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Keywords: Unemployment dynamics; Gross worker flows; Job finding rate; Separation rate
JEL classification: E24; E32; J6

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This paper studies worker flows dynamics in Japan for the period between 1980 and 2009. We construct gross worker flows data from the monthly Labour Force Survey. Our data enables us to examine the size and cyclical patterns of the flows and transition rates between the states of employment, unemployment, and not-in-the labor force. We find that the cyclical pattern of worker flows is similar to that found in other countries, while worker flows in Japan are generally smaller than those in the U.S. and European countries. We also decompose changes in unemployment into contributions due to changes in unemployment inflow and outflow rates. We find that both inflow and outflow rate play an important role to account for variation in the unemployment rate in Japan.

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1 Introduction

The behavior of worker flows is crucial to understanding of labor market dynamics. Workers move between the states of employment, unemployment, and not-in-labor force. These movements of workers determine aggregate labor market indicators, such as unemployment and employment. Worker transitions are also an important determinant of unemployment and employment fluctuations over business cycles. While the size and the cyclical pattern of gross worker flows has been studied in the U.S. and European countries, there are a few studies on the Japanese worker flows.[1] In this paper we establish a set of stylized facts on worker flows and unemployment dynamics in Japan.

In the first part of our analysis, we establish a set of stylized facts on worker flows in the Japanese labor market. To do this, we construct worker flows data from the Labour Force Survey (LFS) over past 30 years. Using the panel property of the LFS, we estimate monthly worker flows showing transition between labor market states: employment, unemployment, and not-in-labor force. By using this worker flow data, we can examine the size and cyclical pattern of the worker flows and transition rates.

Based on the data set, this study documents key stylized facts on worker flows and associated transition rates in Japan. The data show large gross worker flows across labor market status. We find that around 3% of the working-age population change labor market state in each month. The cyclical pattern of gross worker flows is similar to that found in U.S. and European countries. Inflows and outflows of unemployment are countercyclical and flows between employment and inactivity are procyclical. We find that the transition rate from employment to unemployment is countercyclical, while the transition rate from unemployment to employment is procyclical. Transition rates between employment and unemployment in Japan are much lower than those in the U.S. In Japan, the monthly job finding and separation rates are about 14% and 0.4%

[1]Following the pioneer work of Blanchard and Diamond (1990), a number of studies examine the size and cyclicality of gross worker flows in the U.S. See Bleakley, Ferris and Fuhrer (1999), Davis and Haltiwanger (1999), Hall (2005a), Shimer (2007), and Finegan, Penaloza, and Shintani (2008). Yashiv (2007) provides a survey of the recent literature on U.S. labor market dynamics. Burda and Wyplosz (1994) document a series of stylized facts for gross worker flows in Europe. Pissarides (1986), Bell and Smith (2002), Burgress and Turon (2005), and Gomes (2009) focus on the U.K.

respectively, while they are around 25-32% and 3-5% in the U.S.[2]

In the second part of our analysis, we study how much of the observed unemployment fluctuations can be accounted by variation in unemployment inflow and outflow rate. In the recent literature, a number of studies decompose variation in the unemployment rate into contributions due to changes in unemployment inflow and outflow rates under the assumption that the actual unemployment rate is approximated by its steady state value (Elsby, Michaels and Solon, 2009; Fujita and Ramey, 2009; Petrongolo and Pissarides, 2008; Shimer, 2007). While this steady-state assumption holds in the US, we find that the unemployment rate considerably deviates from its steady state value in Japan.[3] This suggests that the steady-state decomposition may lead to misleading results. Therefore, in this study we decompose unemployment fluctuations into the contributions attributed to changes in inflows and outflows by using two alternative methods: the conventional steady-state decomposition method and the non-steady state decomposition method developed by Smith (2010), which allows for deviations of the actual unemployment rate from its steady-state value.

This study demonstrates that both inflow and outflow rates contribute substantially to unemployment fluctuations in Japan. The non-steady state decomposition reveals that the change in inflow rate accounts for about 54% of unemployment fluctuations and the change in outflow rate accounts for about 40% of it. We find that the result of the steady-state decomposition is not significantly different from that of the non-steady state decomposition, although the steady-state decomposition overestimates the contribution of unemployment outflows to unemployment fluctuations. This finding suggests that understanding of unemployment dynamics in Japan requires an understanding of the determinants of both the inflow rate and the outflow rate. Furthermore, we find that the relative importance of inflow and outflow rates to unemployment fluctuations changes over time.

This paper provides a systematic study of worker gross flows in Japan along the lines of Blanchard and Diamond (1990) and Bell and Smith (2002). There are relatively few studies that examine the size and the cyclicality of both the gross flows and the associated transition rates in

[2]The monthly job finding and separation rates in the U.S. are taken from Yashiv (2007).

[3]Shimer (2007) demonstrates that the actual unemployment rate is closely approximated by its steady-state value in the U.S. Elsby, Hobijn and Şahin (2009) show that the actual unemployment rate is virtually identical to the steady-state unemployment rate for the U.S.

Japan. Kuroda (2003) examines factors contributing to a rise in the unemployment rate in 1990s by using the flow data. Ohta and Teruyama (2003a) estimate gross worker flows and flow probabilities for each age group. They find that the flow probability from employment to unemployment for young workers rises in 1990s, while the probability from unemployment to employment for old workers falls. Sakura (2006) studies the cyclical pattern of worker flows by using structural vector auto-regression model. Ohta, Genda, and Teruyama (2008) document the size and cyclicality of gross worker flows in their survey of Japanese unemployment after the 1990s. Sasaki (2008) calculate inflow and outflow rates of unemployment by using the administrative data.

This study is also related to the recent literature on unemployment dynamics. A number of studies examine the contributions of changes in inflow and outflow rates to unemployment variation. Hall (2005b) and Shimer (2007) claim that the inflow rate of unemployment is acyclical and the unemployment outflow rate is an important driving force for unemployment fluctuations in the U.S. Reacting this, Elsby, Micheals and Solon (2009) and Fujita and Ramey (2009) provide evidence for countercyclical movements in unemployment inflows and demonstrate that both inflow and outflow rate are important in accounting for unemployment fluctuations in the U.S. For the European countries, Petrongolo and Pissarides (2008) and Elsby, Hobijn and Sahin (2009) find that changes in inflow and outflow rates contribute substantially to unemployment variation. The contribution of this study is that it provides evidence for Japan using different decomposition methods proposed in the literature.

The remainder of the paper is organized as follows. In Section 2, we describe the data construction. Section 3 presents some of the salient features of the Japanese worker flows. In section 4, we conduct cyclical analysis of the data. In Section 5, we study the relative importance of changes in unemployment inflow and outflow rates to unemployment fluctuations. Conclusions are presented in Section 6.

2 The data

The data are constructed from the monthly Labour Force Survey (LFS) conducted by the Statistics Bureau and the Director-General for Policy Planning.[4] The LFS is a rotating panel in which each household participates in a sample for four consecutive months, leaves the sample for the following eight months, and joins the sample for four months in the following year. The half of the sample households is replaced every month and thus the half of the sample is surveyed over two consecutive months. In the LFS, an individual is classified into three categories: employed (E), unemployed (U), and not in the labor force (I). Flows between these states are to be denoted by two consecutive capital letters. For example, EU is the worker flows from employment to unemployment. By matching workers across the two months, the six gross flows can be constructed. Specifically, these six gross flows are those between employment and unemployment, between employment and not-in-labor force, and between unemployment and not in labor force (henceafter inactivity).

Monthly flows rates are calculated as the sum of the relevant flows between period $t-1$ and t divided by the sum of the number of observations on the relevant status at $t-1$. For example, the flow rate from unemployment to employment is obtained by

$$\frac{UE_t}{U_{t-1}} = \frac{UE_t}{UE_t + UU_t + UI_t},$$

where UE_t is the gross flows from unemployment to employment and U_{t-1} is the measured stocks of unemployed workers. Let λ^{XY} be the transition rate from state $X \in \{E, U, I\}$ to another state Y. We assume that actual worker transitions are constant during the month and compute continuous-time transition rates. For example, the transition rate from unemployment to employment is calculated by $\lambda_t^{UE} = -\ln(1 - UE_t/U_{t-1})$.

Due to sample rotation, missing observations, and errors in responses, transition information of a substantial subset of the sample is not available.[5] This failure to match individual workers across months is referred to as margin error. Because of the margin error, the stocks that are obtained

[4]The data for the period after 2000 are released from the website of the Japanese Ministry of Internal Affairs and Communications, http://www.stat.go.jp/. However, the data from the period before 2000 are not released through the website or other statistical books. We can obtain these data at the statistical library in the Ministry of Internal Affairs and Communications.

[5]The effect of missing observations and misclassification error has been studied by Abowd and Zellner (1985) and by Poterba and Summers (1998) using the Current population Survey in the US.

by adding flow data is not consistent with the officially reported stocks of workers. We correct the margin error using the adjustment method of Ministry of Labour (1985).[6] After correcting the margin error, we seasonally adjust the series using the Census Bureau's X12 filter. Then, In order to remove excess volatility that may stem from measurement errors, these monthly series are converted to quarterly frequency by simple averaging. The sample covers 1980Q1-2009Q4.

There is also the problem of time aggregation. If an individual finds and loses a job within the period, these transitions across states are suppressed in discrete data and underlying instantaneous transition rates will be biased. For example, if a worker loses job and finds another job within the period, in the continuous time framework, both these transitions are recorded. In contrast, in the discrete time, the former separation is missed, leading to a negative bias in the separation rate. We correct the data for time aggregation bias when we study the cyclical properties of the gross flows data (see Section 5).

3 Worker flows in Japan

In this section, we present some of the salient features of the Japanese worker flows data. Figure 1 summarizes the average worker flows and transition rates in the sample period 1980-2009. It reports gross worker flows between employment, unemployment, and inactivity in thousand (flows) and associated transition rates (rate). It also reports the average net change of the stock of employment, unemployment, and inactivity.

Figure 1 reveals large gross worker flows across labor market status. The data in Figure 1 show that around 3% of the working-age population change labor market state in each quarter. This is relatively low compared with the U.S. where around 6% of the working-age population change status every month. The striking feature of the data is the size of the gross flows compared to the net flows. For example, over the sample period, unemployment increases by an average

[6] In order to reduce the discrepancies between the officially reported stocks of workers and the stocks of workers constructed from the flow measures, first we replace the latter stock values by the former officially reported stocks of workers. Then, by using an allocation pattern of flow measures in the uncorrected data, we calculate each component of gross flows. See Ministry of Labour (1985) for details of the adjustment method. By using the Labour Force Survey, Kuroda (2003), Ohta and Teruyama (2003a, 2003b), Sakura (2006), Ohta et. al. (2008) also construct the worker flows data.

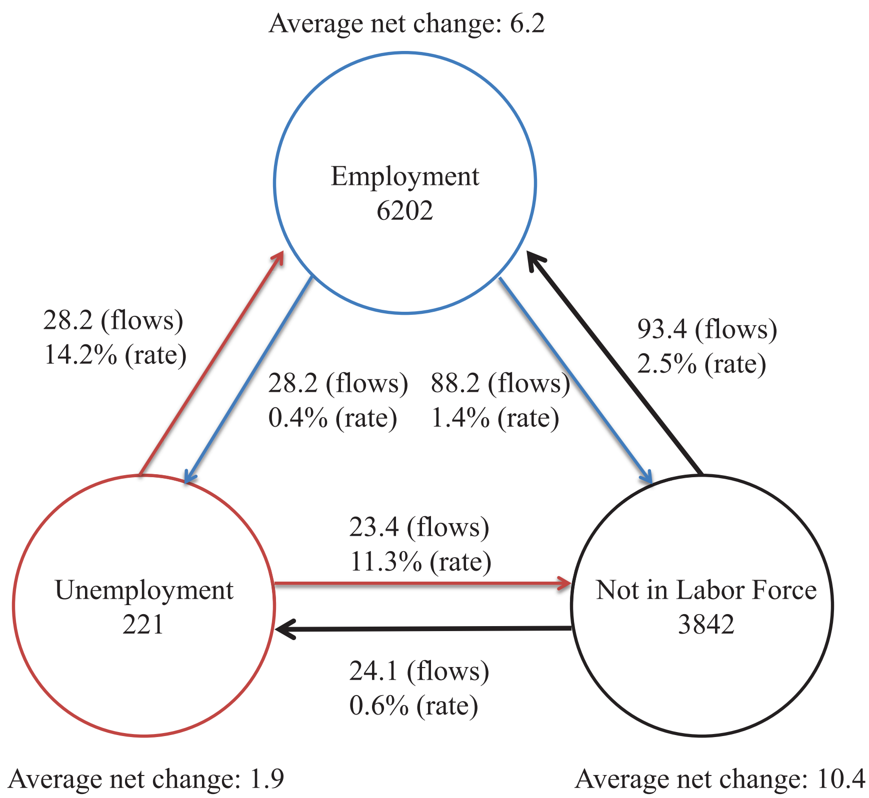

Figure 1: Average gross worker flows and transition rates, 1980-2009

Note: the worker stocks and flows are expressed in thousands. See the text for the definition of a transition rate.

of 1,900 per month. However, we can see that on average about 52 thousands individuals enter the unemployment pool and about the same numbers leave it every month. This is an important observation since it uncovers that large worker flows lie behind the relatively small change in stocks of unemployment.

The stocks of employment and inactivity are sizable. Employment and inactivity average about 62 million and 3.8million and they constitute about 60% and 37% of the total working-age population, respectively. The flows between these two states are also large. On average about 121 thousands individuals become employed and about 116 thousands workers leave the employment pool. Among them, the inflows and outflows of not-in-labor force are substantial, and they are much larger than the flows into and out of unemployment. This implies that the inactivity is an important source of labor supply.

The monthly job finding and separation rates are 14.2% and 0.4%, respectively. These transition rates between employment and unemployment in Japan are much lower than those in the U.S. According to Yashiv (2007), in the U.S., the job finding rate is around 25-32% and the separation rate is 3-5%.

Table 1: Gross worker flows for Japan, the U.S., and the U.K.

Country	*EU*	*EI*	*UE*	*UI*	*IE*	*IU*	Total
Japan	0.3	0.9	0.3	0.2	0.9	0.2	2.8
US	0.8	1.7	1.0	0.8	1.5	0.6	6.5
UK	0.4	0.5	0.5	0.3	0.4	0.4	2.5

Note: gross worker flows are expressed as a percentage of the working-age population. The sample period covers 1980-2009. The monthly values for the U.S and the U.K. are taken from Beakley, Ferris, and Fuhrer (1999) and Gomes (2009), respectively.

Table 1 compares the monthly gross worker flows for Japan with those for the U.S. and the U.K. The monthly values for the U.S and the U.K. are taken from Beakley, Ferris, and Fuhrer (1999) and Gomes (2009), respectively. We report the flows as a percentage of the working-age population. Table 1 shows that the size of gross worker flows in Japan is similar to those in the U.K. and much smaller than those in the U.S.

3.1 Evolution of worker stocks and flows

Figure 2 shows the evolution of the employment rate, the unemployment rate, and the inactive rate in the Japan over the past 30 years.[7] The employment rate has been relatively stable around 62 % until the early 1990s but it declined gradually. The unemployment rate has been significantly low until 1997 and its average was about 2.5%. Then, it has increased gradually and exceeded 5% in 2001. The inactivity rate has been stable and flat until the end of 1990s and then has increased.

Figure 3 displays the workers flows between the three pools, employment, unemployment, and inactivity. We start to see the flows into and out of the unemployment pool. The gross flows from employment to unemployment (EU-flows) and the gross flows from unemployment to employment (UE-flows) displayed considerable variations. EU and UE flows have increased steadily since the early 1990s. While the UE flows exceeds the EU flows in 1980s, the EU flows exceeds the UE flows after 1990s. This contributed to higher unemployment rate in 1990s and 2000s. If we interpret the size of the gross flows as a proxy for labor market flexibility, we could say that the Japanese labor market has become more flexible in 1990s and 2000s than 1980s.

The gross flows from inactive to unemployment (IU flows) and the gross flows from unemployment to inactive (UE flows) have increased in 1990s and exceeded 40,000 in the early 2000s and then declined gradually. While the IU flows exceeded the UI flows in 1980s, the UI flows exceeded to the IU flows after 1990s. This implies that in 1990s unemployed workers are likely to become inactive and it prevented the unemployment rate from increasing. Thus, in 1990s, we can observe the so-called discourage workers effect in Japan. In 1990s, flows into unemployment from employment increased, while flows from unemployment to inactive increased due to the discourage workers effect. It seems that unemployment increased in 1990s because the former effect is stronger than the latter effect.

Figure 4 shows the transition rates between the three states. The job finding rate, the transition rate from unemployment to employment, fell in 1990s, while the separation rate, the transition rate from employment to unemployment, increased. The transition rate from inactivity to employment has decreased gradually over time. This downward trend is due to a decrease in the ratio of new

[7] The employment rate is defined as the ratio of employment (E) to the working-age population ($E + U + I$). The unemployment rate is defined as the ratio of unemployment (U) to the labor force ($E + U$). The inactivity rate is defined as the ratio of inactivity (I) to the working-age population.

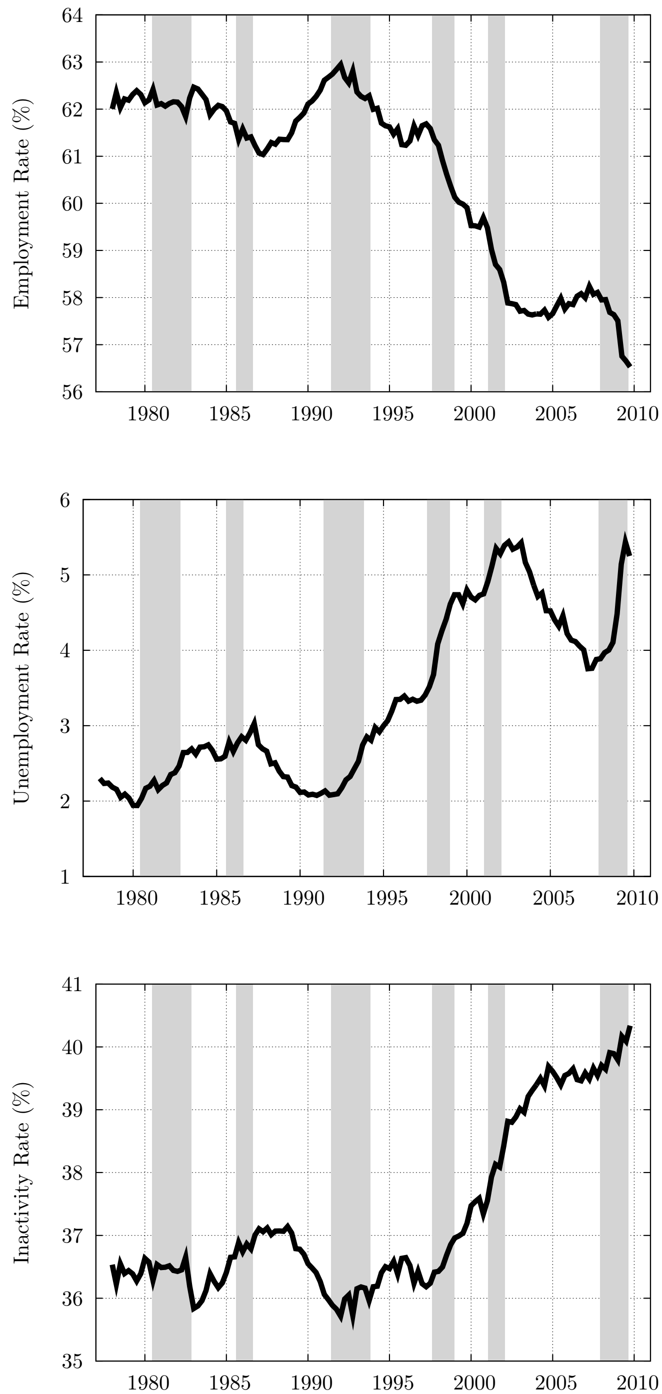

Figure 2: Labor Market Stocks

Note: The employment rate is defined as the ratio of employment to the working-age population. The unemployment rate is defined as the ratio of unemployment to the labor force. The inactivity rate is defined as the ratio of inactivity to the working-age population. Sample covers 1980Q1-2009Q4. Shaded areas indicate ESRI-dated recessions.

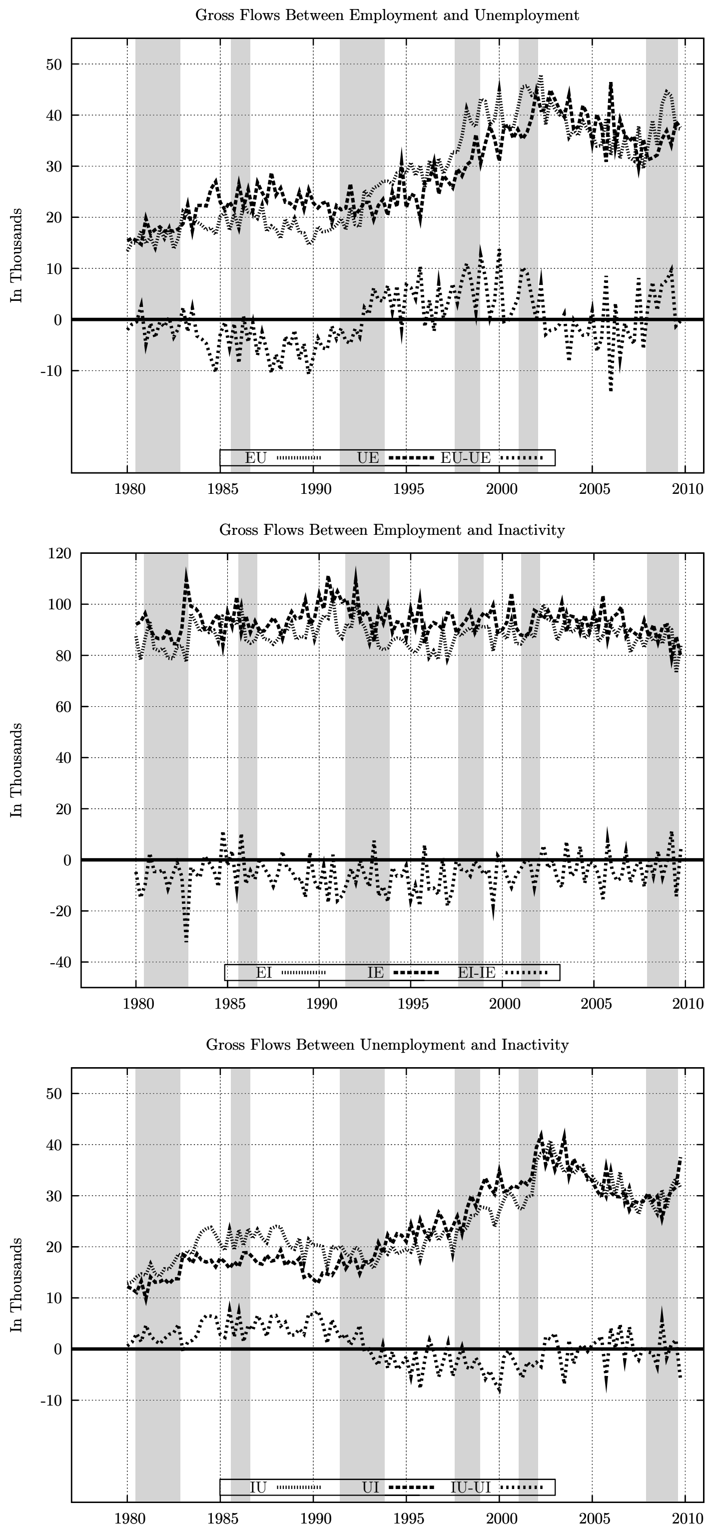

Figure 3: Labor Market Gross Flows

Note: Sample covers 1980Q1-2009Q4. Shaded areas indicate ESRI-dated recessions.

graduate employment to inactivity.

Based on these figures, we find that an rise in the unemployment rate in 1990s and the recent recession is not cause by an increase in inflows to unemployment and a decrease in outflows from it. Rather, behind the rise in the unemployment rate, both inflows to and outflows from unemployment increase. Such rising unemployment rate is attributed to a fall in the job finding rate and an increase in the job finding rate.

4 Cyclical properties of the data

In this section, we study the cyclical properties of gross worker flows and transition rates. To beging with, we compute their correlation with the level of economic activity. We use the real GDP as an indicator of the business cycle. To obtain the cyclical components of the data, we use three alternative detrending methods: the Hodrick-Prescott (HP) filter with the standard smoothing parameter ($\lambda = 1,600$), with a low frequency filter ($\lambda = 10^5$), and the Baxter-King (BK) band-pass filter.[8] Table 2 reports correlations and relative standard deviations of a relevant variable with real GDP.

Inflows and outflows of the unemployment pool are counter-cyclical.[9] This result implies that the flows into and out of the unemployment pool increase in recessions. The counter-cyclicality of EU and IU flows are intuitive. In recessions, more employed workers lose their jobs and more of inactive persons start searching for jobs due to the "added-workers effect". In contrast, the counter-cyclicality of the UE flows may seem counterintuitive. This means that flows from unemployment to employment increase in recessions. This results can be explained by the following way. The UE flows are determined by the job finding rate and a number of unemployed workers, i.e., $UE = \lambda^{UE} \times U$. In recessions, the job finding rate falls and unemployed workers rises. Since the latter effect dominates the former effect, the flow from unemployment to employment rises in recessions. Gross worker flows between employment and inactivity are procyclical. However, their correlations

[8] Following Baxter and King (1999) and Stock and Watson (1999), we use a standard decomposition of the frequency band. Thus, we isolate cycles with period lengths of between 6 and 32 quarters which is the typical length of U.S. business cycles.

[9] Here inflows of unemployment include EU and IU flows, and outflows of unemployment is the sum of UE and UI flows.

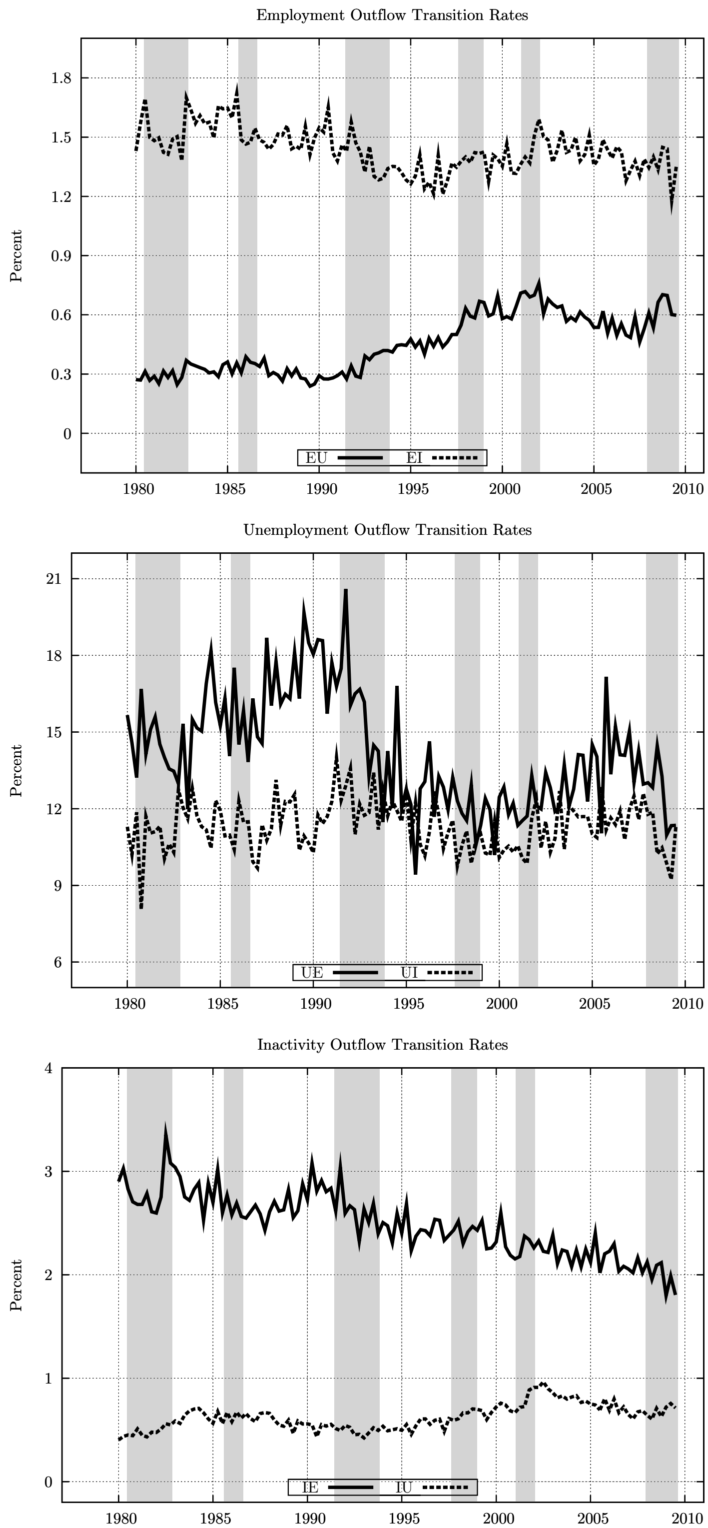

Figure 4: Labor Market Transition Rates

Note: Sample covers 1980Q1-2009Q4. Shaded areas indicate ESRI-dated recessions.

Table 2: Business cycle properties of worker flows and transition rates

	HP $(1,600)$		HP (10^5)		BK	
1980Q1-2009Q4	ρ	σ/σ_y	ρ	σ/σ_y	ρ	σ/σ_y
UE	-0.27	6.02	-0.42	4.57	-0.34	3.90
IE	0.07	3.52	0.08	1.79	0.28	2.20
EU	-0.46	6.28	-0.67	4.92	-0.54	7.80
EI	0.08	3.88	0.07	1.98	0.14	2.55
UI	-0.27	6.02	-0.42	4.57	-0.34	3.90
IU	-0.19	5.39	-0.38	4.94	-0.25	5.23
λ^{UE}	0.23	5.72	0.50	3.85	0.55	4.13
λ^{IE}	0.10	3.57	0.21	1.94	0.31	2.34
λ^{EU}	-0.49	6.31	-0.71	5.01	-0.77	5.46
λ^{EI}	0.00	3.34	-0.05	2.04	0.06	2.51
λ^{UI}	0.16	4.84	0.31	2.75	0.08	3.27
λ^{IU}	-0.17	5.33	-0.39	4.77	-0.23	5.19

Note: y is real GDP. σ is the standard deviation of the relevant variable. λ^{XY} is the transition rate from state $X \in \{E, U, I\}$ to another state Y. All variables are logged, and then they are filtered using the Hodrick-Prescott filter (with smoothing parameter $1,600$ or 10^5), or the Baxter-King filter.

are low and it seems that these flows are less sensitive to business cycle.

The job finding rate λ^{EU} and transition rates from inactivity to employment λ^{IE} and from unemployment to inactivity λ^{UI} are procyclical. The separation rate λ^{UE} and the transition rate from inactive to unemployment λ^{IU} are counter-cyclical. The pro-cyclicality of the job finding rate implies that in the boom, it is relatively easier for unemployed workers to find jobs. The counter-cyclicality of IU transition rate implies that in the recession, an inactive person is more likely to search for a job. These cyclical patterns hold true at leads and lags of up to six quarters expect the transition rate from employment to inactivity as seen in Table 3.

In terms of volatility, job-finding and separation rates are highly volatile. The volatilities of

Table 3: Cross-correlation analysis

	Lags					Leads			
	12	6	3	1	0	1	3	6	12
$\lambda^{UE}_{t\pm j}, y_t$	0.24	0.39	0.49	0.50	0.50	0.50	0.37	0.14	-0.21
$\lambda^{IE}_{t\pm j}, y_t$	-0.11	0.08	0.14	0.19	0.21	0.25	0.23	0.13	-0.04
$\lambda^{EU}_{t\pm j}, y_t$	-0.22	-0.48	-0.68	-0.73	-0.71	-0.67	-0.52	-0.35	-0.01
$\lambda^{EI}_{t\pm j}, y_t$	0.13	0.09	0.00	-0.03	-0.05	-0.09	-0.18	-0.21	-0.41
$\lambda^{UI}_{t\pm j}, y_t$	0.07	0.12	0.17	0.17	0.31	0.31	0.24	0.11	0.11
$\lambda^{IU}_{t\pm j}, y_t$	0.19	0.00	-0.19	-0.19	-0.39	-0.48	-0.57	-0.58	-0.55

Note: y is real GDP. λ^{XY} is the transition rate from state $X \in \{E, U, I\}$ to another state Y. All variables are logged, and then they are filtered using the Hodrick-Prescott filter with smoothing parameter 10^5.

them are roughly four to six times as large as that of real GDP. Furthermore, separation rates are more volatile than job-finding rates across all filtering methods. The transition rates between unemployment and inactivity are also highly volatile and the IU transition rate is more volatile than the UI transition rate.

We assess the robustness of these finding to the choice of an indicator of the business cycle. We repeat the exercise by using the unemployment rate as a cyclical indicator. Furthermore, following Baker (1992) and Gomes (2009), we estimate the cyclicality of the worker flows by running an ordinary least-squares regression of the log of each variable on a liner trend term, season dummy variables, and the unemployment rate. These results are shown in Table 4.

The results conform to the preceding ones. Inflows and outflows of the unemployment pool are counter-cyclical. Flows between employment and inactive do not have any clear cyclical properties. The separation rate and the transition rate from inactivity to unemployment are counter-cyclical, while the job finding rate and transition rates from inactive to employment and from unemployment to inactive are procyclical. In terms of magnitude, the separation rate is twice as much as the job finding rate. This implies that the separation rate is more important determinants of unemployment fluctuations than the job finding rate. In the next section, we

Table 4: Business cycle properties of worker flows and transition rates

	HP $(1,600)$	HP (10^5)	BK	Baker (1992)
UE	0.32	0.66	0.55	0.152 (0.017)
IE	-0.09	-0.11	-0.06	-0.01 (0.009)
EU	0.44	0.75	0.68	0.197 (0.018)
EI	-0.03	-0.01	-0.03	0.006 (0.009)
UI	0.59	0.84	0.81	0.215 (0.014)
IU	0.11	0.34	0.50	0.167 (0.018)
λ^{UE}	-0.37	-0.47	-0.51	-0.122 (0.017)
λ^{IE}	-0.12	-0.16	-0.13	-0.017 (0.009)
λ^{EU}	0.48	0.78	0.72	0.216 (0.016)
λ^{EI}	0.05	0.21	0.07	0.025 (0.010)
λ^{UI}	-0.15	-0.33	-0.07	-0.055 (0.012)
λ^{IU}	0.43	0.68	0.48	0.164 (0.017)

Note: λ^{XY} is the transition rate from state $X \in \{E, U, I\}$ to another state Y. All variables are filtered using the Hodrick-Prescott filter (with smoothing parameter $1,600$ or 10^5), or the Baxter-King filter. The last column, Baker(1992), reports the coefficient on the unemployment rate in a regression of the series in logs on seasonal dummy variables, time trend, and the unemployment rate. Standard errors are presented in parentheses.

will examine the relative importance of job finding and separation rates in driving unemployment dynamics more carefully.

5 The ins and outs of Japanese unemployment

In this section, we study the contribution of inflow and outflow rates to the variation in the unemployment rate. In particular, we are interested in measuring relative importance of the inflow and outflow rates to unemployment variability. Recently, a number of studies quantifies these contributions under the assumption that the actual unemployment rate is closely approximated by its steady state value (Elsby, Michaels, and Solon, 2009; Fujita and Ramey, 2009; Petrongolo and Pissarides, 2008). Under this assumption, contemporaneous variation in the unemployment rate is decomposed into parts due to contemporaneous variation in inflow and outflow rates. The unemployment rate will be close to its steady state value when transition rates are high. Applying the steady state decomposition to the US labor market is reasonable since transition rates are high in the U.S. However, the steady state assumption might not hold as a reasonable approximation in Japan, as transition rates are much lower than those in the U.S. In fact, Elsby, Hobijn, and Şahin (2009) and Smith (2010) demonstrate that unemployment deviates considerably from its steady state in a country with low transition rates.[10] Consequently, they show that the steady state decomposition leads to misleading result on the relative importance of changes in inflow and outflow rates for the unemployment fluctuations in such a country. Therefore, we decompose unemployment fluctuations into the contributions attributed to changes in inflows and outflows by applying two decomposition methods: the conventional steady state decomposition and non-steady state decomposition method developed by Smith (2010), which allows for deviations of the actual unemployment rate from its steady state value. We also correct the data for time aggregation bias by applying the method proposed by Shimer (2007).

5.1 Steady state decomposition

The evolution of the unemployment rate u_t over time can be obtained by

$$\frac{du_t}{dt} = s_t(1 - u_t) - f_t u_t, \tag{1}$$

where s_t is the rate of inflows into unemployment and f_t is the rate of outflows from unemployment.

The starting point of the conventional unemployment decomposition is approximating the unemployment rate by its steady-state level. First, we consider the simple two state case where workers are either employed or unemployed. Now, f_t and s_t represent the job finding rate and the

[10] Elsby, Hobijn, and Şahin (2009) show that Anglo-Saxon economics which have high inflow and outflow rates, with the exception of the U.K., exhibit substantial deviations of unemployment from its steady state value. Smith (2010) provides evidence that the steady state approximation does not hold for the U.K.

separation rate, respectively. We can approximate unemployment by

$$u_t \simeq u_t^* = \frac{s_t}{s_t + f_t}, \tag{2}$$

where u^* is the steady state unemployment rate.

Let $C_{s,t}^*$ denote the contribution of changes in inflow rate to changes in the steady state unemployment rate. Similarly, let $C_{f,t}^*$ denote the contribution of changes in outflow rate to changes in the steady state unemployment rate. By taking difference of (2), we obtain

$$\begin{aligned} \Delta u_t^* &= (1-u_t^*)u_{t-1}^* \frac{\Delta s_t}{s_{t-1}} - u_t^*(1-u_{t-1}^*)\frac{\Delta f_t}{f_{t-1}} \\ &= C_{s,t}^* + C_{f,t}^* \end{aligned} \tag{3}$$

where $\Delta x_t \equiv x_t - x_{t-1}$. The first term of the right-hand side measures the contribution of changes in the separation rate s_t to changes in the steady state unemployment rate. Similarly, the second term is the contribution of changes in the job finding rate f_t to the variation in unemployment.

In three states case where workers are either employed (E), unemployed (U), or inactive (I), the dynamics of unemployment, employment, and inactivity are described by

$$\begin{aligned} \dot{E}_t &= \lambda_t^{UE} U_t + \lambda_t^{IE} I_t - \left(\lambda_t^{EU} + \lambda_t^{EI}\right) E_t, \\ \dot{U}_t &= \lambda_t^{EU} E_t + \lambda_t^{IU} I_t - \left(\lambda_t^{UE} + \lambda_t^{UI}\right) U_t, \\ \dot{I}_t &= \lambda_t^{EI} E_t + \lambda_t^{UI} U_t - \left(\lambda_t^{IE} + \lambda_t^{IU}\right) I_t, \end{aligned}$$

where λ_t^{XY} denote an instantaneous transition rate from state $X \in \{U, E, I\}$ to state $Y \neq X$ at time t.

In steady state, the flows into employment are equal to the flows out of it. Similarly, flows in and out of unemployment are equal. Thus, the steady-state conditions for employment and unemployment are

$$\lambda_t^{UE} U_t + \lambda_t^{IE} I_t = \left(\lambda_t^{EU} + \lambda_t^{EI}\right) E_t, \tag{4}$$

$$\lambda_t^{EU} E_t + \lambda_t^{IU} I_t = \left(\lambda_t^{UE} + \lambda_t^{UI}\right) U_t. \tag{5}$$

By rearranging (4) and (5), we can express steady state unemployment rate as a function of all six transition rates:

$$u_t^* \equiv \frac{U_t}{U_t + E_t} = \frac{\lambda_t^{EU} + \frac{\lambda_t^{IU}}{\lambda_t^{IU} + \lambda_t^{IE}} \lambda_t^{EI}}{\lambda_t^{EU} + \frac{\lambda_t^{IU}}{\lambda_t^{IU} + \lambda_t^{IE}} \lambda_t^{EI} + \lambda_t^{UE} + \frac{\lambda_t^{IE}}{\lambda_t^{IU} + \lambda_t^{IE}} \lambda_t^{UI}}. \tag{6}$$

The second term in the numerator is the transition rate from employment to unemployment through inactivity. The first and second terms together are the overall inflow rate to unemployment from employment, the direct transition from employment to unemployment plus the transition rate working through inactivity. Similarly, the sum of the third and fourth terms in the denominator is the transition rate from unemployment to employment, directly and working through inactivity.

Let $s_t \equiv \lambda_t^{EU} + \lambda_t^{IU}\lambda_t^{EI}/(\lambda_t^{IU} + \lambda_t^{IE})$ and $f_t \equiv \lambda_t^{UE} + \lambda_t^{IE}\lambda_t^{UI}/\left(\lambda_t^{IU} + \lambda_t^{IE}\right)$. Then, (6) becomes identical to (2) and so the decomposition in (3) holds. The contributions of total inflow and outflow rates can be further divided into terms attributed to the flows between employment and unemployment and the flows between employment and inactivity. From (6), we obtain

$$\begin{aligned} \frac{\Delta s_t}{s_{t-1}} &= \frac{1}{s_{t-1}}\left[\Delta\lambda_t^{EU} + \Delta\left(\frac{\lambda_t^{IU}\lambda_t^{EI}}{\lambda_t^{IU} + \lambda_t^{IE}}\right)\right], \\ \frac{\Delta f_t}{f_{t-1}} &= \frac{1}{f_{t-1}}\left[\Delta\lambda_t^{UE} + \Delta\left(\frac{\lambda_t^{IE}\lambda_t^{UI}}{\lambda_t^{IU} + \lambda_t^{IE}}\right)\right]. \end{aligned}$$

Then the contributions of the separation rate $C^*_{EU,t}$ and the job finding rate $C^*_{UE,t}$ to unemployment variability are

$$C^*_{EU,t} = (1-u_t^*)u_{t-1}^*\frac{\Delta\lambda_t^{EU}}{s_{t-1}} \text{ and } C^*_{UE,t} = -u_t^*(1-u_{t-1}^*)\frac{\Delta\lambda_t^{UE}}{f_{t-1}},$$

respectively.

Similarly, the contributions of transitions rate from employment to unemployment working through inactivity $C^*_{EIU,t}$ and the contributions of transitions rate from unemployment to employment working through inactivity $C^*_{UIE,t}$ can be obtained by

$$\begin{aligned} C^*_{EIU,t} &= \frac{(1-u_t^*)u_{t-1}^*}{s_{t-1}}\Delta\left(\frac{\lambda_t^{IU}\lambda_t^{EI}}{\lambda_t^{IU} + \lambda_t^{IE}}\right), \\ C^*_{UIE,t} &= \frac{-u_t^*(1-u_{t-1}^*)}{f_{t-1}}\Delta\left(\frac{\lambda_t^{IE}\lambda_t^{UI}}{\lambda_t^{IU} + \lambda_t^{IE}}\right). \end{aligned}$$

Following Fujita and Ramey (2009) and Petrongolo and Pissarides (2008), we quantify the contribution of inflow and outflow rates by calculating the "beta values" in finance. Thus, we calculate

$$\beta_i^* = \frac{cov\left(\Delta u^*, C_i^*\right)}{var(\Delta u^*)} \quad i = s, f, EU, UE, EIU, UIE,$$

as measures of the contributions of fluctuations in the relevant transition rate to overall fluctuations in the unemployment rate. Since $\Delta u^* = C^*_{EU} + C^*_{EIU} + C^*_{UE} + C^*_{UIE}$, $\beta^*_{EU} + \beta^*_{EIU} + \beta^*_{UE} + \beta^*_{UIE} = 1$.

Table 5: Decompositions of unemployment fluctuations

		Steady-state decomposititon						Non-steady-state decomposition					
period	feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*	β_s	β_f	β_{EU}	β_{EIU}	β_{UE}	β_{UIE}
1980Q1-2009Q4	full sample	0.54	0.45	0.44	0.10	0.53	-0.07	0.54	0.40	0.46	0.08	0.41	-0.01
1980Q1-1990Q4	stable low u	0.55	0.42	0.45	0.11	0.44	-0.02	0.58	0.35	0.44	0.14	0.35	0.00
1991Q1-2002Q1	3 recessions	0.50	0.48	0.42	0.07	0.60	-0.12	0.34	0.43	0.34	0.00	0.46	-0.03
2002Q2-2007Q3	boom and fall in u	0.54	0.42	0.45	0.09	0.63	-0.21	0.49	0.33	0.40	0.09	0.48	-0.15
2007Q4-2009Q4	big u rise	0.56	0.42	0.45	0.11	0.44	-0.02	0.57	0.13	0.44	0.13	0.05	0.08
1980Q1-2009Q4	no time aggregation	0.56	0.43	0.44	0.12	0.51	-0.08						

Note: See text for definitions of β_i^* and β_i for $i \in \{s, f, EU, EIU, UE, UIE\}$. Full sample covers 1980Q1-2009Q4. Data are adjusted for margin error, and all series expect for the last row are adjusted for time aggregation error by the method of Shimer (2007).

Table 5 reports the results of this decomposition for full sample and four sub-samples. For full sample, the inflow rate accounts for around 54% of unemployment variability and the outflow rate accounts for 45% of it. Within the contribution of the inflow rate, changes in job finding rate account for most of this, and explains 44% of steady-state unemployment fluctuations. The role of the transition rate working through inactivity is also important and explains 10% of unemployment volatility. The separation rate have the dominant role in explaining unemployment fluctuations and accounts for 53% of it. Interestingly, although the contribution of the job finding rate to the overall unemployment fluctuations (53%) is larger than that of the separation rate (44%), the contribution of the inflow rate is larger than that of the outflow rate. This is due to the negative beta value of the outflow transition rate via inactivity. The result suggests that both the separation rate and the job finding rate are important to explain the unemployment fluctuations.

In order to examine whether there exists relationship between the direction of unemployment dynamics and the contributions of inflow and outflow rates, we divide the sample period into 4 sub-samples based on the movement of unemployment. In the period of 1980-1990, the unemployment rate was relatively stable and low, averaging 2.5%. During this period, job finding and separation rates accounted for comparable proportions of unemployment fluctuations. In 1990s, Japan experienced stagnation and the unemployment rate rose shapely. Specifically, the unemployment rate rose from a low level of 2.1% before the 1991-93 recession to a peak of 5.4 % in 2002. During this recession period of 1991-2002 and the subsequent recovery period of 2002-2007, changes in unemployment are driven mainly by changes in the job finding rate. In these periods, about 60% of unemployment fluctuations is attributed to changes in the job finding rate. In contrast, the shape rise in unemployment in the recession from 2007 is driven by both job finding and separation rates. Based this observation, we conclude that there is no apparent relationship between the direction of change in the unemployment rate and the contribution of underlying flow rates.

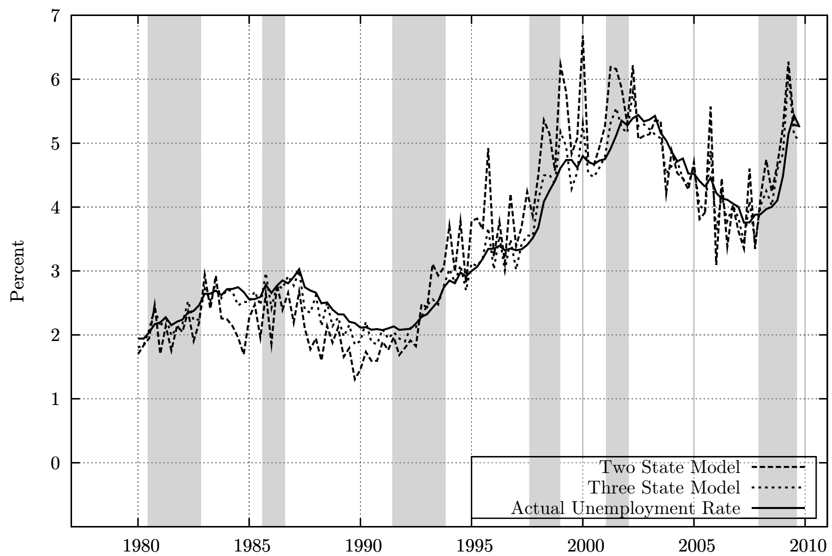

Figure 5: Actual versus steady state unemployment rates

Note: the solid line indicates the actual unemployment rate. The thick dashed line indicates the steady state unemployment rate in the two states model calculated from (2). The dashed line indicates the steady state unemployment rate in the three states model calculated from (6). Shaded areas indicate ESRI-dated recessions. Sample covers 1980Q1-2009Q4.

We now examine whether the steady state assumption holds as a reasonable approximation in Japan. In Figure 5, we plot the steady-state unemployment rates in the two and three states models calculated from (2) and (6), together with the actual unemployment rate. Figure 5 shows that both steady state unemployment rates tend to move with the actual unemployment rate, but we can observe not small discrepancies between the actual and steady state unemployment rates. This contrasts with the case in the U.S., in which actual and steady state unemployment rates are coincident.[11]

There are two possible sources of discrepancies between actual and steady state unemployment rates. First source of discrepancies comes from ignoring flows into and from inactivity. Figure 5 shows that the steady state unemployment rate in the three states model moves with actual unemployment rate more closely than two states model. The correlations between the actual unemployment rate and the steady state unemployment rate are 0.92 for two states model and 0.99 for three states model, respectively. This suggests that flows in and out of the inactivity play an important role in explaining the unemployment dynamics in Japan.

The other source of discrepancies comes from the assumption that the actual unemployment is closely approximated by its steady state value. To see how large this bias is, we calculate standard deviations of the logarithmic deviation of unemployment from steady state, and they are 0.08 in the two states model and 0.03 in the three states model. Thus, the actual unemployment rate substantially deviates from its steady state value. This discrepancy comes from low rates of unemployment inflow and outflow. Intuitively, when inflow and outflow rates are low, it takes time for a worker who loses a job to find another one. Then, changes in the inflow rate affect unemployment in the period, as well as unemployment in the subsequence periods. Thus, contemporaneous variation in unemployment is determined by not only contemporaneous but also past changes in inflow and outflow rates. The finding suggests that there is good reason to hesitate in applying steady state decomposition method to the Japanese labor market.

5.2 Non-steay state decomposition

We now decompose the variation in unemployment rate by using the method proposed by Smith (2010), which allows for deviations of the actual unemployment rate from its steady state value.[12]

[11] See Shimer (2007) and Elsby, Hobijn, and Şahin (2009).

[12] Elsby, Hobijin and Şahin (2009) also propose a non-steady state decomposition method that works with log unemployment changes. Since it is difficult to decompose the contributions of log changes in total inflow and outflow rates into terms attributed to the flows between employment and unemployment and the flows between

This approach uses the expression for unemployment dynamics (1) as its starting point. (1) can be rewritten as

$$u_t = \frac{s_t}{s_t + f_t} - \frac{1}{s_t + f_t}\frac{du}{dt}. \tag{7}$$

By differentiating (7) with respect to time, we get the following second-order differential equation:

$$\frac{d^2 u_t}{dt^2} = \frac{1}{s_t + f_t}\left[f_t \frac{ds_t}{dt} - s_t \frac{df_t}{dt}\right] + \frac{du_t}{dt}\left[\frac{1}{s_t + f_t}\frac{d}{dt}\left(s_t + f_t\right) - \left(s_t + f_t\right)\right].$$

This can be treated as a first order differential equation in du_t/dt. By discretizing and rearranging it, we have the following recursive expression for the dynamics of actual the unemployment rate

$$\Delta u_t = \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2}\Delta u_t^* + \frac{s_t + f_t}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2}\Delta u_{t-1}, \tag{8}$$

where u_t^* is the steady state unemployment rate and Δ denotes a discrete change over period. Note that the coefficient on Δu_t^* gives the rate of convergence to the steady state. When transition rates are high, changes in the actual unemployment rate can be approximated very closely by changes in the steady state unemployment rate. Conversely, in the case that transition rates are low, changes in unemployment rate are captured by not only changes in steady state unemployment but also past changes in transition rates and equilibrium unemployment. This highlights a potential pitfall of applying the steady state decomposition to study unemployment dynamics in Japan, where the transition rates are low.

Let $C_{f,t}$, $C_{s,t}$, and $C_{0,t}$ denote the contribution of contemporaneous and past changes in the inflow rate, the outflow rates, and the initial deviation from steady state, respectively. Based on equation (8), they are defined by

$$\begin{aligned} C_{f,t} &= \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2} C_{f,t}^* + \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2} C_{f,t-1} \text{ with } C_{f,t} = 0, \\ C_{s,t} &= \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2} C_{s,t}^* + \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2} C_{s,t-1} \text{ with } C_{s,t} = 0, \end{aligned}$$

and

$$C_{0,t} = \frac{\left(s_t + f_t\right)\left(s_{t-1} + f_{t-1}\right)}{s_{t-1} + f_{t-1} + \left(s_t + f_t\right)^2} C_{0,t-1} \text{ with } \Delta u_0 - \Delta u_0^*,$$

employment and inactivity, this study uses the non-steady state decomposition method based on a non log change.

where $C^*_{f,t}$ and $C^*_{s,t}$ are the contributions of changes in inflow rate and outflow rates to steady state unemployment dynamics, respectively. From (3), they are obtained by

$$C^*_{f,t} = -u^*_t(1-u^*_{t-1})\frac{\Delta f_t}{f_{t-1}} \text{ and } C^*_{s,t} = (1-u^*_t)u^*_{t-1}\frac{\Delta s_t}{s_{t-1}}.$$

Note that, similar to the steady state decomposition, the contribution of the total inflow and outflow rates can be divided into terms that can be attributed to the flows between employment and unemployment and inactivity transitions.

The contribution of the various flow rates can be summarized in the following beta values.

$$\beta_i = \frac{cov(\Delta u_t, C^i_t)}{var(\Delta u_t)},\ i = s, f, EU, UE, EIU, UIE.$$

The results of non-steady-state decompositions are reported in Table 5. For the full sample period, variation in the inflow rate accounts for 54 percent of unemployment fluctuations and outflow rates account for 40 percent of unemployment fluctuations. Thus, variation in the inflow rate plays an important role to account for variation in the unemployment rate in Japan. This result confirms to the preceding one. This finding suggests that in analyzing unemployment fluctuations in Japan, researchers should consider fluctuations at both inflow and outflow margins.

Comparison between the steady state decomposition and the non-steady state decomposition shows that although contributions of outflows to unemployment fluctuations in the steady state decomposition are slightly larger than those in the non-steady state decomposition one, their relative importance of each component is similar between these two methods.

We now examine whether the correction for time aggregation matters or not. If a worker find and lose a job within a period, discrete time data may fail to capture these transitions and yield biased measures of underlying transition rates in a continuous time framework. In fact, a number of studies demonstrate that correction for time aggregation problem leads to substantial changes in the measured worker transition rates in the US data (Shimer, 2007; Elsby, Michaels and Solon, 2009; Fujita and Ramey, 2009). In order to access the importance of time aggregation correction, we quantify the contributions of inflow and outflow rates to unemployment fluctuations by using the data without time aggregation correction. Results are reported in the last row in Table 5 and show that there is no substantial difference between results corrected for time aggregation and uncorrected data.

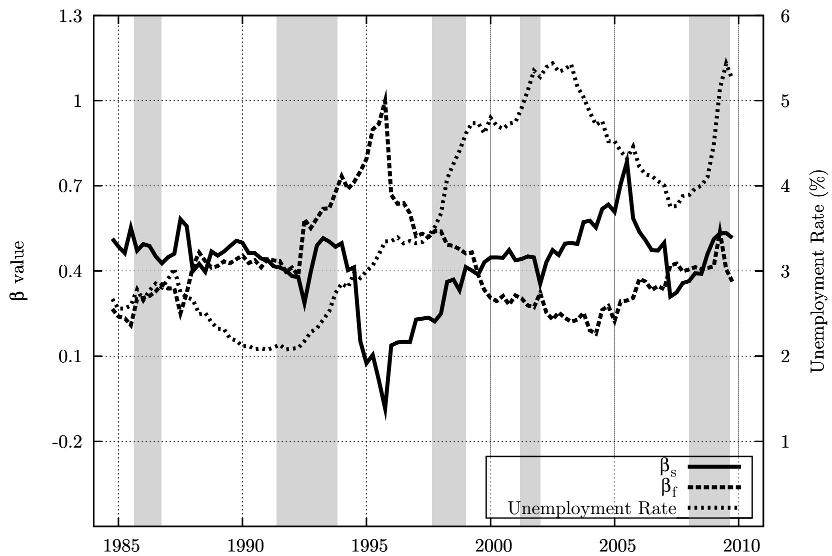

Figure 6: Dynamic contributions of inflow and outflow rates to unemployment fluctuations

Note: the solid line indicates the actual unemployment rate. The thick dashed line indicates the rolling 5 year β_s. The dashed line indicates the rolling 5 year β_f. Shaded areas indicate ESRI-dated recessions.

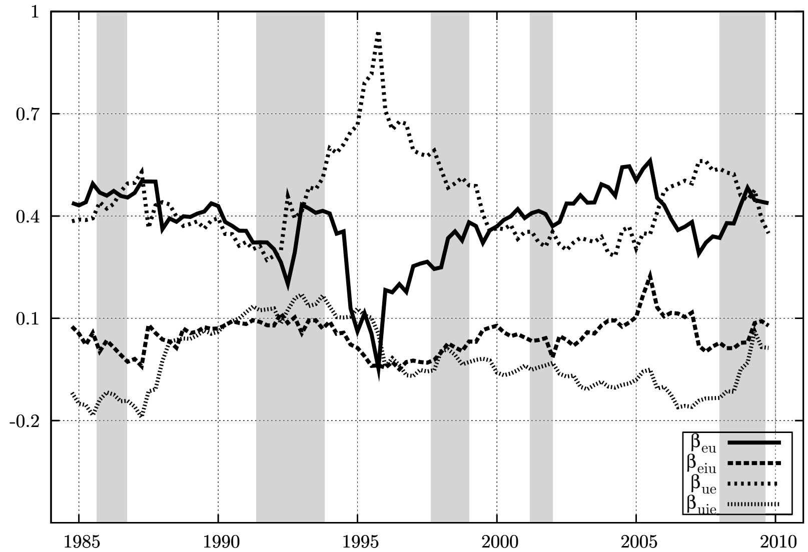

Figure 7: Dynamic contributions of inflow and outflow rates to unemployment fluctuations

In order to analyze dynamic contributions of inflow and outflow rates to unemployment fluctuations, we calculate rolling 5 year betas. They are shown together with the unemployment rate in Figure 6. Figure 6 shows that the relative importance of inflow and outflow rates to the variation in the unemployment rate changes over time. During the bubble period, late 1980s, the relative contributions of inflow and outflow rates are stable. The inflow rate is dominant in accounting for unemployment fluctuations in 2000s, while the contribution of the outflow rate dominates in 1990s. Although the contribution of outflow rate is dominant in 1990s when the unemployment rate rises steadily, the increase in the unemployment rate accompanies with an increase in the relative importance of the inflow rate.

We can further decompose the contributions of the inflow and outflow rates into parts attributed to the flows between employment and unemployment and the flows between unemployment and inactivity. Figure 7 shows that most of variation in unemployment rate is driven by job finding and separation rates.

6 Conclusion

This paper studies worker flows dynamics in Japan over past 30 years. By using data constructed from the Labour Force Survey, we provide a number of key facts on worker flows and unemployment dynamics, which is essential to understand the Japanese labor market.

We examine the size and cyclicality of both the gross worker flows and associated transition rates between the states of employment, unemployment, and inactivity. There are large gross worker flows across labor market status. We find that about 3% of the working-age population change labor market state in each month. Inflows and outflows of unemployment are countercyclical, while flows between employment and inactivity are procyclical. These finding are broadly consistent with results for the U.S. and the European countries. In contrast, we find that job finding and separation rates in Japan are much lower than those in the U.S.

We also decompose unemployment fluctuations into the parts due to changes in inflow and outflow rates. Conventional decomposition methods applied to U.S. data evaluate these contributions under the assumption that the unemployment rate is closely approximated by its steady state value. However, we find the unemployment rate considerably deviates from its steady state value. Therefore, we decompose unemployment fluctuations into the contributions attributed to changes in inflow and outflow rate by using both the conventional steady state decomposition and the non-steady state decomposition. We demonstrate that both inflow and outflow rates contribute substantially to unemployment fluctuations in Japan. This study contributes to the recent literature on unemployment dynamics by providing evidence for Japan.

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