that all variables in the two data sets have standard deviations significantly greater than the standard deviation of industrial production, which is 0.018 over the SIPP sample period and 0.023 over the CPS sample period. By this standard, all four variables exhibit high cyclical variability.

4 Conclusion

In this paper we draw on the SIPP to construct new aggregate gross flow series for U.S. workers over September 1983–September 2003. These series are longitudinally consistent

and conform to CPS survey concepts. We use these data to assess the robustness of conclusions drawn in FR using CPS data.

The SIPP data confirm the bulk of the FR findings: total job loss and the job loss hazard rate are strongly countercyclical and lead the cycle; the job finding hazard rate is strongly procyclical and trails the cycle; and total job loss is significantly more volatile than total hiring at business cycle frequencies.

Two notable differences emerge with respect to hiring activity: (1) whereas total hiring trails the cycle in the CPS data, it leads the cycle in the SIPP data; and (2) the FR conclusion that the job finding rate is more volatile than the job loss rate is strongly reversed in the SIPP data.

Both data sets provide powerful evidence in favor of a "separation-driven" view of employment adjustment, whereby downturns are preceded by waves of job loss, associated with spikes in the job loss rate. We find, in addition, that downturns are accompanied by sharp increases in total hiring. The job finding rate falls only in the months following downturns.

The evidence is ambiguous with respect to the timing of hiring adjustment. According to the CPS, increases in total hiring trail the cycle in concert with the declining job finding rate. The SIPP, on the other hand, points to a more rapid hiring response. This difference pertains to the speed at which newly unemployed workers can find new jobs. In either case, however, cyclical fluctuations in hiring are closely associated with job loss.

Our results have important implications for the role of job loss and job finding rates in driving unemployment fluctuations. Recessions are initiated by spikes in the job loss rate, inducing surges in job loss and hiring. The job finding rate adjusts later, but it does not decline sufficiently to reverse the increases in total hiring. In other words, higher unemployment during a recession is driven by increases in unemployment inflows, not reductions in unemployment outflows.[8]

Beyond reevaluating the FR findings, our data construction exercise provides the first

---

[8]This evidence disconfirms the assertions of Hall (2005a,b) and Shimer (2005a,b), who argue that recessionary increases in unemployment are tied to lower unemployment outflows induced by declines in the job finding rate. This point is discussed further in Davis (2005).

comprehensive comparison of the CPS and the SIPP. The broad concurrence of results obtained from the two data sets offers strong reassurance as to the quality of the data. The disparity between cyclical volatilites observed in Table 1 does, however, raise concerns that should be more closely investigated in future work.

In comparing the CPS and SIPP results, we have conducted our analysis using the full sample from both data sets. Although these sample periods are not identical, we do so to maximize available information for calculating population moments. It is of interest to compare the two data sets over a common sample period. This question is best handled within an econometric framework that models the statistical differences between the two data sets. This constitutes an important avenue for future research.

Finally, the SIPP panels provide a rich source of person-level information that has yet to be exploited fully. In particular, extensive longitudinal measures of individual labor force status are available at weekly frequency. In future work we intend to analyze this information more closely.

A   Appendix

A.1   Survey design

Each SIPP panel is formed from a nationally representative sample of individuals 15 years of age and older selected from households in the civilian noninstitutional population. These sampled individuals, along with others who subsequently live with them, are interviewed once every four months over the life of the panel. Each panel is randomly divided into four rotation groups, with each rotation group interviewed in a separate month. For a given panel, a set of interviews conducted for each of the four rotation groups constitutes one interview wave. At each interview respondents are asked to provide information about the previous four months.

Original sample members 15 years or older who move to another address are interviewed at the new address. If persons not previously in the survey join a respondent's household, they are interviewed for as long as they live with the original respondent.

Although the pre-1996 panels were designed to have eight waves of interviews, a number of panels were terminated early because of insufficient funding. In addition, the intended initial sample size of 20,000 households was rarely achieved.

The SIPP survey underwent a substantial redesign in 1996 to improve the quality of longitudinal estimates. The overlapping panel structure was eliminated in favor of a substantially larger sample size, and panel length was increased from 32 months to 48 months. In addition, computer-assisted survey techniques, such as dependent interviewing, were introduced.[9]

A.2 Survey content

The information necessary to calculate labor force flows is contained in the core content of the SIPP. At every interview the survey asks questions covering demographic characteristics, labor force participation, government program participation, amounts and types of earned and unearned income received (including transfer payments), noncash benefits from various programs, asset ownership, and private health insurance.[10] Most core data are measured on a monthly basis. Some core items are recorded only once per wave (e.g., race), while others are measured on a weekly basis (e.g., labor force status).

The Census Bureau publishes two types of SIPP microdata files: full panel files and core wave files. Core wave files are released following the completion of each survey wave and contain detailed labor force information and individual sampling weights. Full panel files are released only after completion of the entire panel. They contain edited and longitudinally consistent demographic information.[11] These panels contain one record for each person interviewed at any time during the panel; this forms the basis for defining a person's observations in the SIPP.

The full panel files are, in principle, sufficient for measuring worker transitions between

---

[9]Similar improvements were implemented in the CPS following its redesign in 1994.

[10]Westat (2001).

[11]The full panel is created by stripping any edited or imputed values from the core data, linking those data, and then applying a longitudinally consistent edit and imputation procedure to missing observations. See Westat (2001).

labor force states. Unfortunately, they have two major drawbacks. First, individuals'
records are indexed by reference month, not calendar date of the interview. Because
each rotation group begins in a different month, there is not a one-to-one correspondence
between reference month and calendar month within each panel file. Second, the full
panel files do not contain sufficiently detailed information on labor force classification and
sampling weight. Thus, we draw on additional data from the core wave files to construct
our gross flow measures.

We begin with the longitudinally consistent demographic data from the full panel files.
The necessary calendar date, detailed labor force information, and sampling weight are
then obtained from the core wave files. Individuals are matched longitudinally by sample
unit identifier, entry address identifier, and person number.[12]

A.3 Data construction

The sections below provide details on the construction methods for each set of panels.
Table 2 presents a summary of the SIPP panels used in this paper.

1984–1988 panels. The Census Bureau publishes full panel files for each of the five
panels in this period (1984, 1985, 1986, 1987, 1988). No full panel file is available for the
shortened 1989 panel, but few usable observations are lost by excluding it. The following
variables are taken from the full panel files: the three identification variables, rotation
group, interview status, sex, and age. The identification, rotation group, and sex variables
are constant across the panel for each person, but interview status and age can change in
each month.

The core wave files for this period have a "rectangular" structure (one observation
per person per wave) and must be reshaped to a person-month format (four observations
per person per wave). For each person, the following variables are taken from the core
wave files: the three identification variables, date, sampling weight, and three labor force
variables.

---

[12]In the 1996 nomenclature these variables are `ssuid`, `eentaid`, and `epppnum`.

Labor force status is determined by answers to three questions that are asked separately for each week:

1. Did this person have a job or business during this week of the reference period? (`wkwjob`);

2. Was this person with a job or business but without pay for this week of the reference period? (`wkwabs`);

3. Was this person looking for work or on layoff during this week of the reference period? (`wklook`).

A weekly labor force status variable consistent with CPS definitions is constructed according to the following rules. Together they partition the possible answers into three labor force states:

A person is *employed* if $wkwjob = 1$, or if $wkwjob = 0$ and $wkwabs = 1$;

A person is *unemployed* if $wkwjob = 0$ and $wklook = 1$;

A person is *not in the labor force* if $wkwjob = 0$ and $wklook = 0$.

The constructed labor force status variable and all other variables from the core wave files are then merged into the full panel file to create the dated time series for each person.

1990–1993 panels. Full panel files are also published for the 1990, 1991, 1992, and 1993 panels. The same seven variables are taken from the full panel files as in the previous panels. The core wave files for this period are published in person-month format and require no reshaping. The same five non-labor-force variables are taken from the core wave files. A change in the weekly labor force coding allows for direct extraction of the labor force recode variable.

The SIPP weekly employment status recode variable (`wkesr`) classifies persons into five states. The CPS-equivalent labor force status is given by:

A person is *employed* if $wkesr = 1$, 2, or 3;

A person is *unemployed* if $wkesr = 4$;

A person is *not in the labor force* if `wkesr = 5`.

The constructed labor force status variable and all other variables from the core wave files are then merged into the full panel file to create the dated time series for each person.

1996 and 2001 panels. No full panel files are published for the 1996 or 2001 panels. Instead, for 1996, "panel longitudinal" core wave files are published that have undergone the same procedure to ensure longitudinal consistency as the full panel files. Only core wave files are available for the 2001 panel. The weekly labor force classification is constructed using the same procedure as in the 1990–1993 panels.

A.4   Synthetic CPS classifications

The CPS classifies persons as employed, unemployed, and not in the labor force for the month based on their experiences during a specific reference week of that month. A comparable "synthetic" CPS labor force classification is obtained in the SIPP using the constructed weekly labor force status variable. The synthetic classification gives the closest possible measure to what a person would have been classified were he surveyed by the CPS.

As discussed in the preceding subsection, we constructed a variable measuring a person's labor force status for each week of the panel. The first step in creating the synthetic CPS labor force classification is to identify the CPS reference week for each month in the sample. The CPS reference week is defined as the seven-day period, Sunday through Saturday, that includes the 12th of the month. In December, the week of the 5th is used as the reference week, provided that the week falls entirely within the month; otherwise the week containing the 12th is used as the reference week.[13]

After identifying the CPS reference week for each month, we use our weekly SIPP labor force status variable to determine the individual's CPS labor force classification. A person's synthetic CPS labor force classification for the month is the value of our constructed SIPP labor force status variable in the CPS reference week. For example, in June 1992 the 12th of the month fell in the 2nd week of June; thus the CPS labor force

---

[13]Bureau of Labor Statistics (2002).

classification for June is determined using our labor force status variable for week 2.

The synthetic CPS classification is more difficult to construct for the pre-1990 panels. The core wave files before 1990 organize the weekly information chronologically for the entire wave (i.e. `wkwjob1`, `wkwjob2`, `wkwjob4`, ..., `wkwjob18`). However, because each rotation group begins in a different month, `wkwjob1` for rotation group 1 does not represent the same calendar week as `wkwjob1` for rotation group 2. Thus a correspondence between SIPP reference week and calendar week must be determined separately for each rotation group.[14]

Consider the following example. In wave 1 of the 1986 panel, rotation group 1 is first surveyed in January 1986 and asked questions for the reference period beginning in October 1985. The CPS reference week for October 1985 is week 2, so the synthetic CPS labor force classification is determined by the SIPP labor force status for week 2. The CPS reference week for the next month, November 1985, is also week 2, but the synthetic CPS labor force classification for November 1985 is determined by week 7 (since October has five weeks plus the two weeks until the reference week). Following the same procedure, the resulting synthetic CPS labor force classifications for this wave are determined by labor force variables for weeks 2, 7, 10, and 16.

Now consider rotation group 3 from wave 1 of the 1986 panel. They are first surveyed in March 1986 and asked questions for the reference period December 1985–March 1986. Using the procedure described, the synthetic CPS labor force classifications for rotation group 3 of wave 1 are given by the SIPP labor force status for weeks 1, 7, 11, and 15.

After constructing the synthetic CPS monthly labor force classification for all persons, we compute SIPP gross flows using the methods described in Fujita and Ramey (2006). As in FR, we restrict the sample to persons aged sixteen and older.

---

[14]Identifying this correspondence is further complicated because several waves have only three rotation groups.

A.5   Aggregation

Next we aggregate the data across different panels to create a continuous time series. Two additional issues arise at this stage. The first is that, within the same panel, not all months have the same number of observations. The second concerns the statistical treatment of overlapping panels. Both issues relate to sampling precision.

The SIPP survey design calls for one rotation group (a quarter of the sample) to be interviewed in each month of the four-month wave. Although each rotation group is interviewed the same number of times in the panel, the observations span a different set of calendar months because each rotation group enters the panel in a different month. The relationship between calendar month and rotation group is shown for the 1985 panel in Table 3.

Thus, although each person (theoretically) has the same number of monthly observations, not all calendar months have the same number of observations. In particular, the first and last three months of every panel do not have observations from all four rotation groups (see rows 1–3 and 13–15 in Table 3).

Because each panel is nationally representative and because persons are randomly assigned to rotation groups, estimates calculated from only one rotation group should have the same expected value as those calculated from all four. In principle, the only difference is one of sampling precision. There may, however, be some small-sample bias introduced by using months without all four rotation groups. We therefore use only months for which all four rotation groups are in the sample ("full rotation groups"). This truncates the date range of each panel by three months at the beginning and end of each panel.

The second problem, overlapping panels, also is one of precision. Prior to the 1996 panel, the same calendar month may contain observations from two or more different panels. The sample for each panel is independent of that for all other panels, so observations from different panels can, in principle, be combined to create more precise estimates. We do this.

16

A.6   Sample sizes and sample breaks

Figure 5 displays the sample size for each month in our SIPP data after pooling observations across all panels. The dark blue bars in the foreground show the number of observations after eliminating months without four rotation groups. The light gray bars in the background show the totals for all observations.

Looking first at the gray series, Figure 5 shows the seven-month gap in the SIPP data from March–October 2000. When restricting the sample to only full rotation groups, several other breaks in the series arise. The restricted sample covers September 1983–September 2003, with the following breaks.

Gap begin	Gap end	No. of months
1989m10	1989m12	3
1995m10	1996m02	5
1999m12	2000m12	13

To deal with these breaks in the time series, we follow FR and use a procedure called TRAMO (Time Series Regression with ARIMA Noise, Missing Observations and Outliers) developed by Victor Gómez and Augustín Maravall.[15] This procedure parameterizes each series as an ARIMA process. Estimation of the missing observations is performed by a "skipping" approach. This carries out a maximum likelihood estimation of the process by skipping the missing observations and then uses the fixed point smoother for interpolation of the missing values.

---

[15]See Gómez and Maravall (1997, 1999) for details.

References

John Abowd and Arnold Zellner. Estimating gross labor force flows. *Journal of Business and Economic Statistics*, 3:254–83, July 1985.

Marianne Baxter and Robert King. Measuring business cycles: Approximate band-pass filters for economic time series. *Review of Economics and Statistics*, 81(4):575–593, November 1999.

Steven Davis. Comments on "Job loss, job finding, and unemployment in the U.S. economy over the past fifty years" by Robert E. Hall. *NBER Macroeconomics Annual 2005*, 2005.

Michael Elsby, Gary Solon, and Ryan Michaels. The ins and outs of cyclical unemployment. *NBER Working Paper No.12853*, January 2007.

Shigeru Fujita and Garey Ramey. The cyclicality of job loss and hiring. *Federal Reserve Bank of Philadelphia Working Paper 06-17, UC San Diego Discussion Paper 06-08*, 2006.

Shigeru Fujita and Garey Ramey. Reassessing the Shimer facts. *Federal Reserve Bank of Philadelphia Working Paper 07-02*, 2007.

Victor Gómez and Augustín Maravall. Programs TRAMO and SEATS, instructions for the user. November 1997. Banco de España.

Victor Gómez and Augustín Maravall. Missing observations in ARIMA models: Skipping approach versus additive outlier approach. *Journal of Econometrics*, 88:341–363, 1999.

Peter Gottschalk and Robert Moffitt. Changes in job instability and insequrity using monthly survey data. *Journal of Labor Economics*, 17(4-2), October 1999.

Robert Hall. Job loss, job finding, and unemployment in the U.S. economy over the past fifty years. pages 275–310, 2005a.

Robert Hall. Employment efficiency and sticky wages: Evidence from flows in the labor market. *Review of Economics and Statistics*, 87(3):397–407, August 2005b.

Éva Nagypál. Reallocation over the business cycle: The importance of job-to-job transitions. July 2004. Draft, Northwestern University.

Bureau of Labor Statistics. Current Population Survey: Design and methodology. *Technical Paper 63RV.*, 2002. U.S. Census Bureau: Washington, D.C.

Robert Shimer. Reassessing the ins and outs of unemployment. June 2005a. Draft, University of Chicago.

Robert Shimer. The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review*, 95(1):25–49, March 2005b.

Gary Solon. Effects of rotation group bias on estimation of unemployment. *Journal of Business and Economic Statistics*, 4(1):105–109, January 1986.

Westat. *Survey of Income and Program Participation Users Guide.* U.S. Census Bureau: Washington, D.C., third edition, 2001.

Eran Yashiv. Evaluating the performance of the search and matching model. *European Economic Review*, 50(4):909–936, May 2006a.

Eran Yashiv. U.S. labor market dynamics revisited. *IZA dicussion paper 2445*, November 2006b.

Table 1: Standard deviations of cyclical components of worker flows ($E \leftrightarrows U$)

Data source	Job loss	Hiring
Total flows		
SIPP	0.097	0.074
CPS	0.047	0.034
Hazard rates		
SIPP	0.099	0.062
CPS	0.053	0.069

Notes: Calculated from logged and band-pass filtered data. Sample period for the SIPP data: Sept. 1983 - Sept. 2003. Sample period for the CPS data: Jan. 1976 - Dec. 2005.

Table 2: Summary of SIPP panels, 1984–2001

| Panel	Initial interview	Final interview	Initial sample size[a]	Final sample size[a]	No. of waves
1984	1983m06	1986m07	53,726	41,807	9[b]
1985	1984m10	1987m07	36,114	29,706	8[c]
1986	1985m10	1988m03	30,566	29,558	7[d]
1987	1986m10	1989m04	30,770	30,109	7
1988	1987m10	1989m12	31,051	31,035	6
1989[e]	1988m10	1989m12	31,158	32,343	3
1990	1989m10	1992m08	58,149	54,165	8
1991	1990m10	1993m08	37,424	34,905	8
1992	1991m10	1994m12	51,235	46,453	9
1993	1992m10	1995m12	51,995	46,025	9
1996	1995m12	2000m02	95,141	73,205	12
2001	2000m10	2003m12	90,260	65,883	9

Notes: a: Includes all rotation groups. b: Waves 2 and 8 have only 3 rotation groups. c: Wave 2 has only 3 rotation groups. d: Wave 3 has only 3 rotation groups. e: Data not used in analysis.

Table 3: Relationship between survey wave, rotation group, and calendar date, 1985 panel

| Date	Rotation group			
	1	2	3	4
1984m10	w1–1			
1984m11	w1–2	w1–1		
1984m12	w1–3	w1–2	w1–1	
1985m01	w1–4	w1–3	w1–2	w1–1
1985m02	w2–1	w1–4	w1–3	w1–2
1985m03	w2–2	w2–1	w1–4	w1–3
1985m04	w2–3	w2–2	w2–1	w1–4
...	...	...	...	...
1987m01	w8–1	w7–4	w7–3	w7–2
1987m02	w8–2	w8–1	w7–4	w7–3
1987m03	w8–3	w8–2	w8–1	w7–4
1987m04	w8–4	w8–3	w8–2	w8–1
1987m05		w8–4	w8–3	w8–2
1987m06			w8–4	w8–3
1987m07				w8–4

Notes: wn–m indicates wave n, month m.

Figure 1: Data, 12-month moving averages ($E \leftrightarrows U$)
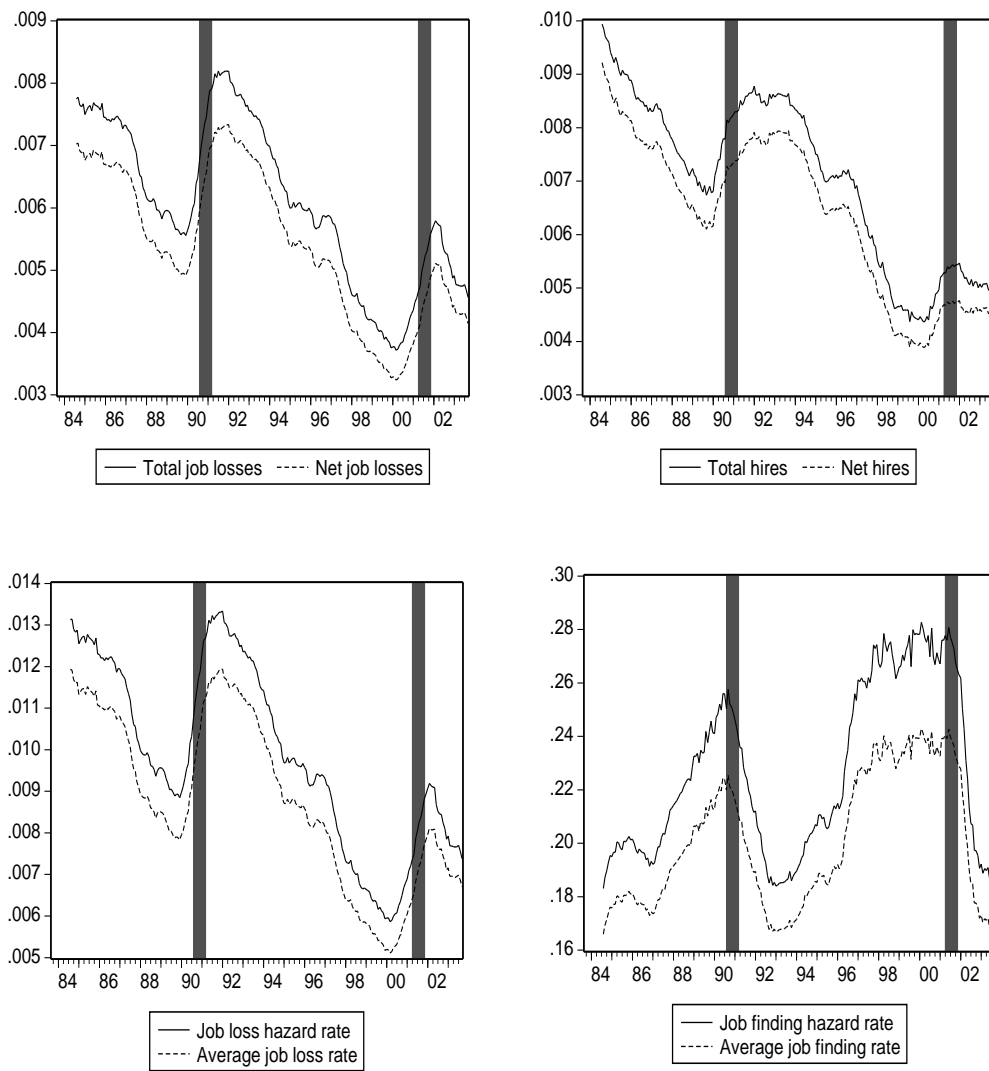
Notes: 12-month backward moving averages of non-seasonally adjusted data. Expressed as a fraction to civilian noninstitutional population of 16 and older.

Figure 2: Data, cyclical components ($E \leftrightarrows U$)
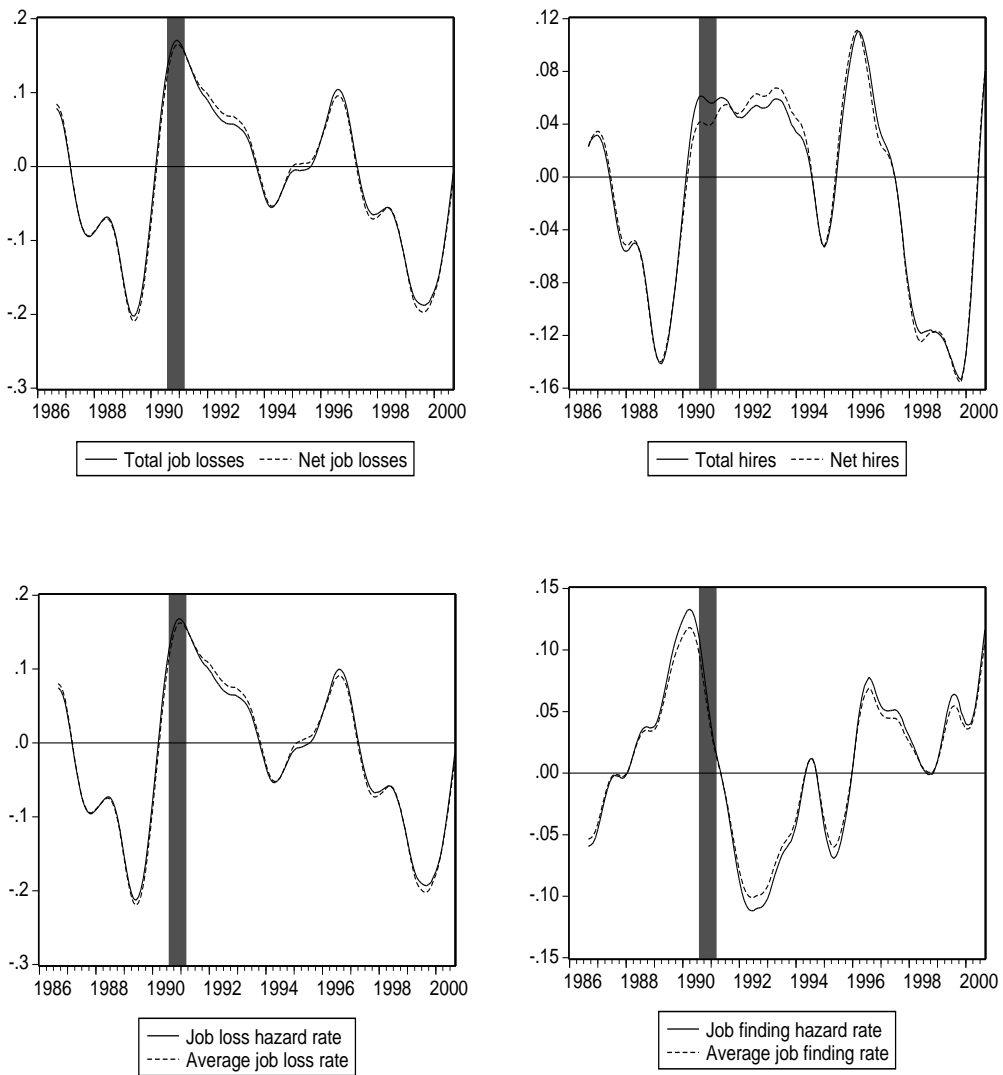
Notes: Logged and band-pass filtered by Baxter and King's (1999) method. Periodicities of 15-96 months are passed.

Figure 3: Cross correlations with industrial production ($E \leftrightarrows U$)
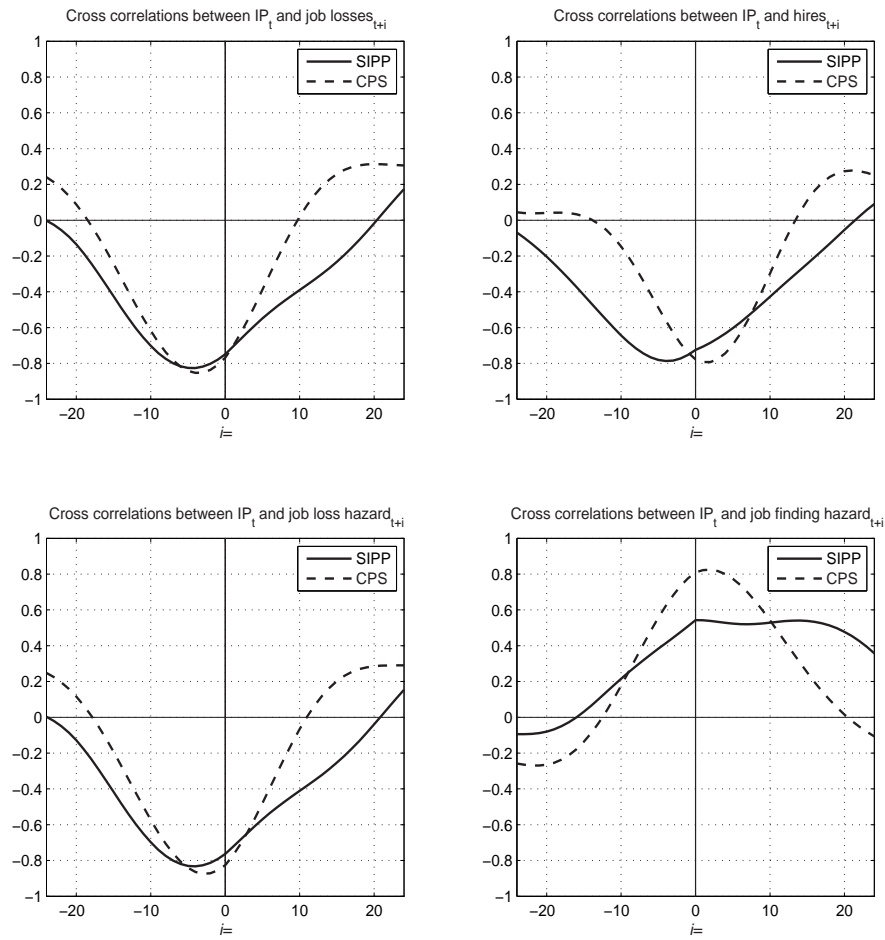

Notes: Based on logged and band-pass filtered data. Cross correlations of CPS data are based on the series constructed by Fujita and Ramey (2006). Sample period for the SIPP data: Sept. 1983 - Sept. 2003. Sample period for the CPS data: Jan. 1976 - Dec. 2005.

Figure 4: Cross correlations with the unemployment rate ($E \leftrightarrows U$)
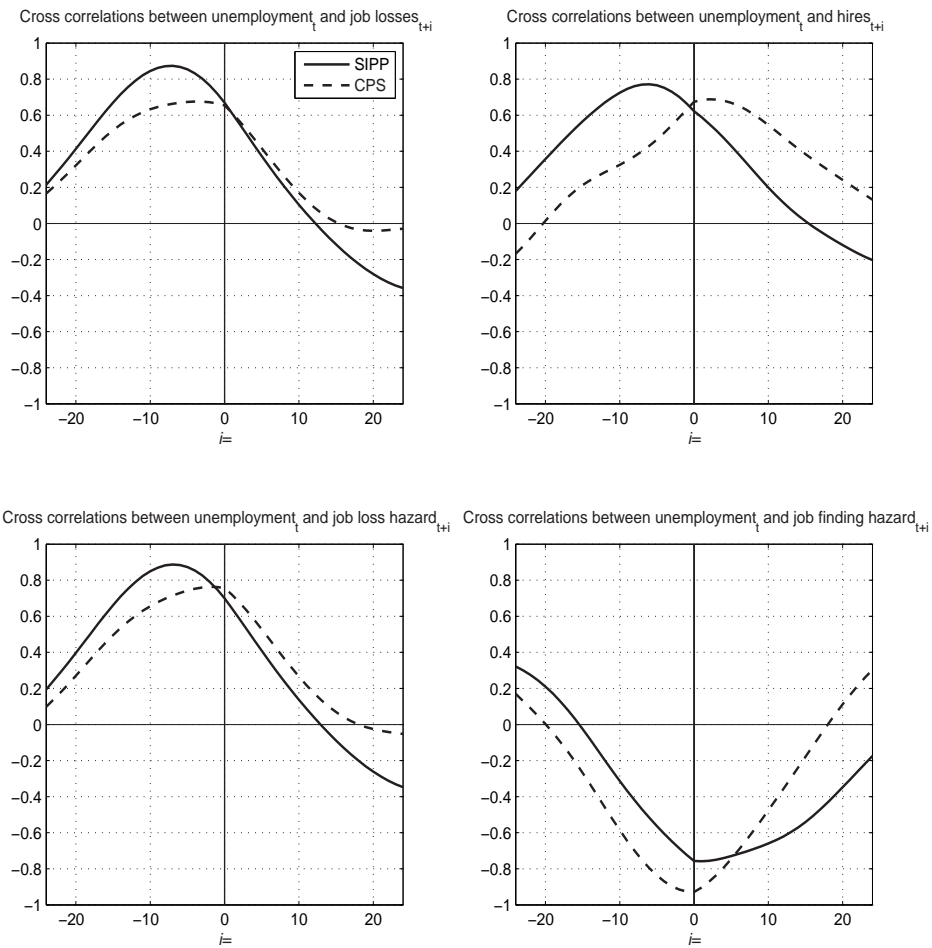
Notes: Based on logged and band-pass filtered data. Cross correlations of CPS data are based on the series constructed by Fujita and Ramey (2006). The CPS official unemployment rate is used for the cyclical indicator. Sample period for the SIPP data: Sept. 1983 - Sept. 2003. Sample period for the CPS data: Jan. 1976 - Dec. 2005.

Figure 5: SIPP sample sizes
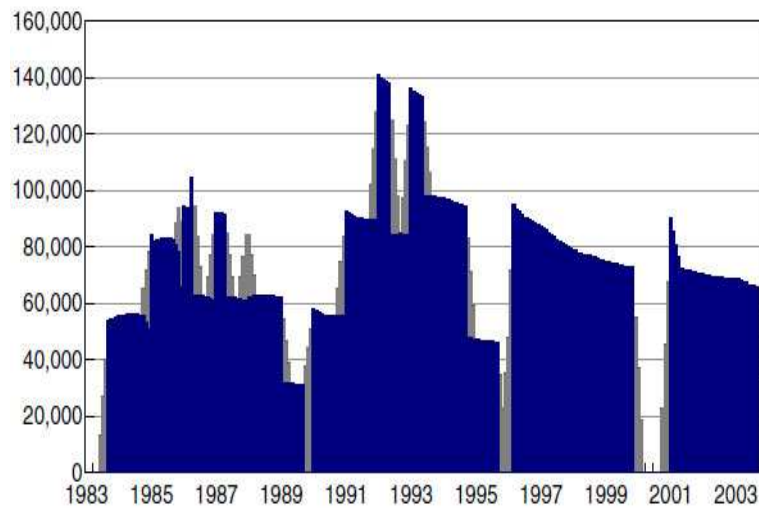
Notes: The dark blue bars in the foreground show the number of observations each month after eliminating months without four rotation groups. The light gray bars in the background show the totals for all observations.