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Labor Market Matching Efficiency and Korea's Low Post-Pandemic Unemployment

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Labor Market Matching Efficiency and Korea's Low Post-Pandemic Unemployment
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ABSTRACT: Following the COVID-19 pandemic, Korea's unemployment rate has remained significantly lower than pre-pandemic levels. This paper examines the dynamics of unemployment through a framework of labor market flows incorporating a matching function and identifies a sustained increase in labor market matching efficiency as the primary driver of persistently low post-pandemic unemployment. The framework further suggests that, barring an unlikely reversal of these efficiency gains, the unemployment rate is likely to remain below 3 percent in the medium term. Notably, despite heightened labor market tightness, post-pandemic wage growth in Korea has been modest. The paper develops a variant of the Diamond-Mortensen-Pissarides model, demonstrating that increased labor market matching efficiency helps account for this apparent paradox.

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WORKING PAPERS

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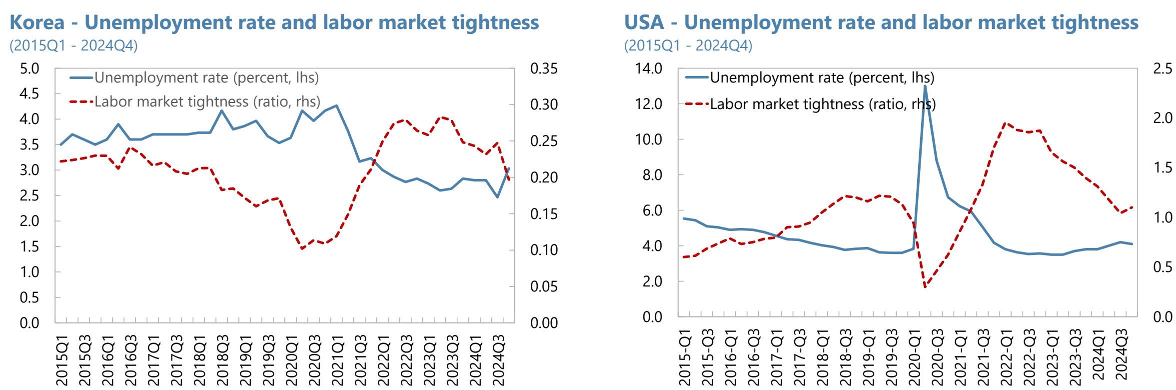
Contents

I. Introduction

Korea weathered the COVID-19 shock impressively. The Korean economy entered the COVID-19 pandemic with sound macroeconomic fundamentals and a resilient financial system. The initial outbreak led to a sharp decline in economic activity and employment and generated substantial economic slack. With the help of comprehensive economic policy response and an effective COVID-19 containment strategy without imposing stringent lockdowns, the overall economic and social impacts were relatively small. Korea began to relax its COVID-19 restrictions in April 2022, when most of its social distancing measures were lifted, including the curfew on business hours and limits on private gatherings. This marked a significant shift in the country's approach to managing the pandemic, as it moved towards treating COVID-19 as an endemic disease. This paper refers to the period since 2021Q3 as "post-pandemic" and that before 2020Q1 as "pre-pandemic".

Following initial pandemic-induced disruptions to the labor market and an associated rise in unemployment that peaked at 4.8 percent in January 2021[1], the unemployment rate declined steadily since 2021Q2 and has remained below 3.0 percent, substantially lower than the pre-pandemic norm of 3.5 – 4.0 percent. As a result, the post-pandemic labor market has stayed substantially tighter than the pre-pandemic average (Figure 1). This reduced unemployment is not common in Advanced Economies (AEs). In the US, for example, unemployment has returned to pre-pandemic levels after a surge in the early phase of the pandemic and the tight labor market mainly reflects high job vacancies. In Japan, the unemployment rate has broadly returned to the levels in the quarters before the onset of the pandemic. Among AEs, the labor market in Australia resembles that of Korea with the unemployment rate staying below the pre-pandemic norm and labor market tightness remaining elevated (Figure 1).

Figure 1. Unemployment Rate and Labor Market Tightness

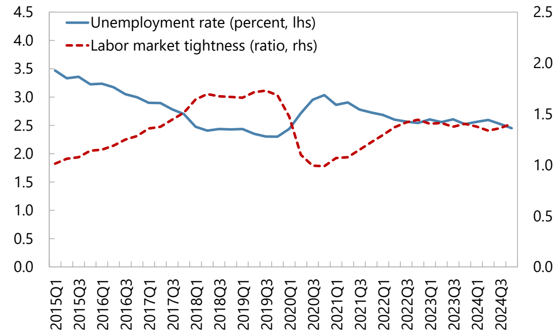


Sources: Haver Analytics and IMF staff calculation.

Sources: Haver Analytics and IMF staff calculation.

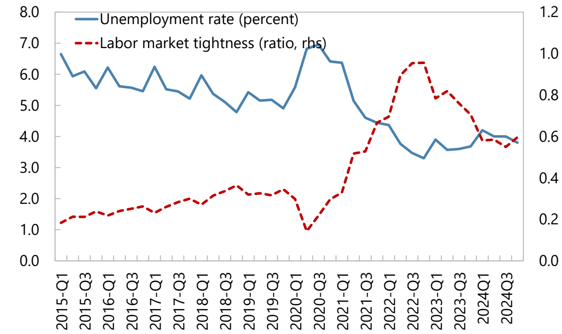
[1] See Lee and Yang (2022), and Nam and Lee (2021) for discussion of Korea's labor market performance in the early phase of the COVID-19 pandemic.

Japan - Unemployment rate and labor market tightness
(2015Q1 - 2024Q4)



Sources: Haver Analytics and IMF staff calculation.

Australia - Unemployment rate and labor market tightness
(2015Q1 - 2024Q4)



Sources: Haver Analytics and IMF staff calculation.

The main objective of this paper is to understand the drivers of Korea's historically low post-pandemic unemployment. To this end, this paper first reviews labor market developments in Korea since the onset of COVID-19, documenting variation in labor supply and demand overtime as well as the unusual inward shifting of the Beveridge Curve. I then use a standard framework of labor market flows incorporating a matching function to compute quarterly labor market matching efficiency. Results suggest that the matching efficiency improved steadily since at least two years before the COVID-19 pandemic through 2022Q2, except for a sharp but temporary decline in 2020Q2, and has sustained at a high level ever since. Counterfactual simulations using the framework are then performed to decompose the contributions of labor supply (labor force participation rate and working-age population growth), labor demand, and matching efficiency to the changes in the unemployment rate for the period 2020-2024. While factors affecting labor supply and demand played some role in determining labor market outcomes, particularly in the early phase of the pandemic with severe labor market disruptions, overall, the improvement in labor market matching efficiency is shown to be the most important factor for the low post-pandemic unemployment.

Moreover, as the labor market matching efficiency started rising much before the pandemic and remained stable through the pandemic, it is unlikely to be mainly driven by cyclical factors which may reverse the gain in efficiency. Rather, higher matching efficiency is likely to have reflected deep structural changes of the labor market and thus maintain its current high level, at least in the medium term. Assuming that the matching efficiency stays at its current level, the framework projects that the medium-term structural unemployment rate will be kept under 3 percent, far lower than its pre-pandemic norm.

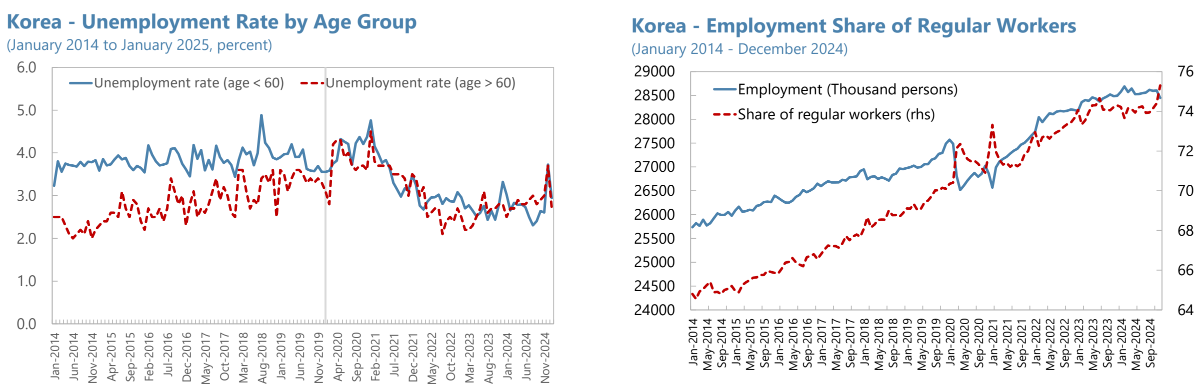
Despite elevated tightness of the post-pandemic labor market, wage growth in Korea has remained subdued. Growth rates of average nominal and real wages were lower compared to pre-pandemic norms. While multiple factors might have jointly resulted in depressed wage growth during this period, the novel contribution of this paper is the hypothesis that higher labor market matching efficiency could have tightened the labor market and slowed wage growth at the same time. To drive home this point, I develop a variant of the canonical Diamond-Mortensen-Pissarides (DMP) model of the labor market to show that either a shortage of labor supply or higher labor market matching efficiency can lead to a tighter labor market. However, at the same level of labor market tightness, the wage rate in the latter case is lower than in the former. Intuitively, while a decline in labor supply increases capital per worker and hence labor productivity, an increase in the matching efficiency does not have the same effect.

The rest of the paper is structured as follows. Section II documents labor market developments since the onset of the COVID-19 pandemic. Section III uses a simple quantitative framework to compute labor market matching efficiency and decompose the variation in the unemployment rate. Section IV forecasts the natural rate of unemployment in the medium term. Section V develops a variant of the DMP model to examine the relationship between wage rate and labor market tightness. Section VI concludes.

II. Labor Market Developments

This section first dispels two common misconceptions about the causes of low unemployment in post-pandemic Korea before reviewing labor market developments. One common view holds that Korea's low post-pandemic unemployment merely reflects growing employment of the elderly. While unemployment among the elderly (age above 60) has indeed declined significantly from as high as 4.5 percent in early-2021, partly due to the government's elderly public employment program, the unemployment rate of those below 60 years old has also trended down significantly and has stayed below 3 percent since 2021H2 except for a few months, suggesting that the low unemployment is a broad labor market phenomenon not specific to one age group (Figure 2, left chart).

Figure 2. Employment and Unemployment



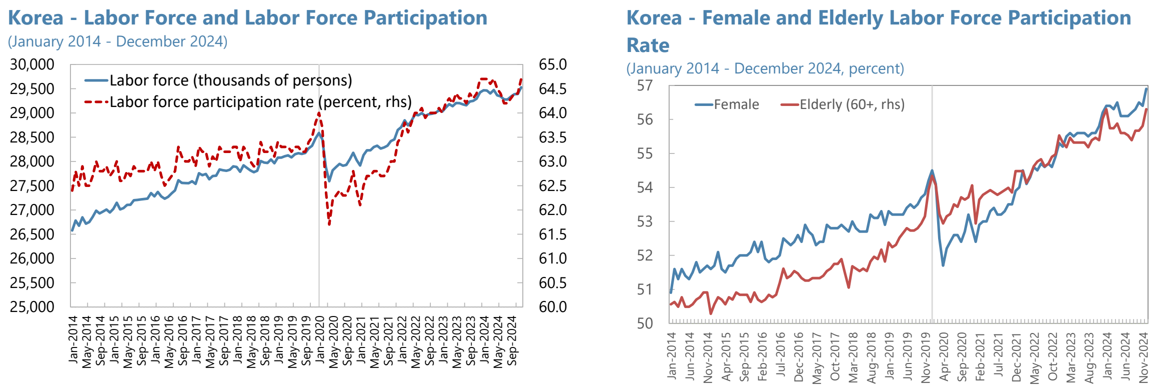
Sources: Haver Analytics and IMF staff calculation.

Sources: Haver Analytics and IMF staff calculation.

There is another view that the low unemployment reflects substitution of regular workers by temporary workers. The argument goes that as one regular worker is replaced potentially by more than one temporary workers, total employment would be higher and thus unemployment would be lower, even though the total hours worked need not see a substantial increase. This view is not supported by data. The share of regular workers has been steadily trending up since pre-pandemic times and has even temporarily surged in the early phases of the pandemic as regular workers were less likely to be laid off compared to temporary workers. This share has increased from about 65 percent in January 2014 to 75 percent by end-2024 (Figure 2, right chart). Therefore, the composition of regular v.s. temporary workers could not be a main driver of the low post-pandemic unemployment in Korea.

Since the unemployment rate is an equilibrium outcome labor market determined by labor supply, labor demand, as well as how the two are matched, I hereby turn to these factors in order. After an initial decline upon the COVID-19 shock, labor supply in Korea has returned to the pre-COVID rising trend. The labor force contracted significantly at the onset of the pandemic as rising COVID cases and public health interventions discouraged labor force participation. It gradually recovered since then and has returned to the pre-COVID trend by early 2022 (Figure 3, left chart). The trend increase in labor force participation from 62.4 percent in January 2014 to 64.7 percent in December 2024 mainly reflects steady rises in female and elderly labor force participation, despite temporary reversals at the beginning of the pandemic (Figure 3, right chart). Since post-pandemic labor force does not exhibit a clear deviation from its pre-pandemic trend, it is unlikely to be a main contributor to the post-pandemic low unemployment and tight labor market, unlike in many other AEs (Duval et al, 2022).

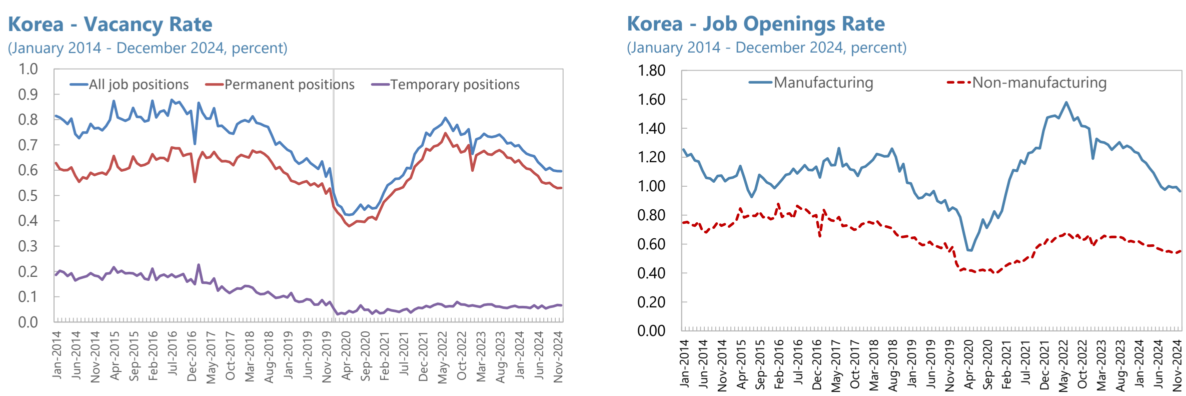
Figure 3. Labor Supply



Sources: Haver analytics and IMF staff calculation.

Sources: Haver Analytics.

Figure 4. Labor Demand

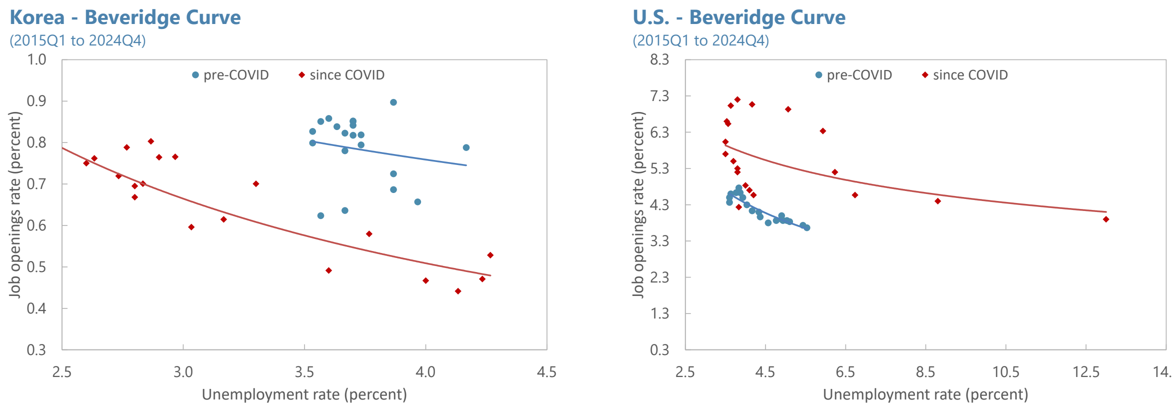


Sources: Haver Analytics and IMF staff calculation.

Sources: Haver Analytics and the author's calculation.

Labor demand has also broadly recovered to pre-COVID levels. Job vacancies fell significantly as COVID-19 hit and remained suppressed throughout 2020, before strong economic recovery in 2021 fueled a strong rebound. The job vacancy rate (the ratio of job vacancies to the labor force) peaked in the first half of 2022, before it moderated reflecting weakening growth momentum from 2022H2 onwards (Figure 4, left chart). Labor demand has displayed stronger cyclicality than labor supply, nevertheless, the job vacancy rate averaged 0.7 percent, which is exactly the average level in 2018-2019. The variations in the job vacancy rate largely reflected those of vacancies of permanent job positions, while the number of temporary job vacancies has remained relatively stable. This is also inconsistent with the notion that the low unemployment reflected substitution of regular workers by temporary ones. An alternative measure of labor demand – the job openings rate (the ratio of job vacancies to the sum of vacancies and employment) – paints a similar picture (Figure 4, right chart). In addition, the job openings rate of the manufacturing sector has been more volatile than that of the non-manufacturing sector, reflecting shifts of demand to and from manufacturing since the pandemic.

Figure 5. Beveridge Curve



Equilibrium outcome of the labor market is not only determined by labor supply and labor demand, but also by the process of matching job vacancies with job seekers. Although the efficiency of this matching process is not directly observable, some clues are contained in the Beveridge curve. In contrast to the US where the Beveridge curve has shifted outward since the pandemic started (2020Q1), the Beveridge curve of Korea has shifted inward, implying that the unemployment rate would be lower given the same job openings rate relative to the pre-pandemic period. The inward shift of the Beveridge curve is commonly interpreted as a sign of higher labor market matching efficiency. However, the evidence from the Beveridge curve is suggestive only, as there can also be other causes of the shift.[2] To pin down the role of labor market matching efficiency, the next section first obtains its estimates using a simple framework.

III. Quantifying Drivers of Unemployment

I use a standard framework of labor market dynamics accounting for the flows of individuals in and out of employment. This framework has long been used to study the Beveridge curve (e.g. Blanchard and Diamond, 1989) and has been used in recent research to study the prospect of soft landing of the US economy (e.g., Figura and Waller, 2024). I do not close the model by making assumptions about the job creation process, wage determination, or other fundamentals, which are included in a fuller model in Section V. Instead, I focus on deriving conclusions that must hold for any general equilibrium model whose labor market is described by (1) the standard law of motion for unemployment and (2) the usual matching function relationship. The starting point is accounting for the dynamics in the labor market by accounting for the flows of individuals in and out of employment.

$$E_t = E_{t-1} - s_t E_{t-1} + H_t, \tag{1}$$

[2] See Ahn and Crane (2020), Elsby, Michaels, and Ratner (2015) for discussion and decomposition of the movement of the US Beveridge curve.

where E_t is the number of employed workers in period t, H_t denotes the number of gross hires in period t, and s_t denotes the separation rate in period t, i.e., the share of workers who are employed in period $t-1$ that lose jobs in period t. Therefore, $s_t E_{t-1}$ is the number of job separations in period t. Equation (1) therefore states that employment (in number of persons) in period t decreases with job separations and increases with gross hires in period t. gross new hires depend on the number of job vacancies and the number of unemployed workers. The more jobs waiting for workers, the more hires; the more workers looking for jobs, the more hires as well. Following the literature, we assume the existence of a matching function that takes the following standard form:

$$H_t = \mu_t V_t^{\sigma} U_t^{1-\sigma}, \tag{2}$$

where V_t and U_t denote the number of job vacancies and unemployed workers in period t. The time-varying parameter μ_t governs the efficiency of the matching process in period. Higher efficiency translates into more new hires in period t. The parameter σ captures the relative importance of vacancies for creating hires. If σ is low, vacancies are less important at creating matches than unemployed workers. We divide both sides of equations (1) and (2) by the size of the labor force in period t, and rewrite the two equations as follows:

$$e_t(1+n_t) = (1-s_t)e_{t-1} + h_t(1+n_t) \tag{3}$$

$$h_t = \mu_t v_t^{\sigma} u_t^{1-\sigma} \tag{4}$$

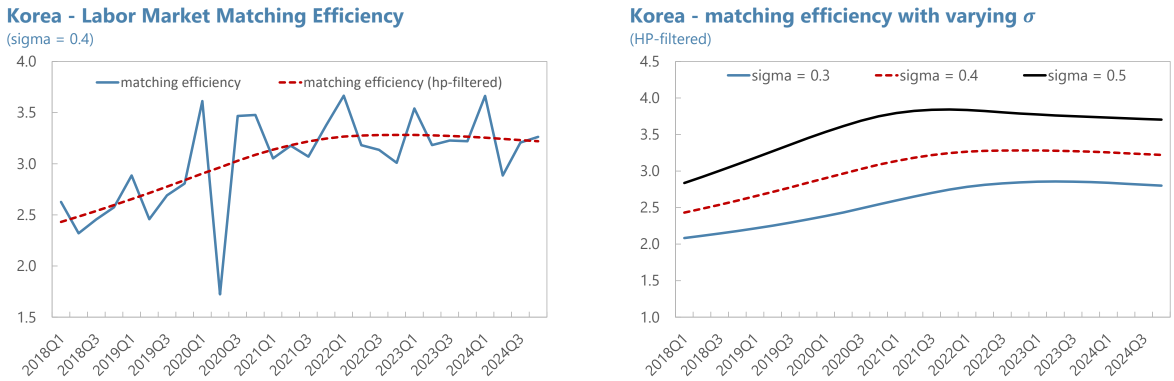
Lower case variables express the corresponding uppercase variables in ratio to the labor force. For example, u_t and v_t represent the unemployment rate and job vacancy rate in period t respectively. Note that the employment rate e_t and the unemployment rate u_t sum up to one. There is an additional variable, n_t, which is the growth rate of the labor force in period t. Data on all these variables are readily available except μ_t, the unobservable matching efficiency, and h_t, gross hires in ratio to the labor force.[3]

Korea's labor market matching efficiency μ_t can be computed with a simple two-step approach. First, I use equation (3) to compute h_t. Then, with computed h_t, and data on v_t and u_t, the matching efficiency, μ_t, can be calculated using equation (4). The calculation of efficiency depends on the parameter σ in the matching function. The literature uses a range of 0.3 – 0.5 for this parameter. We use the middle value of 0.4, which is close to Figura and Waller (2024)'s estimate of 0.38 using US data. Results are broadly similar for values within this range.

Figure 6 presents estimates of the Korea's labor market matching efficiency at quarterly frequencies from 2018Q1 to 2024Q4. The choice of the starting point is due to lack of data on separation rates prior to 2018. Labor market matching efficiency has improved substantially despite pandemic-induced temporary disruptions. Figure 6 (left chart) shows a clear rising trend through 2022Q1, and stabilization thereafter. The matching efficiency fell significantly in 2020Q2 as the pandemic caused disruptions to the labor market and the broad economy, but it rebounded strongly within a quarter. Alternative values of σ generate similar paths of the matching efficiency (Figure 6, right chart). All three paths suggest that steady improvements in the matching efficiency started well before the pandemic, and that matching efficiency has sustained at much higher values relative to pre-pandemic times.

[3] The job separation rates (available at monthly frequency starting Jan-2018) are obtained from the statistics on employment by industry and size by the Ministry of Employment and Labor. Data on other variables are available from Haver Analytics.

Figure 6. Labor Market Matching Efficiency



Sources: Author's calculation.

Sources: IMF staff calculation.

While the causes of the improvement in labor market matching efficiency is hard to pin down and will be left for future research, the fact that this improvement is a process spanning years suggests that it is unlikely the result of temporary or cyclical factors. Rather, it is most likely driven by structural factors that have contributed to more efficient functioning of the labor market. This may have reflected progress in digitalization of the job matching process including through the growing use of online job search and hiring platforms, or government policies that promoted information flow and lowered costs of job search and hiring. At the same time, some cyclical factors might have also contributed to higher labor market matching efficiency during certain periods since the pandemic started. The expansion of service sector jobs as COVID restrictions were lifted, together with the increase in labor force participation of females and the elderly, who are disproportionately likely to seek jobs in the service sector, might also have contributed to improved labor market matching efficiency. This is because the matching efficiency is likely to be higher in the service sector relative to manufacturing, as required skills of job seekers are more homogeneous, which facilitates the matching process.

I now examine how shifts in labor supply, labor demand, and matching efficiency since the beginning of the pandemic in 2020Q1 contributed to the movements in the unemployment rate respectively. This decomposition is performed through counter-factual simulations. In each simulation, I hold one of the four key variables (matching efficiency, working-age population growth, labor force participation rate, vacancy rate) constant at its pre-pandemic level, and then simulate the counter-factual path of the unemployment rate using the dynamics of the unemployment rate derived from equation (3):

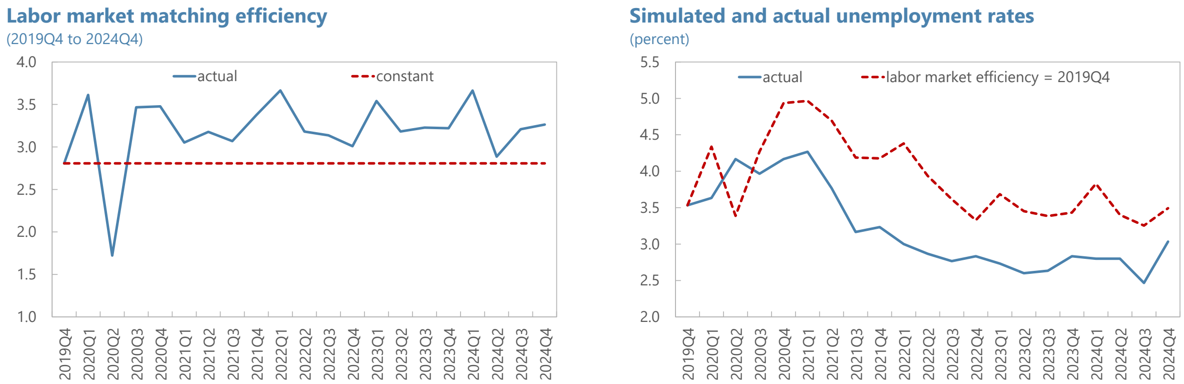
$$u_{t+1} = 1 - \mu_{t+1} v_{t+1}^{\sigma} u_{t+1}^{1-\sigma} - \frac{1 - s_{t+1}}{1 + n_{t+1}} (1 - u_t). \tag{5}$$

Equation (5) is a nonlinear equation that generates a simulated path of $\{u_t\}$ given the series of other variables, i.e., $\{\mu_t\}, \{v_t\}, \{s_t\}, \{n_t\}$.

The first scenario assumes that the labor market matching efficiency is kept constant at the pre-pandemic (2019Q4) level through 2024Q4, which is lower than the actual path except in 2020Q2 (Figure 7, left chart). Under this scenario, the simulated unemployment path would sit significantly higher than the actual except for

2020Q2 (Figure 7, right chart). This implies that higher matching efficiency has contributed significantly to a lower unemployment rate since the second half of 2020.

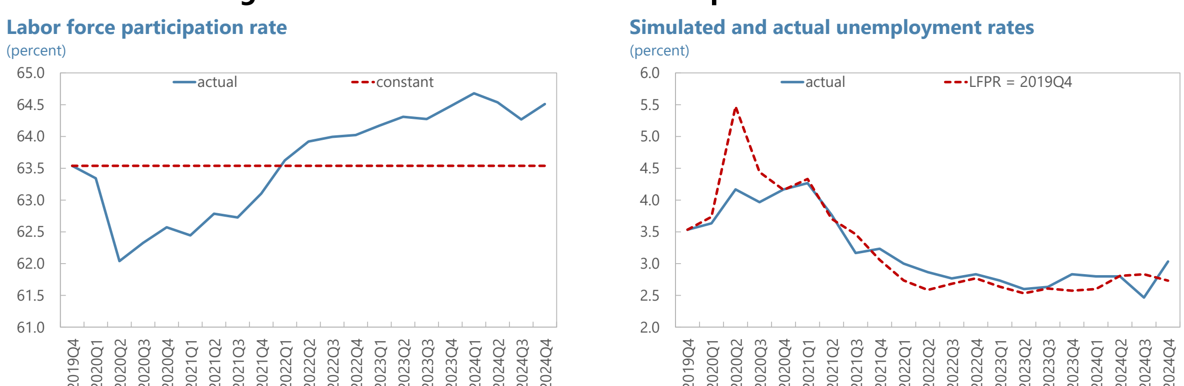
Figure 7. Constant Matching Efficiency Scenario



Sources: Haver Analytics and the author's calculation. Sources: Haver Analytics and the author's calculation.

The next two scenarios consider the effects of labor supply on the unemployment rate. Figure 8 presents a scenario where the labor force participation rate is kept constant at the 2019Q4 level. The actual participation rate dropped below this level until 2022Q1 when it finally recovered to the pre-pandemic levels and returned to the rising trend (Figure 8, left chart). The simulation shows that the initial decline in labor force participation contributed to lower unemployment than the counterfactual. In other words, had labor force participation not declined, the unemployment rate would have been much higher. On the other hand, other than the initial period, the gradual recovery of labor force participation did not have a significant effect on unemployment, as the actual and simulated paths of the unemployed are fairly close to each other since 2020Q4 (Figure 8, right chart).

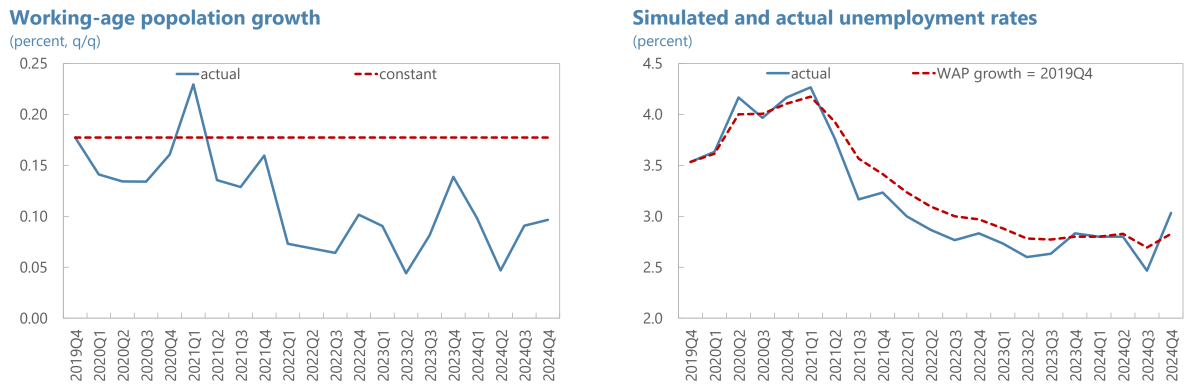
Figure 8. Constant Labor Force Participation Rate Scenario



Sources: Haver Analytics and the author's calculation. Sources: Haver Analytics and the author's calculation.

Korea's working-age population (15+) has been steadily declining overall. Figure 9 presents a scenario where the growth rate of the working-age population (q/q) is kept at the 2019Q4 level (left chart). The simulated unemployment rate path is somewhat higher than the actual for much of the post-pandemic period. This suggest that the slowing growth of the working-age population has moderately lowered the unemployment rate since the beginning of 2021.

Figure 9. Constant Working-age Population Growth Scenario

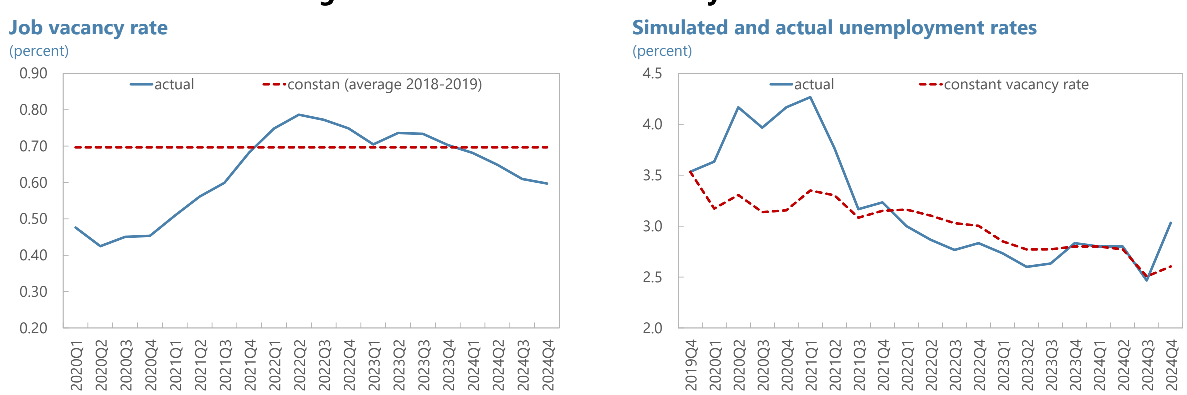


Sources: Haver Analytics and the author's calculation.

Sources: Haver Analytics and the author's calculation.

Lastly, I consider a scenario where the job vacancy rate is kept at its average level in 2018-2019. The actual vacancy rate exceeded this level until 2021Q4 and eventually fell below in 2024 (Figure 10, left chart). The simulation shows that low job vacancies has significantly increased the unemployment rate during the pandemic. Afterwards, since the job vacancy rate stayed in the vicinity of the 2018-2019 average, its impact on unemployment has been moderate.

Figure 10. Constant Job Vacancy Rate Scenario

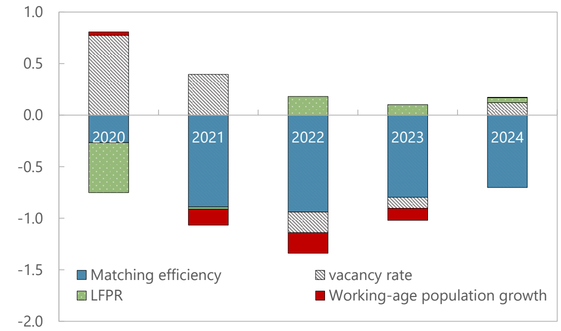


Sources: Haver Analytics and the author's calculation.

Sources: Haver Analytics and the author's calculation.

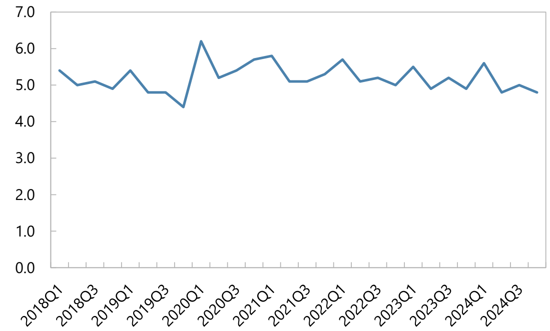
To compare the above factors, Figure 11 aggregates the four scenarios and consolidates respective contributions of the four factors to the annual unemployment rate from 2020 to 2024. In the first two years, reduction in job vacancies were the most significant force pushing up unemployment, while higher matching efficiency and the decline in labor force were the main factors pushing down unemployment. The growth of the working-age population had opposite effects on the unemployment rate in 2020 and 2021, but these effects were relatively small. In the next three years, higher matching efficiency contributed significantly to lower unemployment rate. Recovery of the vacancy rate and slower growth of the working age population also played a role in reducing unemployment except in 2024, when lower vacancy rate increased unemployment. The rising labor force participation increased the number of people looking for jobs and exerted some upward pressure on the unemployment rate. Overall, higher labor market matching efficiency contributed by far the most to the reduction of the unemployment rate in this period. The job separation rate remained relatively stable and hence is unlikely to have affected the unemployment rate in a significant way (Figure 12).

Figure 11. Decomposition of Change to Unemployment
(percentage points)



Source: Author's calculation.

Figure 12. Job Separation Rate
(percent)



Source: MInistry of Employment and Labor.

IV. Medium-term Structural Unemployment

The framework of labor market dynamics used in the previous section can also be used to forecast structural unemployment rate over the medium term. Here, I define the structural unemployment rate as the steady-state level of the unemployment rate. Imposing steady states on equation (5), I obtain the following non-linear equation that the structural unemployment rate has to satisfy.

$$\bar{u} = 1 - \mu \bar{v}^{\sigma} \bar{u}^{1-\sigma} - \frac{1-\bar{s}}{1+\bar{n}}(1-\bar{u}) \tag{6}$$

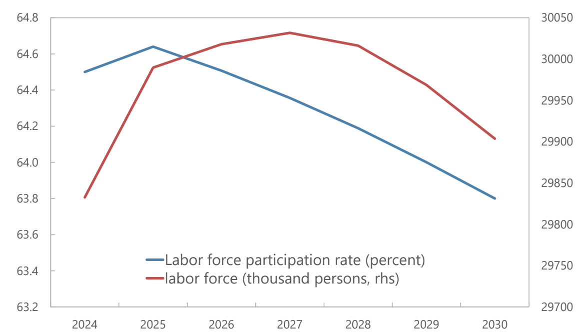
To solve for the steady state unemployment rate, $\bar{u}$, I first set the steady-state values for other variables. The job separation rate is set to $\bar{s} = 5.1\%$, which is the mean in the last three years. The job vacancy rate is set to $\bar{v} = 0.68\%$, which is the average level in 2023-2024. I assume that the matching efficiency stabilizes at 3.2, which is the quarterly average in 2024. I set the value of $\bar{n}$ to the average forecasted quarterly growth rate of the labor force. The labor force forecast depends on projected working-age population growth and the labor force participation rate. The United Nations projects that Korea's working-age population growth rate will decline from 0.31 percent in 2025 to 0.10 percent by 2030. The labor force participation rate is projected by updating Swiston (2021), which uses the "cohort approach," relying on labor force entry and exit rates by age and gender cohort, to project medium-term LFPR. Aggregate labor force participation is projected to peak in 2025 and gradually decline thereafter, reflecting the shift toward a more elderly population with lower propensities to participate and the projected plateauing of the increase in educational attainment. Combining assumptions on working-age population growth and labor force participation, labor force growth is projected to slow down and start shrinking in 2028. The resulting labor force forecast is shown in Figure 13. The average q/q labor force growth is 0.02 percent between 2025 and 2030. Table 1 below compares these variables in pre-COVID and post-COVID periods.

Table I. Parameter Values

		Pre-COVID	Steady state assumptions
v	Job vacancy rate	0.70%	0.68%
s	Job separation rate	5.0%	5.1%
μ	Labor market matching efficiency	2.6	3.2
n	Labor force growth rate (quarterly)	0.2%	0.02%

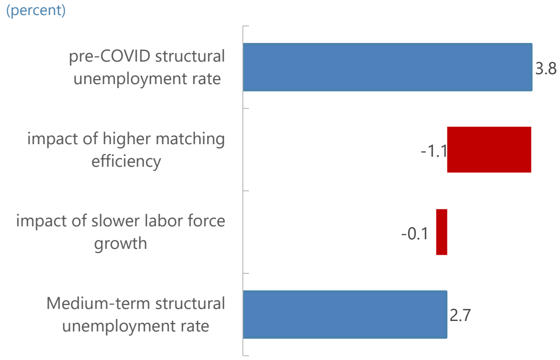
With these parameter assumptions, I first use equation (6) to calculate the 2018-2019 pre-COVID structural unemployment rate, which turns out to be 3.8 percent, on par with the actual unemployment rate of these two years. I then project the medium-term structural unemployment rate, which is 2.7 percent, close to the actual unemployment rate in 2023 and 2024 (2.7 percent and 2.8 percent respectively). It is lower than the pre-COVID structural unemployment rate by 1.1 percentage points. A decomposition of this reduction similar to that used in the previous section reveals that the decline in structural unemployment rate is almost entirely accounted for by the higher labor market matching efficiency, while slower labor force growth is expected to contribute moderately to low unemployment (Figure 14). There is a high degree of uncertainty surrounding this estimate, particularly in the MT vacancy rate which can fluctuate with the economy. As a robustness check, I also calculate the structural unemployment rate with $\bar{v} = 0.6$, which is the minimum actual vacancy rate since 2018 except in the early phases of the pandemic. The structural unemployment rate in this case is 2.9 percent. Therefore, this exercise suggests that medium-term structural unemployment is likely to remain noticeably lower than pre-COVID levels particularly if the gains to labor market matching efficiency are sustained.

Figure 13. Labor Force Projection



Sources: UN Population Projections, Swiston (WP/21/92), and author's calculation.

Figure 14. Medium-term Structural Unemployment Rate
(percent)



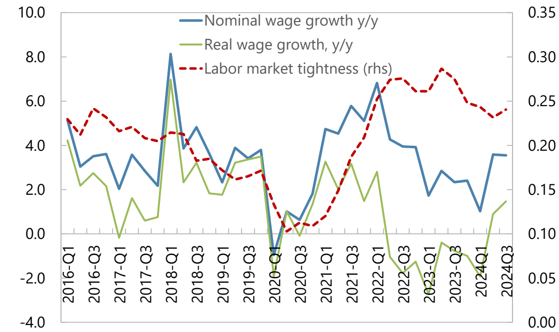
Source: author's calculation.

V. Wage Growth and Matching Efficiency

Despite the tightest labor market in almost a decade, wage growth in post-pandemic Korea remained subdued. Growth of both nominal and real wages broadly tracked changes in labor market tightness until 2021. Since then, growth of both nominal and real wages slowed down, and persisted at lower rates compared to the pre-pandemic norms, even as the labor market tightness remained elevated. This observation is at odds with conventional wisdom which holds that wage growth should increase with labor market tightness. Indeed, Heise, Pearce and Weber (2024) and Holzer (2022) find that labor market tightness correlates with wage inflation in the U.S. including during the COVID-19 period. Hajdini (2024) finds that a stronger positive relationship between labor market tightness and wage growth has emerged in the aftermath of the pandemic. Autor, Dube, and McGrew (2024) and Duval et al (2022) show that in the US and other AEs, post-COVID labor market tightness drives wage growth, especially in low-pay jobs.

The anomalies in post-pandemic wage growth in Korea are not easily explained by business cycle fluctuations of the macro economy. For example, economic growth reached 2.7 percent in 2022, much above Korea's potential growth of around 2 percent. Nevertheless, wage growth slowed down dramatically throughout that year.

Figure 15. Wage growth and labor market tightness
(percent)



Sources: Haver Analytics and author's calculation.

In this section, I show that this puzzle can be explained by higher labor market matching efficiency, which tends to increase labor market tightness but not the wage rate, at least in the short term.

To examine the impact of higher labor market matching efficiency on labor market tightness and the wage rate, and to compare with the situation where labor market becomes tighter due to reductions in labor supply (such as in many countries in the early stages of the pandemic, see Duval et al 2022), I develop a variant of the Diamond-Mortensen-Pissarides (DMP) model of labor market search and matching. Relative to the canonical DMP model (Pissarides, 1990, Chapter 1), I introduce two extensions: (1) a labor force participation margin; (2) physical capital in production. The model developed in this section is consistent with the analytical framework used in previous sections.

Time is discrete. There is a measure 1 of working-age population, with a labor force participation rate of L. The size of the labor force is therefore equal to L. The unemployment rate is u. The measures of employed and unemployed workers are therefore $(1-u)L$ and uL, respectively. A firm entering the economy can post one vacancy and incurs cost of posting the vacancy, c, in each period. When a vacancy is filled, production takes place in the firm using capital and labor. Aggregate capital stock of the economy is fixed at K and evenly owned by the working-age population.[4] The firm rents capital k at rental rate λ, and produce output $y = k^{\alpha}$ with one unit of labor and pays the worker wage w, which is determined through Nash bargaining with fixed bargaining power. Firms and workers are separated at an exogenous separation rate of s in each period.

The measure of successful matches between vacancies and job seekers (unemployed workers) in a given period is given by a Cobb-Douglas matching function, $M(u,v) = \mu v^{\sigma} u^{1-\sigma}$. Let $\theta = v/u$ define labor market tightness. The probability of filling a vacancy is thus:

$$\Pr(vacancy\ filled) = \frac{\mu v^{\sigma} u^{1-\sigma}}{v} = \mu \theta^{\sigma-1} = q(\theta)$$

And the probability of an unemployed worker finding a job is:

$$\Pr(find\ job) = \frac{\mu v^{\sigma} u^{1-\sigma}}{u} = \theta q(\theta)$$

The job finding rate, $\theta q(\theta)$, is increasing in labor market tightness, while the probability of filling a vacancy, $q(\theta)$, decreases with labor market tightness. For simplicity, let $\beta = (1+r)^{-1}$. I focus on stationary equilibrium. Derivation of equilibrium is provided in Annex I. Here we present equilibrium conditions.

[4] Alternatively, one can interpret capital stock as natural resource with fixed supply in each period. The assumption of fixed capital stock implies that it is more of a short-term model, which does not capture potential adjustment of investment in response to changes to labor market matching efficiency.

The equilibrium job creation curve is given by

$$w^* = (1-\alpha)y^* - \frac{r+s}{q(\theta^*)}c.$$

And the equilibrium wage curve is given by

$$w^* = \phi[(1-\alpha)y^* + c\theta^*],$$

where ϕ is the worker's share of total surplus generated by the match. The firm's output (output per worker) is given by

$$y^* = \left[\frac{K}{(1-u^*)L}\right]^{\alpha}.$$

Lastly, in a stationary equilibrium, flows into and out of unemployment offset each other, requiring that

$$u^* = \frac{s}{s+\theta^* q(\theta^*)}.$$

The Annex shows that in a stationary equilibrium, a decrease in the labor force participation rate, L, and an increase in the labor market matching efficiency, μ, both lead to a tighter labor market. A decrease in labor supply raises capital per employed worker and hence output per firm, therefore inducing more firms to enter (posting vacancies), and leading to a tighter labor market. Higher labor matching efficiency increases the job finding rate and reduces unemployment, resulting in higher labor market tightness. As employment increases, capital per worker decreases, reducing output per worker/firm and the wage rate.

With this result, it is possible to conceive two almost identical economies with the same level of equilibrium labor market tightness, differing only in the labor force participation rate and matching efficiency. The Annex shows that the wage rate in the economy with higher participation and higher matching efficiency is lower than the economy with lower labor participation and lower matching efficiency. This is because output per firm/worker in the economy with higher matching efficiency is lower because of higher labor supply. Although the model focuses on stationary equilibrium rather than transition dynamics, it does imply that an increase in labor market tightness stemming from rising labor market matching efficiency rather than lower labor supply would result in lower wage growth.

VI. Conclusion

The unemployment rate in Korea has remained substantially lower compared to the pre-pandemic norms. This paper decomposes the changes in unemployment and identifies the sustained increases in the labor market matching efficiency as the main driving force of low unemployment. Medium-term unemployment is likely to remain low since the improvement is driven largely by structural factors. The paper also argues that the increased labor market matching efficiency help explain why wage growth has remained subdued despite a tight labor market. For future work, it is important to unpack the sources of the increase in labor market matching efficiency.

Annex I. Solving the model in Section V

Value Functions

Let U and V denote the value of an unemployed and employed worker respectively. Value of an unemployed worker is given by

$$U = \lambda K + \beta\big[\theta q(\theta) W + \big(1 - \theta q(\theta)\big) U\big]. \tag{1}$$

And the value of employment, W, is given by

$$W = w + \lambda K + \beta[sU + (1 - s)W]. \tag{2}$$

Value of an unmatched firm (value of a vacancy), V, is

$$V = -c + \beta\big[q(\theta) J + \big(1 - q(\theta)\big) V\big]. \tag{3}$$

When a vacancy is filled, the firm rents capital at rate λ. Capital demand is given by

$$\alpha k^{\alpha-1} = \lambda.$$

Output per firm/worker is therefore

$$y = k^{\alpha} = \left(\frac{\lambda}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}.$$

Note that the form of the production function implies that α share of output y is paid as capital rentals. The firm retains the rest and pays wage w to the worker.

Value of a filled vacancy, J, is hence given by

$$J = (1 - \alpha)y - w - \lambda + \beta[sV + (1 - s)J]. \tag{4}$$

Free entry of firms ensures that in equilibrium, $V = 0$. Therefore, equations (3) and (4) imply that

$$\frac{c}{\beta q(\theta)} = \frac{(1 - \alpha)y - w}{1 - \beta(1 - s)}.$$

Let $\beta = (1 + r)^{-1}$, the above equation can be restated as the job creation curve:

$$w = (1 - \alpha)y - \frac{r + s}{q(\theta)} c. \tag{5}$$

Nash Bargaining

For an unemployed worker, the match-surplus for a given w, is

$$S_U = W - U$$

Where from the value function for W,

$$W = \frac{1 + r}{r + s}\left[w + \lambda K + \frac{sU}{1 + r}\right].$$

Therefore,

$$S_U = \frac{1 + r}{r + s}\left[w + \lambda K - \frac{r}{1 + r} U\right].$$

Match surplus for the firm is

$$S_f = J - V = J = \frac{1 + r}{r + s}\big((1 - \alpha)y - w\big).$$

Total surplus is therefore given by

$$S_{tot} = S_U + S_f = \left[(1 - \alpha)y + \lambda K - \frac{r}{1 + r} U\right].$$

The Nash Equilibrium solution is $S_U = \phi S_{tot}, and\ S_f = (1 - \phi) S_{tot}$. That implies

$$(1 - \phi)\left[w + \lambda K - \frac{r}{1 + r} U\right] = \phi\big((1 - \alpha)y - w\big).$$

Therefore,

$$w = \phi(1-\alpha)y + (1-\phi)\left(\frac{r}{1+r}U - \lambda K\right) \tag{6}$$

To eliminate U, use equations (1) and (2) to derive:

$$S_U = W - U = \frac{(1-\beta)U - \lambda K}{\beta\theta q(\theta)} = \frac{rU - (1+r)\lambda K}{\theta q(\theta)} \tag{7}$$

On the other hand,

$$S_U = \phi S_{tot} = \frac{\phi}{1-\phi}S_f = \frac{\phi}{1-\phi}J = \frac{\phi}{1-\phi}\frac{c}{\beta q(\theta)} \tag{8}$$

Equations (7) and (8) imply that

$$\frac{rU - (1+r)\lambda K}{\theta q(\theta)} = \frac{\phi}{1-\phi}\frac{c}{\beta},$$

which delivers an expression of U in terms of θ and parameters:

$$U = \frac{1+r}{r}\left[\frac{\phi}{1-\phi}c\theta + \lambda K\right] \tag{9}$$

Replacing U in (6) with (9) yields the wage curve:

$$w = \phi((1-\alpha)y + c\theta) \tag{10}$$

The job creation curve and the wage curve determine w^*, θ^*.

Stationary Equilibrium

The capital rental market clearing condition requires that demand of capital equals supply, K:

$$k(1-u)L = \left(\frac{\lambda}{\alpha}\right)^{\frac{1}{\alpha-1}}(1-u)L = K.$$

The capital rental rate is therefore

$$\lambda = \alpha\left(\frac{K}{(1-u)L}\right)^{\alpha-1}.$$

And output per firm/worker is

$$y = \left(\frac{\lambda}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} = \left[\frac{K}{(1-u)L}\right]^{\alpha}. \tag{11}$$

The measure of employed workers losing job due to job separation is $s(1-u)L$, and the measure of unemployed workers finding job is $uL\theta q(\theta)$, where $\theta q(\theta)$ is the job finding rate. In stationary equilibrium, these flows offset each other, i.e.,

$$s(1-u)L = uL\theta q(\theta).$$

The equilibrium unemployment rate can thus be expressed in terms of θ and parameters:

$$u = \frac{s}{s+\theta q(\theta)}. \tag{12}$$

The job creation curve (5), wage curve (10), output (11) and unemployment (12) form a system of equations determining stationary equilibrium values of θ, u, y, and w.

Comparative statics

The equilibrium conditions can be further simplified by eliminating w using (5) and (10) and replacing y using (11) where u is in turn replaced using (12). The product of these operations is a single equation in θ:

$$(1-\phi)(1-\alpha)\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha} = \left[\frac{r+s}{q(\theta)} + \phi\theta\right]c. \tag{13}$$

First, labor market tightness, θ, decreases with labor force participation rate, L. This can be proved by evoking the Implicit Function Theorem on (13):

$$\frac{d\theta}{dL} = \frac{(1-\phi)(1-\alpha)\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha}\frac{\alpha}{L}}{(-\sigma)(1-\phi)(1-\alpha)\alpha\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha-1}\frac{K}{L}s\left(\frac{1}{\mu}\theta^{-\sigma-1}\right)-(r+s)c\left(\frac{1}{\mu}(1-\sigma)\theta^{-\sigma}\right)-c\phi} < 0.$$

The sign of this derivative is negative because the numerator is positive while the denominator is negative. That is,

$$\frac{d\theta}{dL} < 0$$

Second, θ is increasing in labor market matching efficiency, μ. Recall that $q(\theta) = \mu\theta^{\sigma-1}$.

$$\frac{d\theta}{d\mu} \propto \frac{(1-\phi)(1-\alpha)\alpha\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha-1} s\frac{K}{L}-(r+s)c\theta}{(1-\phi)(1-\alpha)\alpha\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha-1}\frac{K}{L}s(-\sigma)-c[(r+s)(1-\sigma)\theta+\mu\phi\theta^{1+\sigma}]}.$$

The denominator of the RHS expression is obviously negative. To investigate the sign of the numerator, first realize that it is proportional to the expression below.

$$(1-\phi)(1-\alpha)\alpha\left[\left(\frac{s}{\theta q(\theta)}+1\right)\frac{K}{L}\right]^{\alpha} s-(r+s)c\theta\left(\frac{s}{\theta q(\theta)}+1\right)$$

Using (13), the above expression can be reduced to

$$(\alpha-1)\frac{r+s}{q(\theta)}sc+[\alpha s\phi-(r+s)]c\theta.$$

Note that $\alpha < 1$, and also $as\phi < s$ since $\phi < 1$. The above expression is therefore negative. Thus,

$$\frac{d\theta}{d\mu} > 0.$$

Since $\theta q(\theta)$ is increasing in θ and that $\frac{d\theta}{d\mu} > 0$, equation (12) implies that $\frac{du}{d\mu} < 0$. Equation (11) then implies that y is decreasing in μ. With equation (5), this implies that $\frac{dw}{d\mu} < 0$.

Wage comparison

Given the results above, consider two economies, indexed by $i = 1,2$, with $L_1 < L_2$ and $\mu_1 < \mu_2$, and all other parameters take identical values. I show that if $\theta_1 = \theta_2 = \theta$, then $w_1 > w_2$.

First, (5) and (10) imply that

$$(1-\phi)(1-\alpha)y_i = \left[\frac{r+s}{\mu_i\theta^{\sigma-1}}+\phi\theta\right]c. \quad (14)$$

Since $\theta_1 = \theta_2$ and $\mu_1 < \mu_2$, (14) implies that $y_1 > y_2$.

Next, recall (5)

$$w_i = (1-\alpha)y_i - \frac{r+s}{q(\theta)}c.$$

It is straightforward to see that $w_1 > w_2$.

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