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Accounting for Ins and Outs of Unemployment in Korea*

Seongtae Kim** · Junsang Lee***

This paper studies unemployment dynamics in Korea from 2000 to 2011 by using data from the Economically Active Population Survey (EAPS). We examine the size and cyclicality of both the gross work flows and associated transition rates between the labor market states of employment, unemployment, and inactivity. In order to study the contribution of inflow and outflow rates to variations in the unemployment rate, we decompose unemployment fluctuations into the parts due to changes in inflow and outflow rates. Decomposition methods find that inflow to unemployment contributes substantially to unemployment fluctuations in Korea and particularly inflow through inactivity plays a larger role in unemployment dynamics in Korea, compared to other countries.

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** Author for Correspondence, Department of Macroeconomic and Financial Policy, Korea Development Institute, 47 Hoegi-ro, Dongdaemun-gu, Seoul, 130-740, Korea, E-mail: kst@kdi.re.kr
*** First Author, Department of Economics, College of Economics, Sungkyunkwan University, Dasan Hall 25-2, Sungkyunkwan-ro, Jongno-gu, Seoul, 110-745, Korea, E-mail: junsanglee @skku.edu

1. INTRODUCTION

This paper explains the unemployment dynamics in Korea between 2000 and 2011. We build up gross work flows data using the monthly Economically Active Population Survey (EAPS). Our data set enables us to examine the size and cyclical patterns of the flows and transition rates between employment, unemployment and not-being-active-in the labor force. We construct stylized facts on work flows and associated transition rates for Korea. By using these stylized facts and findings, we decompose driving forces of unemployment dynamics in Korea.

The dynamics of flows between employment, unemployment and inactivity determines fluctuations in aggregate indicators, such as employment and unemployment rates. Hence, they are important to our understanding of labor market dynamics and business cycle fluctuations. Furthermore, work flows and transition rates lie at the heart of theoretical models of unemployment anchored in the Mortensen and Pissarides (1994) search and matching framework.

This paper constructs a number of stylized facts about the properties of the Korean labor market flows by exploring data from EAPS. These stylized facts are of interest to policy makers and macroeconomists. For policy makers, they can help improve the monitoring of business cycles, the detection of turning points and the assessment of labor market tightness. For macroeconomists, this paper provides a reference for the calibration of a number of parameters, and also a guideline for the properties one should expect a model to have for Korean economy.

By documenting stylized facts on work flows and associated transition rates in Korea, we find that Korea has a relatively large portion (about 5%) of its working age population changing their labor market status, compared to other countries. The cyclicality of work flows and associated transition rates are investigated, and we find that Korea's cyclical patterns of work flows are similar to those found in the US. Inflow and outflow of unemployment are counter-cyclical. We show that transition probability from unemployment to employment is procyclical, while that from employment to unemployment is counter-cyclical. One outstanding feature that the Korean labor market has is that work flows between employment and inactivity are relatively larger than those in the UK and Japan.

Moon (2009) studies the cyclical behavior of the Korean labor market by looking into cyclical transition between labor market states of employment, unemployment and not-in-labor force. He finds that employment fluctuation is well explained by the fluctuation of non-participants in Korea. We also study the cyclical fluctuation of unemployment but focus on what accounts for the cyclical behavior of unemployment: job-finding or separation. The seminal work on labor market flow by Blanchard and Diamond (1990) and Davis and Haltiwanger (1992) set the conventional wisdom that recessions are mainly driven by high job loss rates (separation rates). In two recent papers, Shimer (2007) and Hall (2005) have challenged this view by presenting evidence that cyclical unemployment dynamics are largely driven by a time-varying job-finding rate and that the separation rate is very close to being acyclical.

We decompose unemployment fluctuations into the parts due to changes in inflow and outflow rates, using three different methods: Shimer (2007)'s method, conventional steady state decomposition method and non-steady state decomposition method. Our objective is to study the role of worker flows played in explaining the unemployment dynamics. All of three decomposition methods confirm that both inflow rates to unemployment contribute substantially to unemployment fluctuations and dynamics in Korea, and particularly inflow through inactivity plays a large role in unemployment dynamics in Korea, which is consistent with Moon (2009).

The remainder of this paper is organized as follows. Section 2 describes our data construction. Section 3 studies some stylized facts about Korean work flow and section 4 examines cyclicality of work flows by conducting cyclical analysis of the data. In section 5, we study the contribution of changes in unemployment inflow and outflow rates to unemployment dynamics. Section 6 concludes.

2. DATA

This section explains how we construct our data set by using the monthly Economically Active Population Survey (EAPS). The EAPS is conducted by the Social Statistics Bureau of the Statistics Korea and has been used to measure employment statistics in Korea. The EAPS has approximately 32,000 households in the sample and 1/36 of total households leave and are replaced by the same number of new households every month. The EAPS is not meant to be constructed for a panel data set. We however use household and individual codes from the monthly EAPS data over two consecutive months and construct a panel data from 2000 to 2011.

In the EAPS, individuals in the working-age population aged between 15 and 64 are classified into three categories: employed (*E*), unemployed (*U*) and inactive (*I*). The sum of the stocks in the first two labor market states (*E*+*U*) is the size of labor force and the sum of the stocks in all three states (*E*+*U*+*I*) points to the size of working age population. Work flows between these states are denoted by two consecutive capital letters: *EE*, *EU*, *EI*, *UE*, *UU*, *UI*, *IE*, *IU*, and *II*. For example, *EU* means the flow of individuals who transit from the 'employed' state (*E*) to the 'unemployed' state (*U*) over one month.

By matching individuals across the two consecutive months, we compute gross flows and transition rates between labor market states. We denote ω_{jt} as a weight of sample *j* at month *t* and G_t^{XY} as a set of individuals that transit from a labor state $X \in \{E, U, I\}$ to the state $Y \in \{E, U, I\}$ at month *t*. Then, the gross flows from state *X* to state *Y* can be computed as follows:

$$F_t^{XY} = \sum_{i=G_t^{XY}} \omega_{jt}. \quad (1)$$

Monthly transition rates, denoted as P_t^{XY}, are calculated using the gross flows. For example, the transition rate from employment state (*E*) to unemployment state (*U*) is computed as:

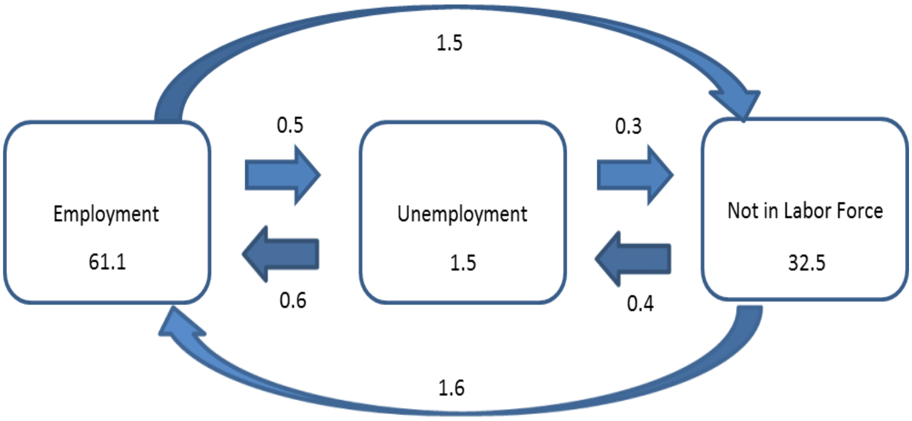
$$p_t^{EU} = \frac{F_t^{EU}}{\sum_{Y \in \{E,\, U,\, I\}} F_t^{EY}}. \tag{2}$$

Then, we seasonally adjust the series using the US Census Bureau X-12 monthly seasonal adjustment method and corrected the time aggregation bias in converting these monthly series to quarterly frequency as in Shimer (2007). Therefore, when we build up the quarterly transition rates, we allow for a worker to transit across the employment states during the quarter.

3. WORK FLOWS IN KOREA

In this section, we discuss some characteristics of the Korean work flows data. Figure 1 shows the average work flows between employment, unemployment and inactivity as a percentage of working-age population. There are three labor statuses — employment, unemployment and not-in-labor-force — and economic agents in the working-age population flow between these statuses.

Figure 1 Average Gross Work Flows, 2000-2011



Notes: Gross work flows are expressed as a percentage of the working-age population. The sample period for Korea covers 2000-2011.

Table 1 Gross Flows for Korea, Japan, the US and the UK

Country	EU	EI	UE	UI	IE	IU	Total
Korea	0.5	1.5	0.6	0.3	1.6	0.4	4.9
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

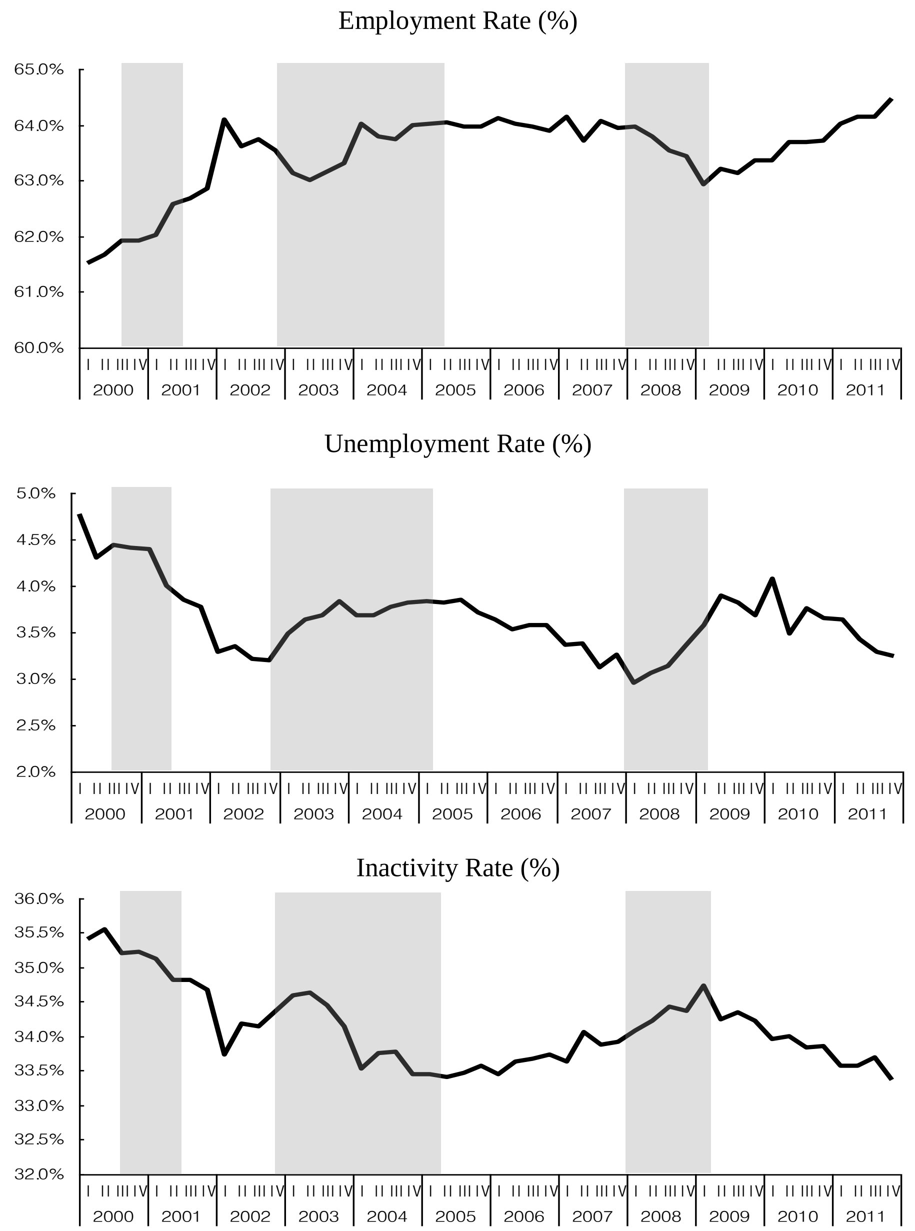
Notes: Gross work flows are expressed as a percentage of the working-age population. The sample period for Korea covers 2000-2011. The values for Japan, the US and the UK are obtained from Lin and Miyamoto (2012), Bleakley *et al*. (1999) and Gomes (2009) respectively.

Table 1 compares the average monthly gross work flows for Korea with those for Japan, the US and the UK. The size of outward work flows in Korea is larger than those in Japan and the UK but smaller than that in the US. The larger size of work flows, compared to the UK and Japan suggests that the labor market in Korea is relatively more mobile and dynamic.

Figure 2 shows that the evolution of the rates of employment, unemployment and inactivity in Korea from 2000 Q1 to 2011 Q4.[1)] For the past 11 years, the Korean economy has seen a gradually-growing employment rate. The employment rate recorded above 61% in 2000 1Q with the economic recovery after the Asian crisis and reached above 64% in the end of 2011. The employment rate went up in early 2000 and after 2010 with economic recoveries. It was oscillating between 63 and 64% in the middle of 2000. Figure 2 shows that the unemployment rate increased in the shaded areas, which indicates the periods between peak and trough from the Business Cycle Clock by Statistics Korea. The inactivity rate has steadily increased since 2005 till the end of 2008 and has been gradually shrinking since 2010. Overall inactivity rate has been declining for the past decade.

1) 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 sum of employment and unemployment). The inactivity rate is defined as the ratio of inactive to the working-age population.

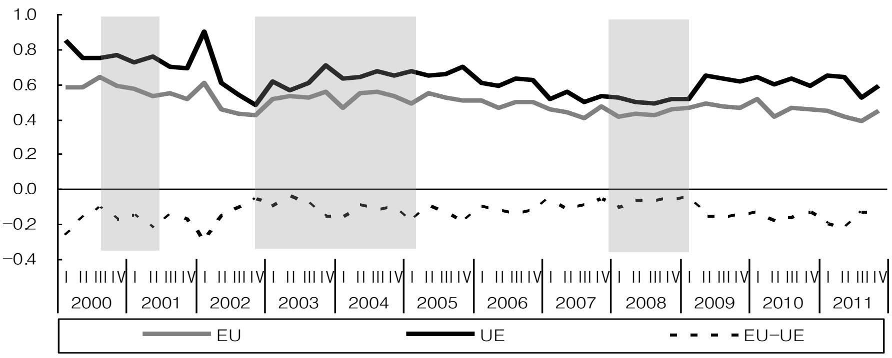
Figure 2 Labor Market Stocks



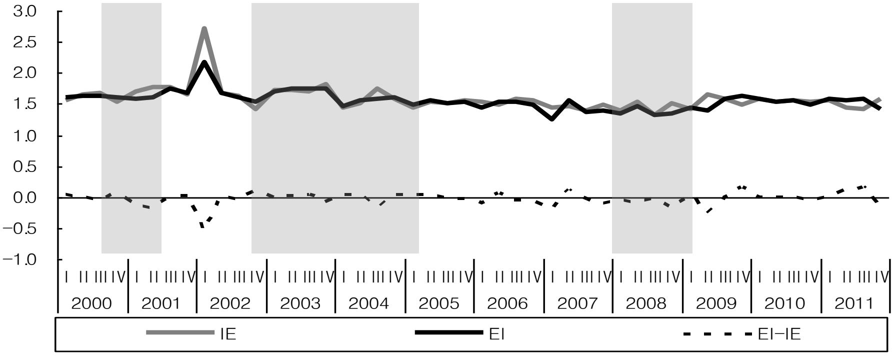
Note: Shaded areas indicate periods between peak and trough from the Business Cycle Clock by Statistics Korea, Korea.

Figure 3 Labor Market Gross Flows and Net Flow, 2000-2011

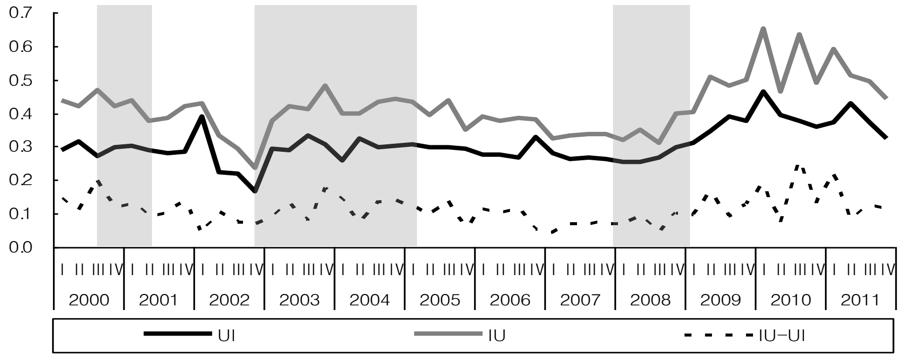
Gross Flows and Net Flow between Employment and Unemployment (%)



Gross Flows and Net Flow between Employment and Inactivity (%)



Gross Flows and Net Flow between Unemployment and Inactivity (%)



Note: Shaded areas indicate periods between peak and trough from the Business Cycle Clock by Statistics Korea, Korea.

Figure 3 shows the pairwise interactions between three states in labor market. The first row displays gross flows in percentage between employment and unemployment and their net work flow. Work flow from unemployment to employment has been always higher than that from employment to unemployment. The net work flow between employment and unemployment has declined since the end of 2008, which implies the measure of work flow from unemployment to employment has outnumbered that from employment to unemployment. The second row of the figure shows gross flows and net flows between employment and inactivity. The size of gross work flows between employment and inactivity is the largest among other pairwise gross flows. The net flow from employment to inactivity declined with trend till the end of 2007 and has increased since then. The third row depicts the gross flows and net flows between unemployment and inactivity. The gross work flows show relatively larger increases after 2008 and then they have decreased but have not reached to the level before. It suggests that those who look for a job increased during the recession. In sum, we observe that outflow from unemployment to employment has been filled with the inflow from inactivity to unemployment.

Figure 4 displays outflow transition probabilities across the three pools. Average transition probability from employment outwards over our sample periods shows that average probability to inactivity is approximately 3.2 times higher than the average probability into unemployment, while the one to inactivity is only 1.5 times bigger than one into unemployment in the US over the period from 1967 Q3 to 2007 Q2[2)] and 1.46 times bigger in the UK.[3)] Transition probabilities from unemployment shows that the monthly job finding rate from unemployment state is 25.9% on average over the sample in Korea while the corresponding rate is 32.11% over the period between 1967 Q3 and 2007 Q2 in the US and 27.8% for 1996-2007 in the UK. Inactivity outflow transition rates show that the direct transition to employment is 3.9 times higher than the transition to unemployment state.

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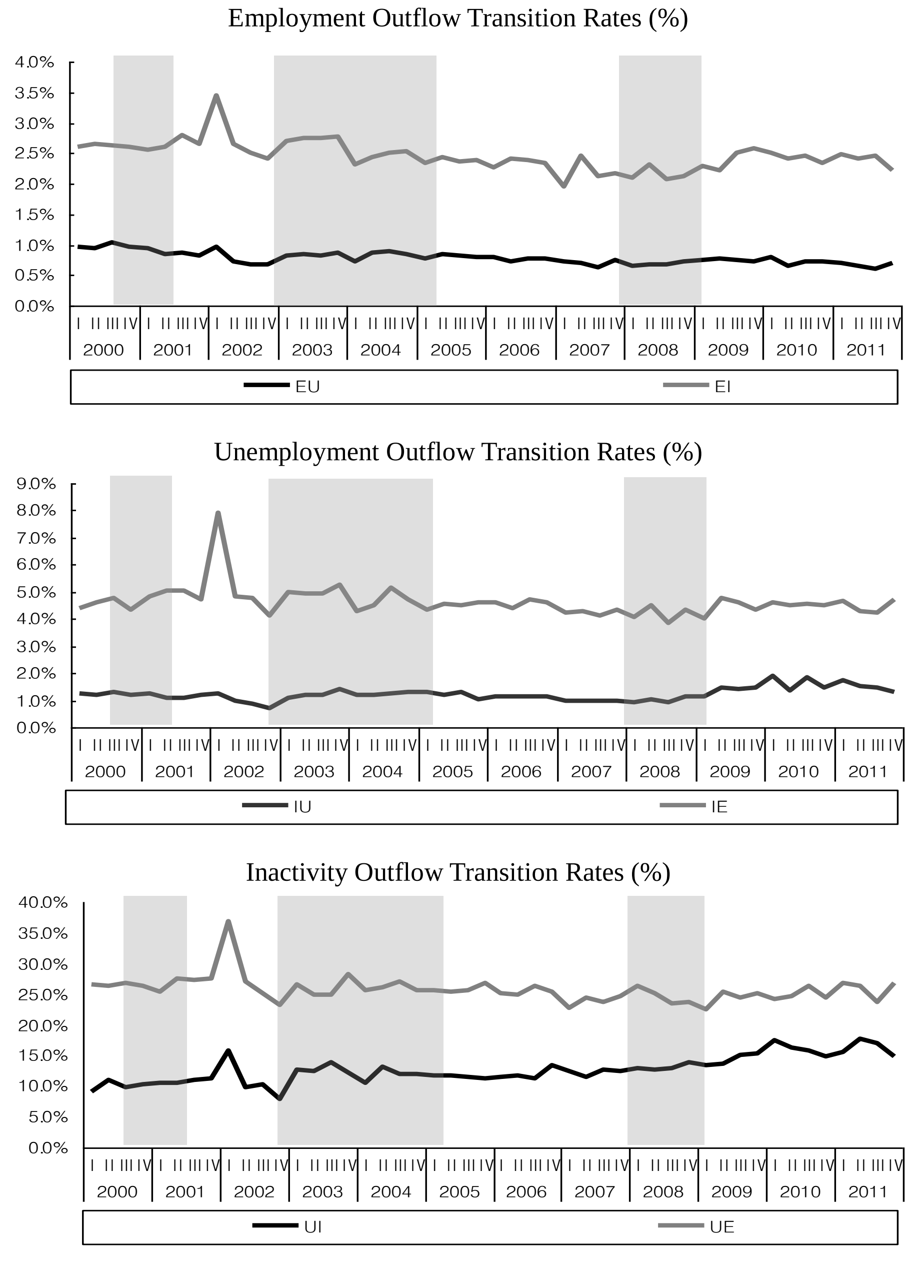
2) See Shimer's dataset from his webpage.

3) See Gomes (2009).

Figure 4 Labor Market Transition Rates



Note: Shaded areas indicate periods between peak and trough from the Business Cycle Clock by Statistics Korea, Korea.

Based on these figures, the decline in unemployment since 2009 was not due to the increase in work flow from unemployment to employment but to the decrease in that from employment to unemployment despite the fact that the outflow from inactivity to unemployment outnumbered that from unemployment to inactivity.

4. CYCLICALITY OF WORK FLOWS

This section studies the cyclicality of gross work flows and associated transition rates. We compute their correlations with the level of economic activity. We use the real GDP as an indicator of the level of economic activity. To obtain the cyclical components of the data, we use three alternative detrending methods: the Hodrick-Prescott (HP) filter with the standard smoothing parameter $(\lambda = 1,600)$ and with a low frequency filter $(\lambda = 10^5)$,[4] and the Boxter-King (BK) band-pass filter.[5]

Table 2 shows that inflows and outflows from the unemployment pool are counter-cyclical. This implies that the flows in and out of the unemployment pool increase in recessions. The counter-cyclicality of EU and IU flows is straightforward. In recession, more employed workers lose their jobs, and more inactive persons start searching for jobs. In contrast, the counter-cyclicality of the UE flows may look puzzling. This means that flows from unemployment to employment increase in recessions. This seemingly puzzling result can be explained in the following way. The UE flows are pinned down by the job finding rate (p_t^{UE}) and the number of unemployed workers (*U*), i.e., $F_t^{UE} = p_t^{UE} \times U$. In recessions, the job-finding rate falls and the number of unemployed workers rises. Since the latter effect dominates the former effect, the flow from unemployment to employment rises in recessions. Gross work flows between employment

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[4] An HP filter with this smoothing parameter $(\lambda = 10^5)$ is very close to linear detrending.

[5] Following Boxter and King (1999) and Stock and Watson (1999), we use a standard decomposition of the frequency band. Thus we isolate cycles with period of 6 quarters which is one of the typical length used in this exercise.

Table 2 Business Cycle Properties of Work Flows

2000Q1-2011Q4	HP ($\lambda=1,600$)		HP ($\lambda=10^5$)		BK	
Gross Flow	ρ	σ/σ_y	ρ	σ/σ_y	ρ	σ/σ_y
F_t^{EU}	–0.43	5.73	–0.26	6.99	–0.66	3.71
F_t^{EI}	–0.04	4.08	–0.03	6.53	–0.02	2.53
F_t^{UE}	–0.23	7.16	–0.15	9.55	–0.37	5.51
F_t^{UI}	–0.40	9.78	–0.28	12.16	–0.49	7.93
F_t^{IE}	–0.07	5.42	–0.06	6.95	–0.23	3.19
F_t^{IU}	–0.42	10.45	–0.34	12.83	–0.48	7.50

Notes: y_t is the percentage deviation from trend of real GDP. $F_{\square}^{XY}$ is the gross work flows 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 $10_{\square}^{5}$), or the Baxter-King filter.

Table 3 Business Cycle Properties of Transition Rates

2000Q1-2011Q4	HP ($\lambda=1,600$)		HP ($\lambda=10^5$)		BK	
Transition Rates	ρ	σ/σ_y	ρ	σ/σ_y	ρ	σ/σ_y
p_t^{EU}	–0.48	0.10	–0.40	0.09	–0.75	0.08
p_t^{EI}	–0.03	0.35	–0.02	0.47	–0.06	0.21
p_t^{UE}	0.24	1.69	0.21	1.73	0.31	1.23
p_t^{UI}	–0.22	1.26	–0.21	1.34	–0.21	0.77
p_t^{IE}	0.01	1.06	0.02	1.19	–0.06	0.64
p_t^{IU}	–0.40	0.22	–0.37	0.24	–0.58	0.15

Notes: y_t is the percentage deviation from trend of real GDP. $p_{\square}^{XY}$ is the transition rates 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 $10_{\square}^{5}$), or the Baxter-King filter.

and inactivity are least cyclical. Their correlations are lowest, and it seems that these flows are less sensitive to business cycles.

In table 3, we display the business cycle property of transition rates. The job-finding rate (p_t^{UE}) is pro-cyclical. The separation rate (p_t^{UE} and the

Table 4 Cross-correlation Analysis

	Lags						Leads				
	6	4	3	2	1	0	1	2	3	4	6
$p_{t\pm j}^{EU}$, y_t	0.21	0.03	0.04	–0.16	–0.40	–0.48	–0.49	–0.27	–0.21	–0.14	–0.06
$p_{t\pm j}^{EI}$, y_t	–0.10	0.09	0.26	0.24	0.13	–0.03	–0.30	–0.25	–0.26	–0.15	0.14
$p_{t\pm j}^{UE}$, y_t	0.03	–0.06	0.12	0.22	0.27	0.24	0.00	–0.09	–0.04	–0.01	0.15
$p_{t\pm j}^{UI}$, y_t	–0.15	–0.01	0.16	0.09	–0.01	–0.22	–0.26	–0.16	–0.16	–0.10	0.08
$p_{t\pm j}^{IE}$, y_t	–0.02	0.04	0.25	0.19	0.17	0.01	–0.27	–0.18	–0.10	–0.03	0.16
$p_{t\pm j}^{IU}$, y_t	0.18	0.14	0.12	0.02	–0.19	–0.40	–0.52	–0.43	–0.38	–0.22	–0.18

Notes: y_t is the percentage deviation from trend of real GDP. $p_{\square}^{XY}$ 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.

transition rates between inactivity and unemployment (p_t^{IU} and p_t^{UI}) are counter-cyclical. The pro-cyclicality of the job finding rate suggests that it is relatively easier to find a job in boom. The counter-cyclicality of the IU transition rate implies that in a recession, inactive person is more likely to search for a job. These cyclical patterns hold true at lead and lag of one quarter, except the transition rate between employment and inactivity, as seen in table 4.

5. THE INS AND OUTS OF KOREAN UNEMPLOYMENT

In this section, we study the contribution of inflow and outflow rates to variations in the unemployment rate. Recently, a number of studies quantified these contributions, assuming that the actual unemployment rate is closely approximated by its steady state value (Elsby *et al*., 2009; Fujita and Ramey, 2009; Petrongolo and Pissarides, 2008). Under this assumption, contemporaneous variation in the unemployment rate is 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, which is true in the US. The steady state assumption may not hold in Korea, even though transition rates are relatively higher than any other countries such as Japan and the UK and they are as high as the US. We also quantify the contributions without the steady state assumption by using non-steady state decomposition as in Smith (2011).

The evolution of the unemployment rate $u_t^{\square}$ over time can be obtained by

$$\frac{du_t}{dt} = s_t(1 - u_t^{\square}) - f_t u_t, \tag{3}$$

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

In conventional unemployment decomposition, we first approximate the unemployment rate with its steady state level, u_t^*. We consider the simple two-state case where workers are either employed or unemployed. Now f_t and s_t represent the job-finding and separation rates, respectively. We can approximate unemployment by

$$u_t \cong u_t^* = \frac{s_t}{s_t + f_t}, \tag{4}$$

where u_t^* is the steady state unemployment rate.

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

$$\dot{E}_t = p_t^{UE} U_t + p_t^{IE} I_t - (p_t^{EU} + p_t^{EI}) E_t, \tag{5}$$

$$\dot{U}_t = p_t^{EU} E_t + p_t^{IU} I_t - (p_t^{UE} + p_t^{UI}) U_t, \tag{6}$$

$$\dot{I}_t = p_t^{EI} E_t + p_t^{UI} U_t - (p_t^{IE} + p_t^{IU}) I_t, \tag{7}$$

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

In the steady state, flows in and out of employment are equal by assumption. Similarly, flows in and out of unemployment are equal. Thus, the steady state conditions for employment and unemployment are

$$p_t^{UE} U_t + p_t^{IE} I_t = (p_t^{EU} + p_t^{EI}) E_t, \tag{8}$$

$$p_t^{EU} E_t + p_t^{IU} I_t = (p_t^{UE} + p_t^{UI}) U_t. \tag{9}$$

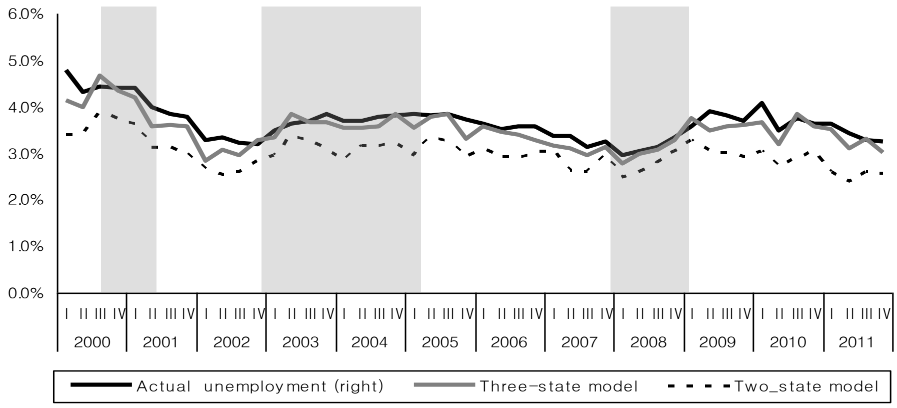
By rearranging (8) and (9), we can express the steady state unemployment rate as a function of all six transition rates:

$$u_t^* \equiv \frac{p_t^{EU} + \dfrac{p_t^{IU}}{p_t^{IU} + p_t^{IE}} \cdot p_t^{EI}}{p_t^{EU} + \dfrac{p_t^{IU}}{p_t^{IU} + p_t^{IE}} \cdot p_t^{EI} + p_t^{UE} + \dfrac{p_t^{IE}}{p_t^{IU} + p_t^{IE}} \cdot p_t^{UI}}. \tag{10}$$

The second term in the numerator is the transition rate from employment to unemployment through inactivity. We allow for workers to transit from employment to inactive and from inactive to unemployment within one period. The first and second terms together are the overall inflow rate from employment to unemployment, which includes the direct transition from employment to unemployment and the transition rate moving through inactivity. Similarly, the sum of the third and fourth terms in the denominator is the transition rate from unemployment to employment, directly and moving through inactivity.

Let us look into whether the steady state assumption is reasonable in Korea by plotting the steady state unemployment rates in the two-state and three-state models computed from equation (4) and (10). Figure 5 shows that the steady state unemployment rates from the three-state case move quite closely

Figure 5 Actual and Steady State Unemployment Rates



Notes: The solid line indicates the actual unemployment rate. The shaded line and dashed line indicate the steady state unemployment rate in the three-state and two-state models respectively. Shaded areas indicate periods between peak and trough from the Business Cycle Clock by Statistics Korea, Korea.

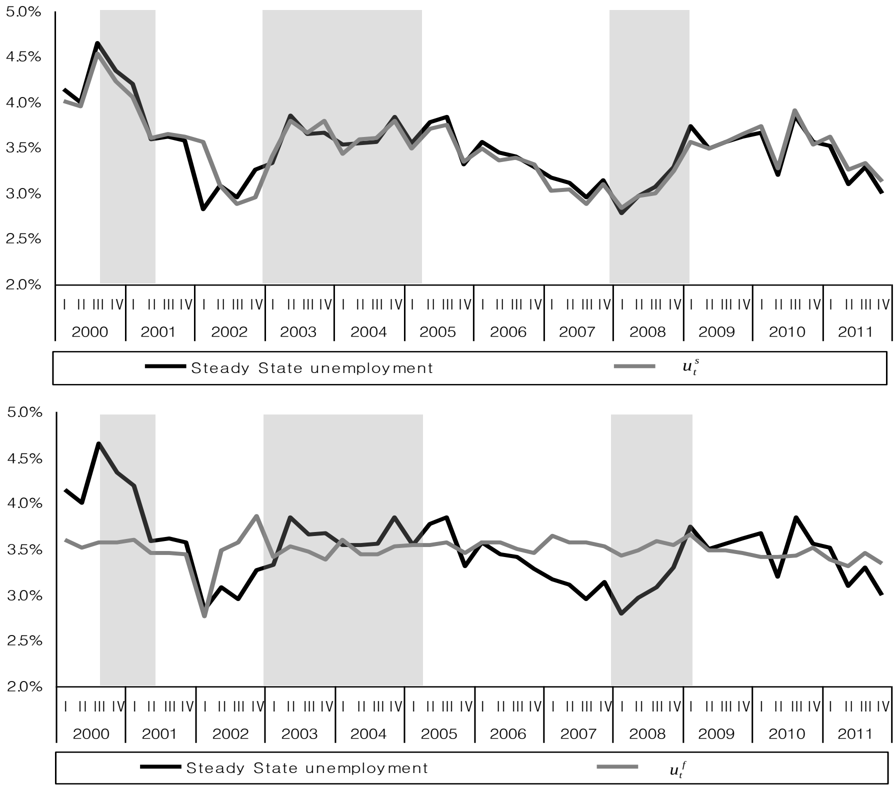
with the actual unemployment rates, while we observe consistent discrepancies between the actual and the steady state unemployment rate with two-state case.

This discrepancy comes from the following possible reason. The reason can be ignoring flows into and out of inactivity. The correlations between the actual unemployment rate and the steady state unemployment rate are 0.81 for the two-state model and 0.93 for the three-state model respectively. This suggests that flows in and out of inactivity play an important role in explaining unemployment dynamics in Korea, and this contradicts with the conventional wisdom that movements in and out of the labor force play little role at business cycle frequencies.

5.1. Shimer (2007) Decomposition

Shimer (2007) isolates the effects of the job-finding rates by constructing counterfactual unemployment rates, if the job separation was always in its sample average and denoted as u_t^f. Similarly, he constructs the series for unemployment, if the job-finding rate was at its sample average and they are

Figure 6 Actual and Counterfactual Unemployment Rates



Notes: Contribution of fluctuations in the job finding and separation rates to fluctuations in the unemployment rate, 2001 Q1-2011 Q4. Shaded areas indicate periods between peak and trough from the Business Cycle Clock by Statistics Korea, Korea.

denoted as u_t^s. Let $\bar{s}$ and $\bar{f}$ denote the average values of s_t and f_t during the sample period and compute $u_t^f = \bar{s}/(\bar{s}+f_t)$ and $u_t^s = s_t/(s_t+\bar{f})$ as measures of the contributions of fluctuations in job finding and separation rates to overall fluctuations in the unemployment, where $s_t \equiv p_t^{EU} + (p_t^{IU}/(p_t^{IU}+p_t^{IE}))\cdot p_t^{EI}$, and $f_t \equiv p_t^{UE} + (p_t^{IE}/(p_t^{IU}+p_t^{IE}))\cdot p_t^{UI}$ from the three-state model.

The top panel in figure 6 shows that a change in the separation rate s_t contributes to every change in the unemployment during the periods between 2000 and 2011. The bottom panel shows that the finding rate rarely explains the changes in the unemployment rates. In order to quantify the cyclicality of the job finding and separation rates, Shimer (2007) looks at the comovement of the detrended data. Over the sample periods, the correlation of the cyclical components[6] of u_t^* and $\bar{s}/(\bar{s}+f_t)$ is 0.27 while the correlation between u_t^* and $s_t/(s_t+\bar{f})$ is very high, 0.83. Furthermore, $s_t/(s_t+\bar{f})$ is more volatile, with a cyclical standard deviation is 0.98 times that of u_t^*, which suggests that u_t^s is as volatile as u_t^*. The relative standard deviation of $\bar{s}/(\bar{s}+f_t)$ is just 0.58. This exercise finds that the separation rate, inflow to unemployment state, contributes more to accounting for the fluctuation in the unemployment in Korea.

Shimer's decomposition has faced strong criticism, because the steady state approximation is non-linear in the two hazard rates. In this sense, if we choose different values for $\bar{s}$ and $\bar{f}$, instead of the sample average, we could get different answer. In the next subsection, we discuss alternative decompositions introduced by Fujita and Ramey (2009), Petongolo and Pissarides (2008) and Smith (2011).

5.2. Steady State Decomposition

Fujita and Ramey (2009) suggest the following decomposition approach. By taking the first difference of (4),

$$\Delta u_t^* = (1-u_t^*)u_{t-1}^* \frac{\Delta s_t}{s_{t-1}} - u_t^*(1-u_{t-1}^*)\frac{\Delta f_t}{f_{t-1}}, \tag{11}$$

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

[6] Following Shimer (2007), the cyclical component is obtained by HP filtering with smoothing parameter = 100,000.

unemployment, i.e., the contribution of the outflow to the unemployment dynamics. Let $C^*_{s,t} \equiv (1-u^*_t)u^*_{t-1}(\Delta s_t / s_{t-1})$ represent the contribution of changes in the inflow rate to changes in the steady state unemployment rate. Similarly, let $C^*_{f,t} \equiv -u^*_t(1-u^*_{t-1})(\Delta f_t / f_{t-1})$ denote the contribution of changes in the outflow rates to changes in the steady state unemployment rate.

Let $s_t \equiv p^{EU}_t + (p^{IU}_t / (p^{IU}_t + p^{IE}_t)) \cdot p^{EI}_t$, and $f_t \equiv p^{UE}_t + (p^{IE}_t / (p^{IU}_t + p^{IE}_t)) \cdot p^{UI}_t$ in the three-state model of unemployment. Then (10) becomes identical to (4), and so the decomposition in (11) holds. The contributions of total inflow and outflow rates can be further divided into terms attributed to the direct flows between employment and unemployment and the indirect flows between employment and inactivity. From (10), we obtain

$$\frac{\Delta s_t}{s_{t-1}} = \frac{1}{s_{t-1}}\left[\Delta p^{EU}_t + \Delta\left(\frac{p^{IU}_t}{p^{IU}_t + p^{IE}_t} \cdot p^{EI}_t\right)\right], \tag{12}$$

$$\frac{\Delta f_t}{f_{t-1}} = \frac{1}{s_{t-1}}\left[\Delta p^{UE}_t + \Delta\left(\frac{p^{IE}_t}{p^{IU}_t + p^{IE}_t} \cdot p^{UI}_t\right)\right]. \tag{13}$$

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

$$C^*_{EU,t} = (1-u^*_t)u^*_{t-1}\frac{\Delta p^{EU}_t}{s_{t-1}}, \tag{14}$$

$$C^*_{UE,t} = -u^*_t(1-u^*_{t-1})\frac{\Delta p^{UE}_t}{f_{t-1}}. \tag{15}$$

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

$$C^*_{EIU,\,t} = \frac{(1-u^*_t)u^*_t - 1}{s_{t-1}} \cdot \Delta\left(\frac{p^{IU}_t}{p^{IU}_t + p^{IE}_t} \cdot p^{EI}_t\right), \tag{16}$$

$$C^*_{UIE,\,t} = \frac{-u^*_t(1-u^*_{t-1})}{f_{t-1}} \cdot \Delta\left(\frac{p^{IE}_t}{p^{IU}_t + p^{IE}_t} \cdot p^{UI}_t\right). \tag{17}$$

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

$$\beta^*_i = \frac{\mathrm{cov}(\Delta u^*,\, c^*_i)}{\mathrm{var}(\Delta u^*)}, \tag{18}$$

where $i = s,\, f,\, EU,\, UE,\, EIU,\, UIE.$

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

Table 5 reports the results of this decomposition for the full sample. For the full sample, the inflow and outflow rates account for around 73% and 27% of unemployment variability, respectively. Within the contribution of the inflow, changes in direct separation rate account for 30% of steady state unemployment fluctuations, while the indirect transition rate working through inactivity explains a larger portion of this, since they account for 44% of unemployment dynamics. The outflow rate plays a less important role in explaining unemployment volatility, accounting for only 27 % of it. Within the contribution of the outflow, changes in direct finding rate account for 15%, while the transition rate through inactivity explains 12% of it. Compared to the UK and Japan, it still holds in Korea that inflow accounts for more of unemployment dynamics. Korea, however, observes that much more important role is played by the inflow than other countries. Specially, this observation can be summarized by the fact that relatively high accountability of transition to unemployment working through inactivity and

Table 5 Decompositions of Unemployment Fluctuations

Steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	Quarterly Frequency	0.73	0.27	0.30	0.44	0.15	0.12
1996.Q1-2007.Q4	UK	0.57	0.40	0.41	0.16	0.31	0.09
1980.Q1-2009.Q4	Japan	0.54	0.45	0.44	0.10	0.53	–0.07
Non-steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	Quarterly Frequency	0.82	0.18	0.42	0.40	0.16	0.02
1980.Q1-2009.Q4	Japan	0.54	0.40	0.46	0.08	0.41	–0.01

Note: Values for the UK and Japan are obtained from Smith (2011) and Lin and Miyamoto (2012).

low of direct job-finding rates.

This decomposition also finds that the inflow rate has significantly affected fluctuations in unemployment in Korea, and not just the direct inflow from employment to unemployment but also the indirect inflow through inactivity plays an important role in explaining them.

5.3. Non-Steady State Decomposition

Smith (2011) proposes a new method in order to decompose the variations in the unemployment rate for the economy, where the unemployment rate deviates from its steady state value. Starting from equation (3), the expression for unemployment dynamics can be rewritten as

$$u_t = \frac{s_t}{s_t + f_t} - \frac{1}{s_t + f_t}\frac{du_t}{dt}. \tag{19}$$

By differentiating (19) with respect to time, unemployment out of steady state can be expressed in terms of the rate of change in the steady state unemployment rate and the rate of acceleration of the actual unemployment rate,

$$\frac{du_t}{dt} = \frac{d}{dt}\left(\frac{s_t}{s_t + f_t}\right) - \frac{d}{dt}\left(\frac{du_t}{dt}\frac{1}{s_t + f_t}\right). \tag{20}$$

Rearranging gives the following second-order differential equation,

$$\frac{d^2u_t}{dt^2} = \frac{1}{s_t + f_t}\left[f_t\frac{ds_t}{dt} - s_t\frac{df_t}{dt}\right] + \frac{du_t}{dt}\left[\frac{1}{s_t + f_t}\frac{d}{dt}(s_t + f_t) - s_t + f_t)\right]. \tag{21}$$

This can be treated as a first order differential equation in du_t / dt. Let us denote the sum of inflow and outflow rates $s_t + f_t$ as ω_t. By discretizing and rearranging it, we have the following recursive expression for the dynamics of the actual unemployment rate,

$$\Delta u_t = \frac{\omega_t \omega_{t-1}}{\omega_{t-1} + \omega_t^2}\Delta u_t^* + \frac{\omega_t}{\omega_{t-1} + \omega_t^2}\Delta u_{t-1}^{\square}, \tag{22}$$

where u_t^* is the steady state unemployment rate and Δ denotes a discrete change over a period. Note that the coefficient on Δu_t^* gives the rate of convergence to the steady state.

When the transition rates are higher, changes in the actual unemployment rate can be approximated more closely by changes in the steady state unemployment rate. Conversely, when transition rates are low, changes in the unemployment rates are determined not only by changes in steady state unemployment but also by past changes in transition rates and steady state unemployment rate.

Contributions to actual unemployment dynamics from changes in the outflow and inflow rate can be defined on the basis of equation (22) as

$$C^{\square}_{f,\,t} = \frac{\omega_t \omega_{t-1}}{\omega_{t-1} + \omega_t^2} C^*_{f,\,t} + \frac{\omega_t}{\omega_{t-1} + \omega_t^2} C^{\square}_{f,\,t-1}, \tag{23}$$

$$C^{\square}_{s,\,t} = \frac{\omega_t \omega_{t-1}}{\omega_{t-1} + \omega_t^2} C^*_{s,\,t} + \frac{\omega_t}{\omega_{t-1} + \omega_t^2} C^{\square}_{s,\,t-1}, \tag{24}$$

where by defining $C^{\square}_{f,\,0} = C^{\square}_{s,\,0} = 0,$ the contributions to steady state unemployment dynamics $C^*_{f,\,t}$ and $C^*_{s,\,t}$ are defined before in the earlier section:

$$C^*_{f,\,t} \equiv -u_t^*(1 - u^*_{t-1}) \frac{\triangle f_t}{f_{t-1}}, \tag{25}$$

$$C^*_{s,\,t} \equiv (1 - u_t^*) u^*_{t-1} \frac{\triangle s_t}{s_{t-1}}. \tag{26}$$

There is also a contribution from the initial condition at time $t = 0.$ The path of this contribution over time can be expressed recursively:

$$C_t^0 = C^0_{t-1} \frac{\omega_t}{\omega_t^2 + \omega_{t-1}}, \tag{27}$$

where C_0^0 is defined as the initial deviation from steady state and $C_0^0 \equiv \Delta u_0 - \Delta u_0^* = u_0 - u_0^*.$

As in 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 relative importance of the various flow rates can be summarized in the following beta values.

$$\beta_i^* = \frac{\mathrm{cov}(\Delta u^{\square},\ C_i^{\square})}{\mathrm{var}(\Delta u^{\square})}, \tag{28}$$

Table 6 Disaggregation of Unemployment Fluctuations by Age Groups

Steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	All Age-group	0.73	0.27	0.30	0.44	0.15	0.12
	15-29	0.90	0.10	0.46	0.44	0.07	0.03
	30-39	0.76	0.24	0.41	0.35	0.11	0.13
	40-49	0.84	0.16	0.56	0.28	0.14	0.02
	50-59	0.79	0.21	0.58	0.21	0.09	0.12
	60-	0.93	0.07	0.30	0.64	–0.02	0.09
Non-steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	All Age-group	0.82	0.18	0.42	0.40	0.16	0.02
	15-29	0.91	0.09	0.45	0.45	0.08	0.01
	30-39	0.83	0.17	0.46	0.36	0.11	0.07
	40-49	0.88	0.12	0.57	0.31	0.11	0.01
	50-59	0.86	0.14	0.58	0.28	0.06	0.07
	60-	0.95	0.05	0.31	0.64	0.03	0.03

where $i = s, f, EU, UE, EIU, UIE.$

Table 6 reports the results of non-steady state decomposition below in the table. Variations in the inflow rate account for 82% of unemployment fluctuations and outflow rates account for 18% of unemployment fluctuations. Hence, variations in the inflow rate play an important role in the variation in the unemployment in Korea. This result confirms the preceding ones.

Contributions of outflows to unemployment fluctuations in the steady state decomposition are smaller than those in the non-steady state decomposition one. The relative importance of each component, however, is similar in each method.

Unlike other countries, the inflow through inactivity to the unemployment in Korea accounts for distinguishably high portion of the variation in unemployment. This suggests that in analyzing unemployment fluctuations in Korea, researcher should take into account fluctuations in inflow through inactivity.

6. DISAGGREGATION OF INS AND OUTS OF UNEMPLOYMENT

This section disaggregates our previous analysis by sex and age-groups in order to account for main driver of unemployment dynamics in Korea.

We first divide our population into five age-groups — 15-29 year-old, 30-39 year-old, 40-49 year-old, 50-59 year-old, 60 and above year-old — and compute the contributions of inflow and outflow to the unemployment of the age-group as we discussed in the earlier section. Table 7 shows the results of not only steady state decomposition but also non-steady state decomposition. We observe that variations in the inflow rates play more important role in the variation in the unemployment in Korea than variations in the outflow rates. The observations are consistent across all age-groups we considered and this result confirms the preceding ones. Two age-groups, 15-29 year-old group and 60 and above year-old group are worthy on note. They include the youngest age-group and the oldest age-group, and the variations of 15-29 year-old group and 60 and above year-old group unemployment are accounted for as high as 90% and 93% by the variations of inflow rates in the steady state decomposition. In the non-steady state decomposition, fluctuations of inflow rate to unemployment explain 91% and 95% of variation of 15-29 age-group unemployment rate and 60 and above age-group unemployment rate, respectively.

We also group our samples by sex and investigate the contributions of inflow and outflows to the unemployment rates of men and women. In both sex groups, the inflow to unemployment accounts for more of variations of unemployment rates than the outflow from unemployment. In both

Table 7 Disaggregation of Unemployment Fluctuations by Sex

Steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	Both Sexes	0.73	0.27	0.30	0.44	0.15	0.12
	Men	0.78	0.22	0.52	0.26	0.23	–0.01
	Women	0.87	0.13	0.24	0.64	0.02	0.10
Non-steady State Decomposition							
Period	Feature	β_s^*	β_f^*	β_{EU}^*	β_{EIU}^*	β_{UE}^*	β_{UIE}^*
2000.Q1-2011.Q4	Both Sexes	0.82	0.18	0.42	0.40	0.16	0.02
	Men	0.88	0.12	0.60	0.29	0.14	–0.02
	Women	0.93	0.07	0.31	0.62	0.04	0.04

decomposition methods, steady state decomposition and non-steady state decomposition, women's unemployment rate fluctuations are accounted for 87% and 93% by the variations of the inflow rates.

7. CONCLUSION

This paper studies work flow dynamics in Korea over the last decade. By using data from the Economically Active Population Survey (EAPS), this paper provides a number of key stylized facts on work flow and unemployment dynamics in Korea.

We examine the size and cyclicality of both the gross work flows and associated transition rates between the states of employment, unemployment, and inactivity. There are large gross work flows across labor market status. We find that about 5% of the working age population changes labor market status in each month. Inflows and outflows of unemployment are counter-cyclical, while flows between employment and inactivity are pro-cyclical. These findings are broadly consistent with results for the US and European countries. We also find that job-finding and separation rates in Korea are little smaller but comparable with those in the US.

We also decompose unemployment fluctuations into the parts due to changes in inflow and outflow rates. Three different decomposition methods commonly find that inflow to unemployment contributes substantially to unemployment fluctuations in Korea and particularly inflow through inactivity plays a larger role in unemployment dynamics in Korea.

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