

BOK ISSUE NOTE

Dec. 19, 2024

Potential Growth of Korea and Its Outlook

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1. This paper estimates the potential growth of the Korean economy, taking into account the impact of the COVID-19 pandemic, demographic shifts, and structural changes in the labor market. Specifically, we revise our semi-structural models to reflect the increased volatility of macroeconomic variables during the pandemic. We also use household-level microdata to account for the heterogeneity of the labor force.

2. The results show that the potential growth rate of the Korean economy has been steadily declining. From around 5 percent in the early 2000s, it fell to the mid-3 percent range in the 2010s. It further declined to the mid-2 percent range between 2016 and 2020 and is estimated to reach around 2 percent between 2024 and 2026. This downward trend is attributed to slower growth in total factor productivity, capital, and labor force.

3. If this trend continues, the potential growth rate could decline further over the next 5 to 10 years. However, this is not inevitable and can vary depending on how we respond through structural reforms. The long-term projection and scenario analysis indicate that structural reforms aimed at (1) enhancing total factor productivity, (2) raising fertility rates, and (3) improving labor productivity among women and older workers can increase the potential growth rate in the late 2040s by 0.7 percentage points, 0.1–0.2 percentage points, and 0.1 percentage point, respectively, compared to the baseline projection.

4. To effectively raise the potential growth, it is necessary to improve productivity through structural reforms across the economy while preemptively addressing anticipated changes in future economic structures. Previous studies on structural reforms suggest that these efforts should focus on improving labor market efficiency, ensuring the efficient allocation of resources, and boosting overall economic productivity by enhancing business

investment conditions and supporting innovative firms. Additionally, addressing the slowdown in the labor force caused by low fertility rates and an aging population requires proactive policies, such as easing the concentration in the Seoul Metropolitan Region and promoting work-life balance. It is also essential to implement multifaceted policy efforts to improve the productivity of women and the elderly.

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- Disclaimer: The views expressed herein are those of the authors, and do not necessarily reflect the official views of the Bank of Korea. When reporting on or citing this paper, the authors' names should be always explicitly stated.
- We are grateful to Byoung-ho Bae, Kyounghoon Park, and Samil Oh for their helpful comments and support. We also thank Sol-bin Lee for the contribution to the initial draft, and Jaeyong Seo and Seung-ryeol Jeong for their technical assistance.



BANK OF KOREA

I. Introduction

In its September 2021 BOK Issue Note, the Bank of Korea estimated the average potential growth rate for 2021-2022 to be around 2 percent, controlling for the impact of the COVID-19 pandemic using dummy variables.¹⁾ Since the economic downturn caused by the pandemic has largely been resolved following the lifting of quarantine measures in 2023, it is now a good time to revisit the methods used to control for the pandemic's effects.

Moreover, the revision of the reference year for Korea's national accounts data,²⁾ coupled with updated population projections, also calls for the reevaluation of the potential growth. The revision of the national accounts has resulted in an upward adjustment of the real GDP growth rate, suggesting that earlier estimates of potential growth based on previous data may have been understated. In addition, the population projections released in December 2023 indicate that the 15+ population will peak in 2032, one year later than previously projected in 2021. These updates should be incorporated into the re-estimation.

Furthermore, given the heterogeneity of the labor force across socio-demographic groups, our previous estimation methods based on aggregate data have limitations in capturing group-specific characteristics. To address this, it is essential to use household-level microdata to construct

labor-related indicators, such as employment rate and hours worked, and incorporate the heterogeneity into the estimation methods.

In this paper, we estimate the potential growth of the Korean economy, taking into account recent changes in the economic structure through updated data and methodologies. The estimation results show that the potential growth rate for 2024-2026 is expected to be around 2 percent on average, indicating a modest decline from 2016-2020. This decline is attributed to slower growth in total factor productivity, labor input, and capital input.

We also conduct a long-term projection and scenario analysis for future potential growth. Assuming that the current trend continues (baseline scenario), potential growth is expected to decline further over the next five to ten years. However, with the effective implementation of structural reforms aimed at enhancing productivity and boosting the fertility rate, potential growth is projected to rise significantly compared to the baseline projection.

This paper is organized as follows: Section II.1 outlines the need to refine the estimation methodology and discusses the expected outcomes. Section II.2 presents the estimate for potential growth and examines the underlying causes of its changes through a breakdown of production inputs. Section III provides long-term projections for potential growth and scenario analysis.

1) See Chung et al. (2021).

2) The Bank of Korea revised the national accounts statistics in June 2024, updating the reference year from 2015 to 2020. As a result, the average real GDP growth rate from 2001 to 2020 was revised upward by approximately 0.1 percentage points compared to the previous series.

Finally, Section IV offers conclusions and policy implications.

II. Estimation of Potential Growth

1. Revision to Estimation Methods

In this paper, we estimate the potential growth of Korea, incorporating two major revisions from the previous BOK Issue Note on potential growth (Chung et al., 2021). First, in dealing with the end-point problem, we use accumulated data and incorporate the increased volatility of macroeconomic variables during the pandemic in the estimation process, rather than relying on the dummy variable method (see **Table 1-1**). Second, we improve the estimation methods and labor market data to account for the heterogeneity of the labor force (see **Table 1-2**).

[Table 1-1] Major Revision Point 1: Data-based¹⁾

Model	Removing dummies	Reflecting time-varying volatility
Semi-structural	○	○
Multivariate filtering	○	○
Production function	○	
Univariate filtering	○	

Note: 1) For more details, see the main text.

[Table 1-2] Major Revision Point 2: Group-specific characteristics¹⁾

Model	Group-specific trends	Hours worked	Labor quality
Semi-structural		○	○
Multivariate filtering		○	○
Production function	○	○	○
Univariate filtering			

Note: 1) For more details, see the main text.

1.1 Dealing with the Pandemic Period

1.1.1 Removing Dummy Variables

In its September 2021 BOK Issue Note, the Bank of Korea introduced dummy variables into its potential GDP estimation models (Chung et al., 2021). The purpose of this was to deal with the end-point problem: the temporary decline in production capacity due to quarantine measures excessively affected the potential GDP estimate.³⁾

However, as the timing of the economic recovery from the pandemic-driven recession has become clearer, the end-point problem has gradually diminished. As a result, the usefulness of the dummy variable approach has decreased. **Figure 1** illustrates this situation. The orange lines depict the employment rate (solid) and its trend component (dashed) using data prior to 2022 without dummies. Although the data shows some recovery, the trend continues to decline toward 2022. This result suggests the need for dummy variables to control for the downward bias if one believed that the

3) The dummy variable approach effectively mitigated the end-point problem of the filtering approach in a situation where the uncertainty about the timing of economic recovery from the pandemic-induced recession.

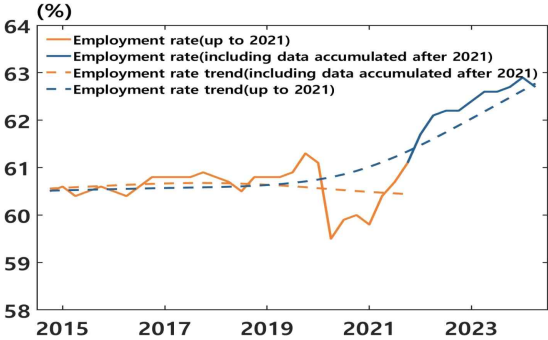
employment rate would recover further from 2022 so that the true trend was not that low as of 2021. The blue lines show that, with more recent data (consistent with this belief), the trend during the pandemic period shifts upward, even without dummies.

As such, we remove the dummy variables previously applied in the estimations. For the semi-structural and multivariate filtering models, the downward trend dummy for the first half of 2020 and the upward trend dummy for the second half of 2020 have been removed. For the univariate filtering approach, the dummies assigned to the penalty for the difference between the data and its trend (from Q1 2020 to Q4 2021) and the penalty for trend fluctuations in Q4 2019 have been removed. For the production function approach, we remove the dummies used in extracting the trend of total factor productivity.⁴⁾

1.1.2 Controlling for the Increased Volatility During the Pandemic

The estimation of potential growth rates through the semi-structural model typically adopts the Laubach and Williams (2003) framework, which is based on classical assumptions. These assumptions include the absence of autocorrelation in the error terms of both the IS curve and the Phillips curve, as well as the assumption that these errors follow a normal distribution with time-invariant standard deviations. However, Holston, Laubach, and Williams (2023) argue that, in the case of the U.S. economy, these assumptions were invalidated during the pandemic due to the magnitude and persistence of pandemic-related shocks. To address this, they propose incorporating time-varying volatility in the shocks to major macroeconomic variables, including GDP, as well as a persistent supply shock.

[Figure 1] Trends for Employment Rate Before and After the Previous Estimation in 2021¹⁾



Note: 1) Trends are extracted using HP filter.
Source: BOK Economic Statistics System (ECOS)

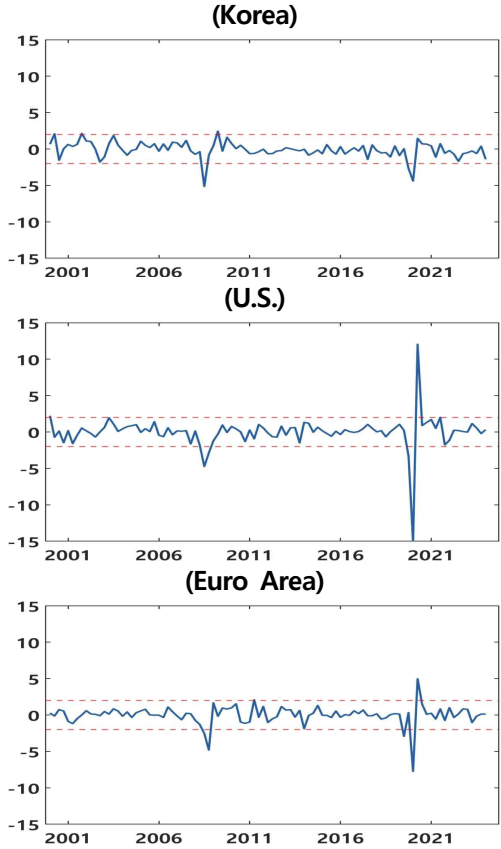
This paper applies the methodology of Holston et al. (2023) to assess the pandemic's impact on the Korean economy, specifically evaluating whether the classical assumptions,⁵⁾ such as normality and (non-)autocorrelation, are violated. We first find that Korea was less affected by the pandemic compared to major economies.⁶⁾ For instance, during the pandemic, the growth rate of Korea did not deviate significantly from a normal distribution compared to pre-pandemic levels (see **Figure 2**). The possibility that the model's error terms

4) Kwon et al. (2019) and Chung et al. (2021) provide more detailed information on the models.
5) Semi-structural and multivariate filter models assume that the error terms in equations related to GDP and prices are not serially correlated and follow a normal distribution with a standard deviation that does not vary over time. The Kalman filter is applied to identify the trends of key economic indicators.
6) This is largely attributed to the fact that Korea maintained a relatively flexible quarantine system, which allowed economic activities to continue to some extent, unlike the strict lockdown measures in other countries.

are autocorrelated is also low.⁷⁾ These findings suggest that it is not necessary to incorporate a separate supply shock variable for the pandemic period in the case of Korea.⁸⁾

However, the estimation of volatility for key economic variables using a stochastic volatility model⁹⁾ indicates that during the pandemic period, volatility is approximately two to three times higher than in the pre-pandemic period (see **Figure 3**). This suggests that without properly accounting for the heightened volatility during the pandemic, there may be distortions in estimating potential GDP for both the pre- and post-pandemic periods.

[Figure 2] Cross-country comparison of Normalized Growth Rate¹⁾



Note: 1) Economic growth rates are normalized using the 2000-2019 average and standard deviation. Values exceeding an absolute value of 2 (denoted by the red dotted line) indicate outliers.

Sources: BOK Economic Statistics System (ECOS), Federal Reserve Economic Data (FRED)

7) Holston, Laubach, and Williams (2023) finds that, in the U.S., the economic shocks caused by COVID-19-related shutdowns and re-openings demonstrate negative autocorrelation. A simple first-order autoregressive model for economic growth rates suggests that, unlike Korea, the U.S. shows a higher possibility of autocorrelation in the model's error terms.

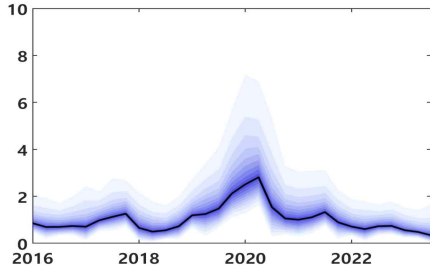
Sample period	Korea		U.S.	
	DW statistic ¹⁾	LM statistic (p value) ²⁾	DW statistic ¹⁾	LM statistic (p value ²⁾
2000:Q2-2020:Q4	2.000	0.009 (0.9249)	2.022	2.958 (0.0854*)
2019:Q4-2020:Q4	1.850	0.261 (0.4473)	2.148	3.022 (0.0828*)

Notes: 1) This represents the Durbin-Watson (DW) test statistic, with values near 2 suggesting no autocorrelation, values near 0 indicating positive autocorrelation, and values near 4 reflecting a negative autocorrelation.
 2) This refers to the p-value from the Breusch-Godfrey Lagrange Multiplier (LM) test, where an asterisk (*) signifies autocorrelation at the 10 percent significance level.

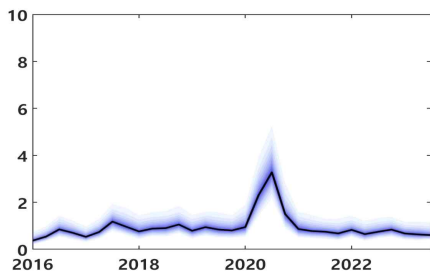
8) Meanwhile, the European Central Bank (ECB) assumes that only permanent or highly persistent medium-term structural shocks affect potential output, while COVID-19-related shocks are regarded as temporary and do not influence potential output (ECB Bulletin, January 2024).

9) A stochastic volatility model is a framework for estimating time-varying volatility in time series data. For more information, see Kim, Shephard, and Chib (1998).

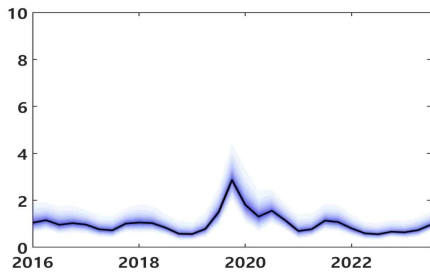
[Figure 3] Increases in Volatility Compared to the Pre-pandemic Period¹⁾
(GDP)



(Prices)



(Labor Force Participation Rate)



Note: 1) Each variable's volatility is normalized by dividing it by the average volatility during the pandemic period (2000-2019). The solid line denotes the median, and the lightest shading indicates the 90% confidence interval.

Sources: BOK Economic Statistics System (ECOS), Authors' estimations

Therefore, we revise our semi-structural and multivariate filtering models by incorporating heteroscedasticity in key variables such as output and prices to reflect the increased volatility observed during the pandemic. This approach mitigates the risk of underestimating potential GDP due to pandemic shocks. In the semi-structural model, heteroscedasticity is applied to the error terms of the IS curve and Phillips curve, based on Lenza and Primiceri (2022)

and Holston et al. (2023). Similarly, in the multivariate filtering model, heteroscedasticity is applied to the error terms in the equations for the output gap, Phillips curve, and labor force participation rate.

Semi-structural Model (LW model)

(IS curve)

$$\tilde{y}_t = \phi_1 \tilde{y}_{t-1} + \phi_2 \tilde{y}_{t-2} - \frac{\kappa}{2} \sum_{i=1}^2 (r_{t-i} - r_{t-i}^*) + \epsilon_t^{\tilde{y}}$$

(Phillips curve)

$$\pi_t = \lambda \pi_t^e + (1 - \lambda) \pi_{t-1} + \beta_1 \pi_t^m + \beta_2 \tilde{y}_t + \epsilon_t^\pi$$

Multivariate Filtering Model (USFED model)

$$\tilde{y}_t = \phi_1 \tilde{y}_{t-1} + \phi_2 \tilde{y}_{t-2} + \epsilon_t^{\tilde{y}}$$

$$\pi_t = \lambda \pi_t^e + (1 - \lambda) \pi_{t-1} + \beta_1 \pi_t^m + \beta_2 \tilde{y}_t + \epsilon_t^\pi$$

$$\tilde{lfp}_t = \delta_{lf,1} \tilde{y}_t + \delta_{lf,2} \tilde{lfp}_{t-1} + \epsilon_t^{lfpr}$$

<Before>

$$\epsilon_t^x \sim (0, \sigma_\epsilon^2): \text{White-noise shock}$$

<After>

$$\epsilon_t^x \sim (0, \sigma_\epsilon^2): \text{Time-varying variance shock}$$

where tilde($\tilde{\cdot}$) represents a cyclical factor; $x \in \{\tilde{y}, \tilde{lfp}, \pi\}$; y_t is log of real GDP; lfp_t is log of labor force participation rate; π_t is the core inflation rate; and π_t^m is the supply factor.

1.2 Accounting for the Heterogeneity of Labor Force

1.2.1 Group-specific Trends

When estimating potential GDP, it is important to consider that labor supply decisions vary across socio-demographic groups. To account for this heterogeneity in the labor force, major institutions extract the

trend component of labor force participation rates for each group, segmented by sex and age (IMF, BOJ), or by sex, age, education level, and race (CBO).¹⁰ In contrast, the Bank of Korea's previous production function approach used aggregated data, which failed to capture this heterogeneity. This paper divides the labor force into 20 groups, segmented by sex, age (under 30, 30s, 40s, 50s, 60 and above), and education level (whether or not holding a 4-year college degree or above), to incorporate group-specific characteristics into the estimation of potential GDP.

Specifically, we use microdata from the Economically Active Population Survey to extract the trends in employment rates and average hours worked for each group. The aggregate trend is then computed as the weighted sum of the group-specific trends using the group shares, as in the following equation.

Definition of Potential Labor in the Production Function Model

<Before>

Potential labor = (15+ population aged 15 or older) x (labor force participation rate trend) x (1 - NAIRU) x (average hours worked trend) x (labor quality trend)

<After>

Potential labor = (population aged 15 or older) x (employment rate trend) x (average hours worked trend) x (labor quality trend)

After the revision, the trends for employment rate and average hours worked are defined as follows:

Employment rate (average hours worked) trend = the inner product of (1) the vector of group-specific employment rate (average hours worked) trend and (2) the vector of the group share

1.2.2 Revision to Hours Worked Data

Before the revision in this paper, the Bank of Korea used OECD data on average hours worked for the estimation of potential GDP.

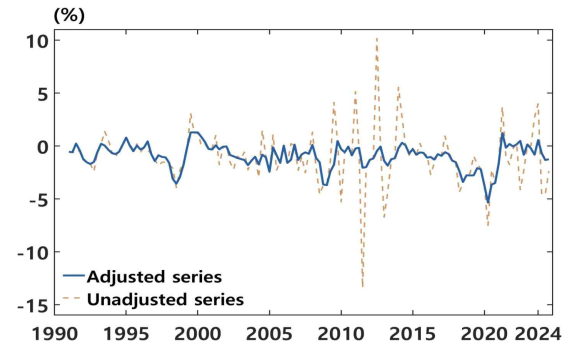
However, since OECD hours worked data is provided at an aggregate level, group-specific information (such as by sex, age, and education level) is not available. Additionally, the Labor Force Survey at Establishments, which forms the basis of the OECD data, has several limitations: (1) It does not include self-employed individuals; (2) the scope of employment types and business sizes covered by the survey has changed over time,¹¹ raising concerns about potential distortions in the overall trend of hours worked; (3) the data is provided annually, limiting its ability to capture quarterly trends; and (4) all other labor market data we use are from the Economically Active Population Survey, so using the Labor Force Survey at Establishments data solely for hours worked makes it difficult to ensure data consistency.

10) See e.g., Pichete et al. (2015), IMF (2015), Kawamoto et al. (2017), Shackleton (2018).

11) Before 2008, the survey covered only employees with contracts of one year or longer, but from 2008 onward, employees with shorter-term contracts were also included. Additionally, the survey covered only establishments with 10 or more employees before 1999, then included those with 5 or more employees from 1999, and establishments with 1 or more employees from 2011.

In this paper, as an alternative to address the issues mentioned above, we construct average hours worked data based on the Economically Active Population Survey and use it to estimate potential GDP (in the three models excluding the univariate filtering). Compared to the existing series (based on OECD data), the Economically Active Population Survey offers several advantages: (1) quarterly data (constructed from monthly data) is available, (2) it includes self-employed individuals, and (3) it provides more comprehensive and consistent coverage. Irregular fluctuations in the data,¹²⁾ such as those caused by lunar holidays, are adjusted using the method proposed by Seo et al. (2024) (see **Figure 4**).¹³⁾

[Figure 4] Comparison of Average Hours Worked Before and After Adjustment¹⁾



Note: 1) Year-on-year change rates on a quarterly basis.
Sources: Economically Active Population Survey microdata (Statistics Korea), Authors' estimations

[Table 2] Comparison of Hours Worked Data

	Before revision	After revision
Data source	OECD	Economically Active Population Survey
Frequency	Annual	Monthly
Self-employment	Excludes	Includes
Consistency with other datasets	Inconsistent	Consistent
Group-specific characteristics	Cannot be reflected	Can be reflected
Irregularity	X	O

1.2.3 Revision to the Estimate for Labor Quality

When measuring labor input in an economy, it is important to consider not only the quantitative aspect, represented by aggregate hours worked (number of employed persons × average hours worked), but also the qualitative aspect, such as the productivity composition of those hours (labor quality).¹⁴⁾

In this paper, the change in labor quality (LQ) is defined by the equation below. It is determined by changes in the marginal product of labor across sex, age, and education levels, as well as changes in the share of total labor hours by each group.

12) The Economically Active Population Survey collects data on hours worked for the week that includes the 15th of each month. As a result, irregular fluctuations unrelated to business cycles, such as those caused by lunar holidays or election days, may occur during this period (Hwang, 2020; Seo et al., 2024).

13) For details of the methodology, see Seo et al. (2024). We differ from Seo et al. (2024) in two aspects: (1) While Seo et al. (2024) adjusted the hours worked series (average hours of employed persons) based on a newly defined category of employed persons, this paper follows the official definition of employed persons as per Statistics Korea. (2) This paper requires hours worked data by gender, age, and education groups for estimating labor quality (or labor composition) and for the revised version of the production function approach. Therefore, we adjust the hours worked data separately for each group.

14) For more details, see Kwon et al. (2019).

Hourly wages are used as a proxy for the marginal product.¹⁵⁾ This paper refines the estimation method in Kwon et al. (2019) using household-level microdata. Specifically, we use the fitted values of hourly wages for each group, derived from a microeconomic model based on individual-level hourly wage data (Bosler et al., 2017).¹⁶⁾

<Before>

$$\Delta \ln LQ_t = \left(\frac{\sum_i^n w_{i,t} H_{i,t}}{\sum_j^n w_{j,t} H_{j,t}} (\Delta \ln H_{i,t} - \Delta \ln \sum_i^n H_{i,t}) \right)$$

where $w_{i,t}$ is an average hourly wage of group i at time t ; $H_{i,t}$ is total hours worked by group; n is the number of groups; $\Delta \ln H_{i,t}$ is the log difference in hours worked over time by group; and $\Delta \ln \sum_{i=1}^n H_{i,t}$ is the log difference of aggregate hours worked over time.

<After>

$$\Delta \ln LQ_t = \left(\sum_i^n \frac{s_{i,t} + s_{i,t-1}}{2} \times \left(\Delta \ln H_{i,t} - \Delta \ln \sum_i^n H_{i,t} \right) \right)$$

$$s_{i,t} = \frac{\exp(X_{i,t}' \hat{\beta}_t) H_{i,t}}{\sum_j^n \exp(X_{j,t}' \hat{\beta}_t) H_{j,t}}$$

where $X_{i,t}' \hat{\beta}_t$ is predicted value of hourly wage (fitted value)¹⁷⁾ of group i at time t .

2. Estimation Results

This section presents the estimation results using the revised method. We use quarterly data from 2000 to 2026, with the values for Q4 2024 to Q4 2026 constructed based on the Economic Outlook from the Bank of Korea, published in November 2024.

The results show that the potential growth rate of the Korean economy has continuously declined. The potential growth rate was around 5.0% on average during 2001-2005, fell to the mid-2% range during 2016-2020, and further decreased to 2.1% during 2021-2023. It is projected to decline to around 2.0% on average during 2024-2026 (see **Table 3**).

[Table 3] Estimates of the Potential Growth Rate¹⁾

(Annual average, %)					
2001	2006	2011	2016	2021	2024
-2005	-2010	-2015	-2020	-2023	-2026
5.0	4.1	3.4	2.6	2.1	2.0

Note: 1) Average of four models

We analyze the causes of the decline in potential growth using the production function approach and the multivariate filtering approach, both allowing for the decomposition of contributions by production inputs. The results of the growth accounting analysis (see **Figure 5**) show that

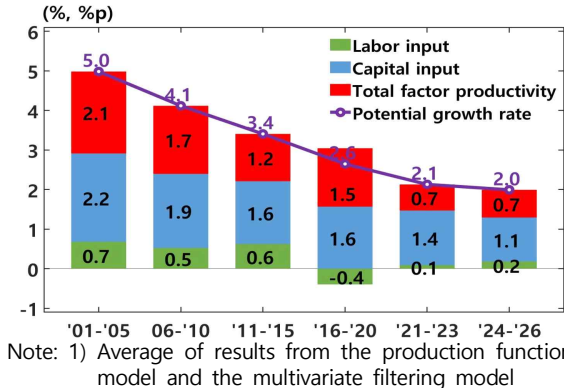
15) We have replaced the marginal product of labor (MP_H) notation used in the previous issue note (Kwon et al., 2019) with hourly wage (w), which is used as a proxy.

16) Data for individual hourly wages are constructed using microdata from the Local Area Labour Force Survey by Statistics Korea and are converted to real terms using the Consumer Price Index.

17) The estimation equation is $\ln w_{i,t} = X_{i,t}' \beta_t + \epsilon_{j,t}$ where $w_{i,t}$ is the log hourly wages for group i , and $X_{i,t}'$ is the vector of explanatory variables consisting of the interaction terms of dummies for year, sex, age group, and education group. Additionally, since the Local Area Labour Force Survey data is available from 2008, we extrapolate the fitted value for 2008 for each group back to 2000.

the contributions of total factor productivity, labor, and capital have all decreased. The decrease in the contribution of total factor productivity is likely attributed to a lack of innovation and inefficiencies in resource allocation. The declines in the contributions of labor and capital are due to demographic shifts and a slowdown in investment as the economy matures.

[Figure 5] Growth Accounting Analysis¹⁾



The declining total factor productivity (TFP)¹⁸⁾ growth may continue in the future due to geopolitical risks during the pandemic, delays in structural reforms, or stagnating productivity growth of innovative firms. These trends are closely related to several determinants of TFP, including the creation, transfer, and absorption of knowledge, efficiency in the allocation of production inputs, institutions and trade, and the environment, as outlined by Isaksson (2007). In particular, the expansion of global supply chain risks hampers the transfer of knowledge and trade (Góes and Bekkers, 2022; Baba et al., 2023), while stagnating productivity growth of innovative firms (Lee et al., 2024) obstructs knowledge creation, thereby limiting TFP

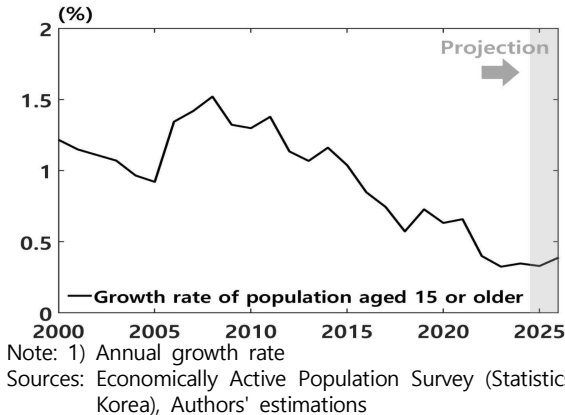
growth. Additionally, insufficient reallocation of employment following the pandemic (Lee et al., 2023) and delays in restructuring marginal firms could hinder the efficient use of production inputs, acting as key causes of the decline in TFP growth.

The change in the growth of labor since 2016 mainly results from shrinking population due to demographic shifts (see Figure 7), changes in employment rates and average hours worked (see Figure 6).

[Figure 6] Contribution Analysis by Labor Input Factor¹⁾



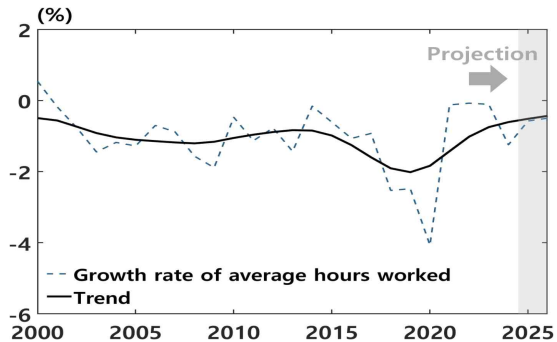
[Figure 7] Growth Rate of 15+ Population¹⁾



18) Total factor productivity (TFP) reflects several factors, such as the efficiency of resource allocation within the economy and the level of technology. Its estimates can vary across institutions depending on the methodology used.

The continuous decline in average hours worked (see **Figure 8**) can be seen as a natural consequence of the increase in real income due to economic growth (Bick et al., 2018). Additionally, changes in institutions related to work hours and the increasing share of part-time workers are considered as contributing factors.¹⁹⁾

[Figure 8] Growth Rate of Average Hours Worked¹⁾



Note: 1) Annual growth rate
Sources: Economically Active Population Survey microdata (Statistics Korea), Authors' estimations

The employment rate's contribution to aggregate labor growth was between 0 and 0.2 percentage points from 2000 to 2020, but it increased to 0.4 percentage points during 2021-2023 (see **Figure 6**). According to Lee et al. (2023), this increase is primarily due to the rising employment rates of the elderly and women. It is driven by the government's active labor market policies, employment recovery in in-person service sectors, and changes in working condition or social norms regarding the sharing of childcare responsibilities (see **Figure 9**).

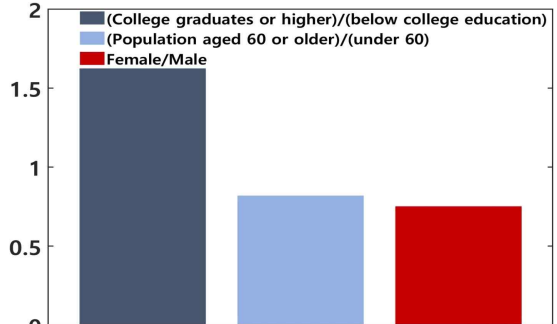
[Figure 9] Growth Rate of the Employment Rate¹⁾



Note: 1) Annual growth rate
Sources: Economically Active Population Survey microdata (Statistics Korea), Authors' estimations

Labor quality growth and its contribution to aggregate labor growth have consistently declined (see **Figure 11**). This trend is primarily driven by the increasing employment share of lower-productivity groups, such as the elderly and women (see **Figure 10**).

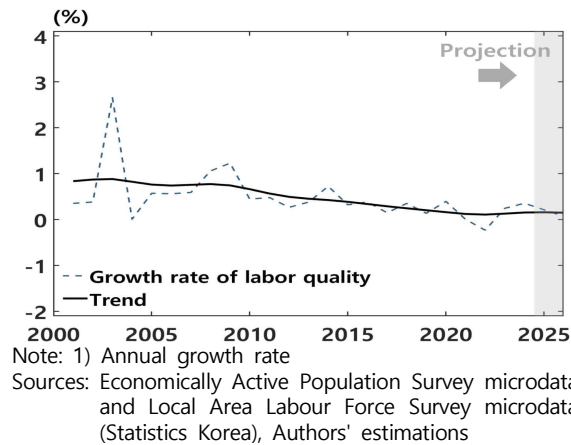
[Figure 10] Relative Productivity by Group¹⁾



Note: 1) Based on average hourly wages by group (2010-2023 data)
Sources: Local Area Labour Force Survey microdata (Statistics Korea), Authors' estimations

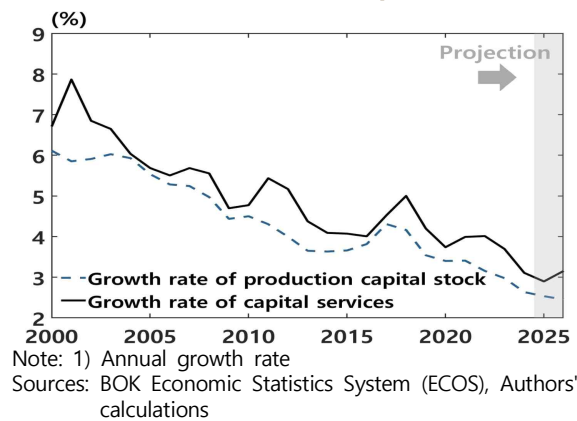
19) The significant decline in the contribution of hours worked during 2016-2020 was partly due to factors such as restrictions on operating hours and suspensions of operations during the pandemic.

[Figure 11] Growth Rate of Labor Quality¹⁾



As shown in **Figure 12**, the growth rate of capital services has steadily declined since the 2000s. This trend reflects a slowdown in investment, likely due to the maturing economy. A similar pattern can be observed in other advanced economies, such as the U.S. and Europe. Additionally, structural factors like population aging may further slow capital accumulation, weakening future growth potential.

[Figure 12] Growth Rates of Capital Services and Production Capital Stock¹⁾



III. Long-Term Projections and Scenario Analysis

Section III presents long-term projections of Korea's potential growth and explores several alternative scenarios. The purpose of these projections is to estimate future changes in potential growth, taking into account structural changes such as demographic shifts, and to examine how much these trends can be improved through structural reforms. In this paper, the projection horizon extends through the late 2040s.

1. Long-Term Projections

The long-term projection is conducted using the production function approach. Specifically, we compute future potential GDP by assuming the future paths for labor (L), capital (K), and total factor productivity (A), and applying these to the production function ($Y = F(A, K, L)$).

1.1 Projection for Labor Input

The projection for labor consists of labor quantity—(1) the population aged 15 and older, (2) the employment rate, (3) average hours worked—and (4) corresponding labor quality.²⁰⁾

1.1.1 Labor Quantity

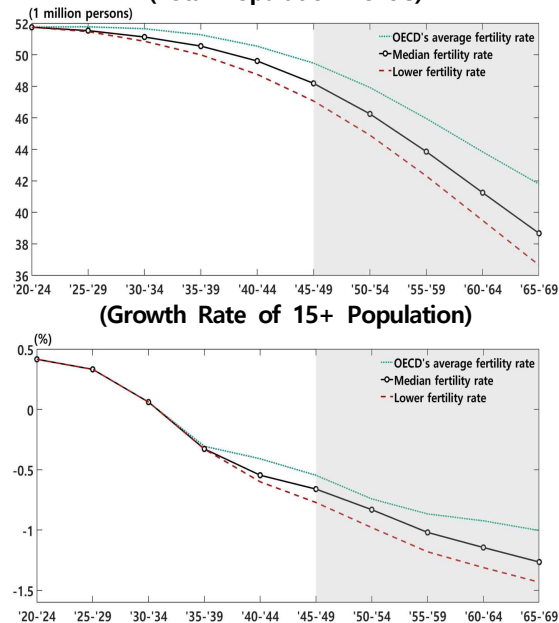
For the projection of the 15+ population, we use the medium scenario from the Population Projections for Korea by Statistics Korea. **Figure 13** shows the projected population level and the growth rate of the

20) For each component of labor input, see the definition of potential labor in Section II.1.2.1.

15+ population. The growth rate of the 15+ population is expected to decrease from an annual average of 0.4% before 2020 to -0.7% in the late 2040s—a decrease of about 1.1 percentage points.

Through the lens of the production function, this decline in the population growth rate reduces potential growth by lowering labor input growth.

[Figure 13] Population Projections¹⁾²⁾
(Total Population Levels)



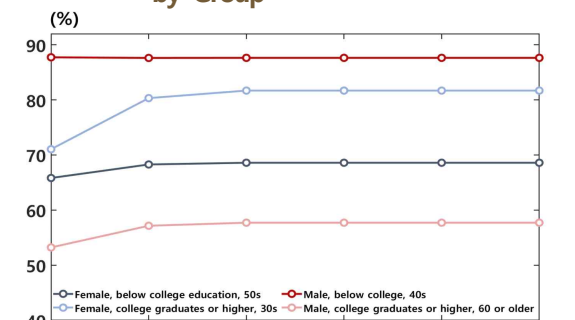
Notes: 1) 5-year average of annual growth rates
2) The shaded area represents the period beyond the long-term outlook horizon of this paper.
Source: Population Projections for Korea (Statistics Korea)

To project the employment rate, we adopt the approach of Lee (2022) and use (1) group-specific employment rate trends (segmented by gender, age, and education), and (2) projections for the group share.²¹⁾ In

other words, the future path of the aggregate employment rate is computed based on assumptions regarding (1) employment rates by group and (2) changes in group share.

First, group-specific employment rates are assumed to follow recent trends in the near future and then remain constant until 2049 (see **Figure 14**).²²⁾ Therefore, the aggregate employment rate in the long run is determined solely by changes in the composition of the groups.

[Figure 14] Projections for Employment Rates by Group¹⁾²⁾



Notes: 1) 5-year average
2) Four groups out of twenty
Sources: Population Projections for Korea (Statistics Korea)

The projection of the group share is based on the Population Projections for Korea and microdata from the Economically Active Population Survey. First, the population share by gender and age is adopted from the median scenario of the Population Projections for Korea. Next, to project the share by gender, age, and educational attainment, we need to assume the future path for the proportion of individuals with a

21) Lee (2022) provides a long-term outlook for the labor force based on (1) assumptions for group-specific labor force participation rates and (2) projected group shares constructed from the Population Projections. We apply this method to project future employment rates and average hours worked.

22) Lee (2022) assumes that the latest data for labor force participation rates by group remain constant over the projection horizon. In this paper, we relax this assumption.

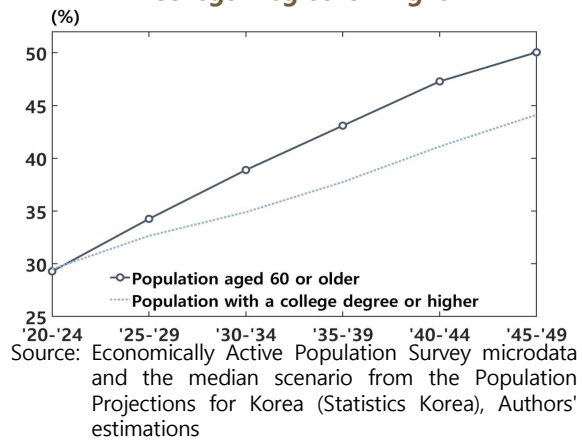
college degree or higher for each gender-age cell. We assume that the past trend in the proportion of college graduates or higher for each gender-age cell will continue through the end of the 2040s. The past trend for each gender-age cell is estimated using microdata from the Economically Active Population Survey.

As an example, **Figure 15** shows the projected paths for the share of the 60+ population (solid line) and those with a college degree or higher (dotted line). In the future, the Korean population will not only age but also become increasingly educated. The proportion of those with a college degree or above is expected to rise from about 20 percent in 2020 to 40 percent by the 2040s.²³⁾

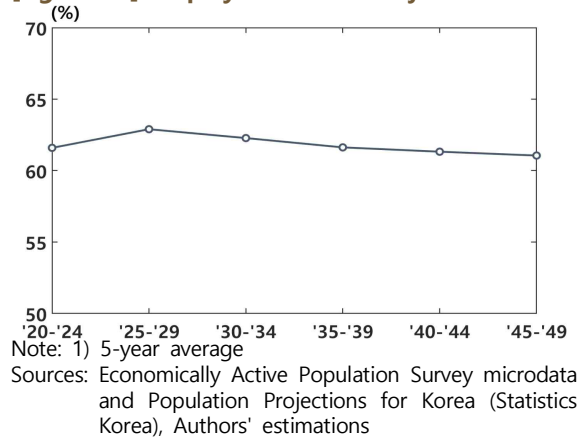
Figure 16 shows the resulting projection for the aggregate employment rate, demonstrating a continued increase until the 2020s, followed by a gradual decrease. Despite the assumption that the employment rate by group remains unchanged in the long run, the aggregate employment rate is projected to gradually decrease. This result is primarily because the proportion of the elderly, whose employment rate is relatively low, is expected to increase (see **Figure 17**). Therefore, **Figure 16** indicates that the composition effect arising from future demographic changes is expected to reduce the proportion of employed in the economy.

The average hours worked are projected in the same way. Since the average hours worked are calculated based on employed individuals, the share of the employed by group is used (see **Figure 18**). **Figure 19** shows the result. The average hours worked are also expected to gradually decrease in the future.

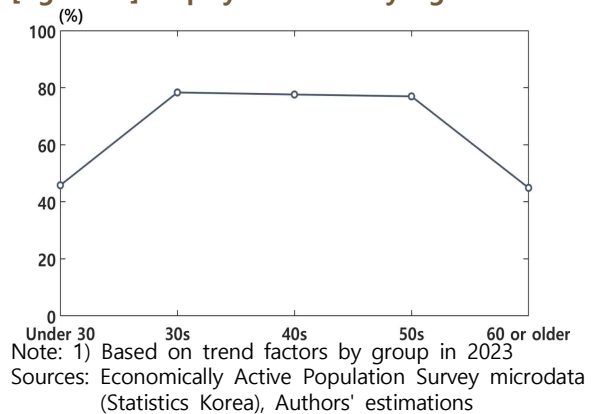
[Figure 15] Projections for Proportions of 60+ Population and those with a College Degree of Higher



[Figure 16] Employment Rate Projection¹⁾

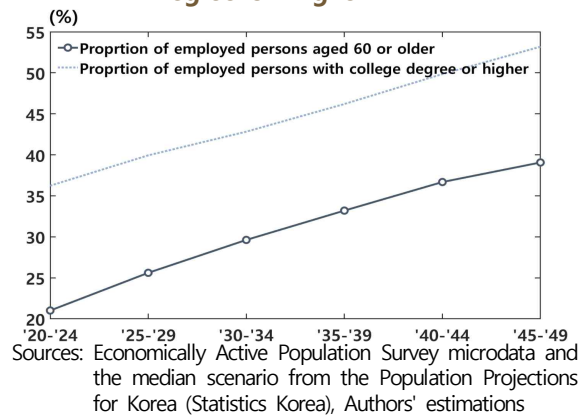


[Figure 17] Employment Rate by Age¹⁾

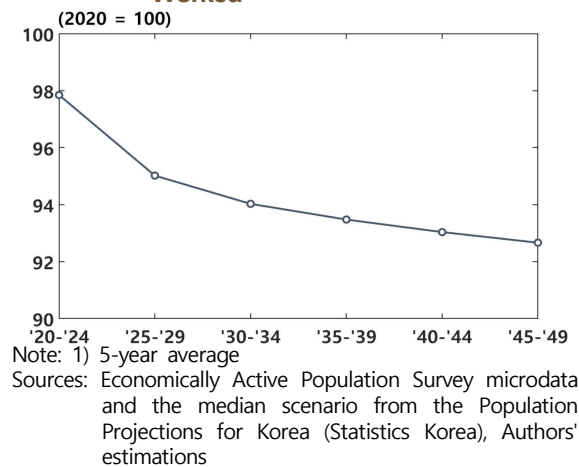


23) Figure 5 of Lee (2002) shows similar results.

[Figure 18] Projections for Proportions of 60+ Workers and those with a College Degree or Higher



[Figure 19] Projections for Average Hours Worked¹⁾



1.1.2 Labor Quality

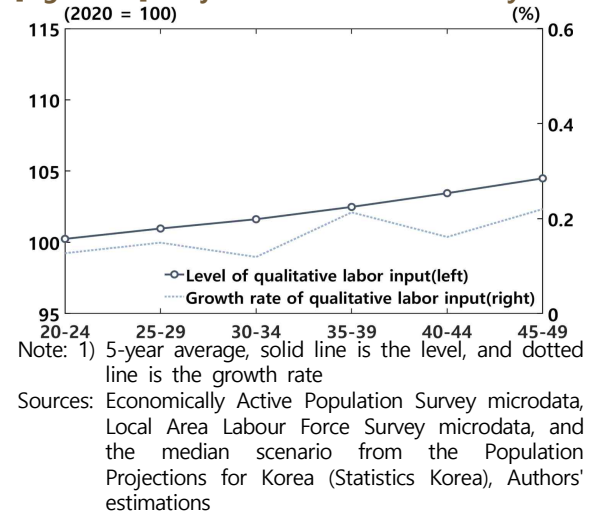
For the projection of labor quality, we need to assume (1) total hours worked by group and (2) hourly wages by group (see Section II.1.2.3).

First, the projection for total hours worked by group is constructed from the projections for group-specific employment rates and

hours worked and the group shares, set in Section III.1.1.1. In addition, marginal product of labor by group, measured by hourly wages, is assumed to follow the recent trend in the near future and remain constant until the end of the 2040s.²⁴⁾

Figure 20 shows that the resulting level (solid line) and growth rate (dotted line) of labor quality are expected to increase further. This result is mainly attributed to the projection that the employment share of highly educated groups—more productive than other groups (see Figure 10)—will continue to rise (as shown by the dotted line in Figure 18).²⁵⁾

[Figure 20] Projections for Labor Quality¹⁾



1.2 Projection for Capital Input and Total Factor Productivity

The baseline projection for capital input is based on past trends. Specifically, it is

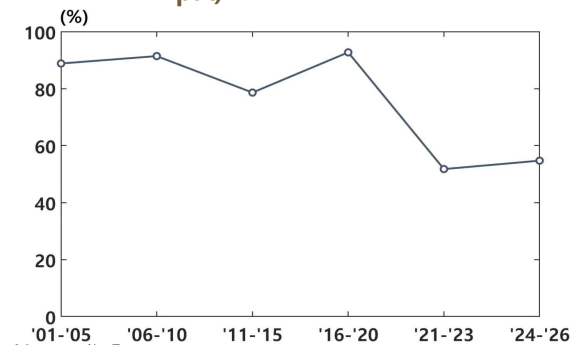
24) This result is due to the assumption that the relative productivity of each group will follow the past trend in the near future and then remain constant for the rest of the projection horizon.

25) More specifically, the increase in the share of highly educated workers (with high productivity) offsets the negative effects caused by the increase in the share of elderly workers (with low productivity). Lee (2022) also finds that future labor input is projected to decline more slowly considering the productivity composition of the labor force.

assumed that the linear trend of the (log) change rate in capital services will continue throughout the projection period.

For the TFP projection, we consider its relationship with capital input, following Cho (2023). **Figure 21** shows the growth contribution of TFP relative to capital. Before the pandemic, the contribution of TFP to potential growth was, on average, around 90 percent of the capital input contribution. However, it declined to about 60 percent on average between 2020 and 2024 (based on the production function approach). We assume that the relative contribution of TFP to capital will remain constant at around 50 percent, which is close to the level for 2026.

[Figure 21] Contribution of Total Factor Productivity (Relative to Capital Input)¹⁾²⁾



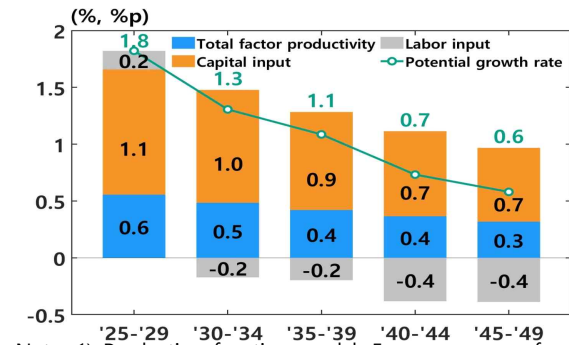
Notes: 1) 5-year average
2) Productivity function model
Source: Authors' estimations

1.3 Baseline Projection for Potential Growth Rate

By reflecting all the baseline projections for production inputs discussed so far, it is projected that the potential growth rate of the Korean economy will continue to decline. The potential growth will decline to the low to mid-1% range in the 2030s and around 0.6% in the late 2040s (see **Figure**

22, solid line). The gradual slowdown in TFP, capital, and labor contributions all contribute to this decline.

[Figure 22] Baseline Projection for Potential Growth¹⁾



Note: 1) Production function model, 5-year average of annual growth rates
Source: Authors' estimations

[Table 4] Baseline Projection for Potential Growth¹⁾

(Annual average, %)				
2025-2029	2030-2034	2035-2039	2040-2044	2045-2049
1.8	1.3	1.1	0.7	0.6

Note: 1) Production function model, 5-year average of annual growth rates
Source: Authors' estimations

2. Scenario Analysis

By applying the baseline projection for production inputs to the production function, the potential growth rate of the Korean economy could enter the 1% range in the late 2020s. However, this projection is based on the assumption that the economic structure, regulations, and institutions will remain largely unchanged. If productivity or the demographic structure improves through structural reforms, the potential growth could exceed the baseline projection. Conversely, if the situation worsens, the potential growth could decline more rapidly than the baseline.

The following sections explore scenarios in which the potential growth could be higher or lower than the baseline projection, focusing on three major aspects: TFP, labor quantity, and quality.²⁶⁾

2.1 Scenarios for Total Factor Productivity

First, we analyze how the future path of potential growth would change if the projection for TFP deviates from the baseline. We consider two scenarios in which TFP evolves differently from the baseline while keeping other factors, such as the growth rates of capital and labor, fixed at the baseline projection.

(1) **[Positive Scenario: Recovery of TFP]** In the positive scenario, we assume that the growth contribution of TFP will recover to about 90% of capital input, which is the average level observed before the pandemic. Additionally, we assume that the resulting TFP growth rate at 2030 will remain constant thereafter. This scenario reflects the potential outcomes of institutional improvements and policy efforts, such as fostering an innovation ecosystem, enhancing labor market policies, and mitigating the concentration of economic activity in the Seoul Metropolitan Region.

For example, expanding R&D investment and supporting entrepreneurship are expected to enhance the quality of innovation, create new sources of economic growth, and improve productivity (Lee et al., 2024; Chung J. et al., 2024). Additionally, advanced technological

innovations, such as AI, could increase automation and efficiency across industries, thereby boosting productivity. The introduction of AI is expected to positively impact TFP by increasing automation levels within firms and improving the speed and accuracy of the decision-making process.

Furthermore, improvements in labor market policies related to care services, such as childcare and family caregiving, are expected to alleviate the burden of household work. This, in turn, can increase female labor force participation and reallocate resources to more productive sectors. If policies effectively alleviate the concentration of the population in the Seoul Metropolitan Region, they can resolve mismatches in regional labor markets, promote balanced development across regions, and enhance productivity, generating positive spillover effects in surrounding areas (Chung M. et al., 2024). Finally, if educational reforms reduce the burden of private education and improve the quality of public education, human capital will be strengthened, contributing to long-term productivity growth (Chung J. et al., 2024).

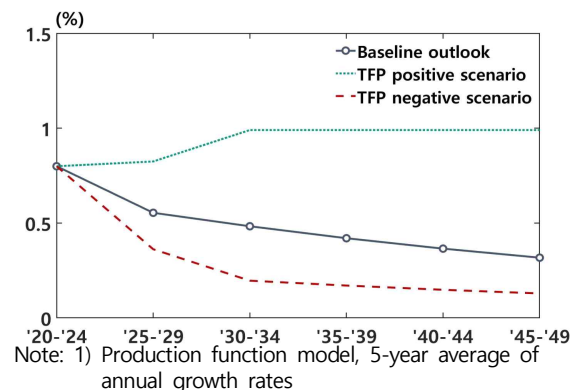
If these structural reforms progress smoothly and the growth rate of TFP exceeds the baseline projection (green dotted line in **Figure 23**), the potential growth rate is expected to be higher than the baseline (green dotted line in **Figure 24**). Specifically, it is projected to reach 1.8% in the early 2030s and 1.3% in the late 2040s; the latter is about 0.7 percentage points higher than the baseline projection.

26) It should be noted that changes in one production input may affect another (general equilibrium), so it may not be appropriate to simply sum the outcomes of each scenario.

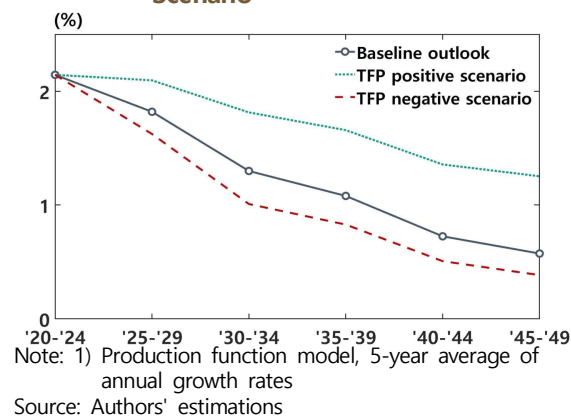
(2) **[Negative Scenario: TFP Slowdown]** On the other hand, the negative scenario assumes that the growth contribution of TFP relative to capital declines to and remains around 20% until the late 2040s.

This scenario reflects several factors, including more sluggish innovation, global economic slowdown, and more rapid population aging. If TFP growth declines compared to the baseline projection (red dashed line in **Figure 23**), potential growth is projected to fall to about 0.4% in the late 2040s (red dashed line in **Figure 24**). This is about 0.2 percentage points lower than the baseline projection.

[Figure 23] TFP Growth Rate Scenario¹⁾



[Figure 24] Potential Growth by TFP Scenario¹⁾



2.2 Scenarios for Fertility Rate

Next, we explore alternative potential growth paths by considering variations in the labor growth rate, either higher or lower than the baseline projection. Specifically, we hold other factors, such as capital and TFP, in the baseline projection and assess how changes in the labor growth rate, driven by different fertility rate scenarios, affect potential growth.

(1) **[Positive Scenario: Increase in Fertility Rate]** The positive scenario assumes that the total fertility rate will recover to the OECD average level. This scenario reflects policies aimed at alleviating the concentration of population in the capital region, implementing labor market reforms to support work-life balance and reduce career interruptions for women, expanding social services to ease childcare burdens, and reducing private education costs. These policies are expected to strengthen social support for childbirth and childcare, contributing to a recovery in the fertility rate (Hwang et al., 2023; Sung et al., 2023; Lee D. et al., 2024; Chung J. et al., 2024).

Specifically, we construct an alternative population share by sex and age based on a fertility scenario that assumes the OECD average fertility rate (1.58 as of 2021) from the Population Projections by Statistics Korea. In this scenario, the total fertility rate is projected to be about 0.17 higher than the baseline scenario in 2030 (0.99) and 0.20 higher in 2040 (1.25). The growth rate of the 15+ population is expected to gradually increase compared to the baseline starting in the late 2030s, when the additional newborns begin to reach 15 years old

(Figure 13). In the late 2040s, the growth rate of the 15+ population is projected to be about 0.1 percentage points higher than the baseline.

In the positive scenario for fertility rates, potential growth rises from the late 2030s. The potential growth rate in the late 2040s is projected to be about 0.1 percentage points higher than the baseline projection (green dashed line in Figure 25).²⁷⁾ However, considering the findings of Inokuma and Sánchez (2024) that an increase in population growth may also enhance productivity growth, the potential growth rate in the 2040s could improve by more than 0.2 percentage points.

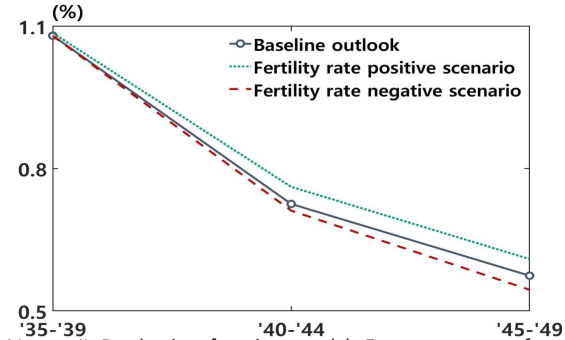
The effect of fertility rate improvement on potential growth is expected to expand starting in the 2050s when the increased newborns become more productive. Also, population growth will gradually accelerate, reaching about 0.2 percentage points higher than the baseline projection in the 2060s (green dashed line in Figure 13).

Given the lag in the impact of fertility rate improvements on potential growth, it is crucial to implement policies to raise fertility rates with urgency. At the same time, it is important to explore other policy options, such as utilizing elderly labor and foreign labor (Kim et al., 2022; Lee J. et al., 2024).

(2) **[Negative Scenario: Further Decline in Fertility Rate]** On the other hand, if the current low fertility rate trend continues,

potential growth is expected to decline more rapidly than the baseline projection due to a faster shrinkage of the labor force. The low fertility scenario from the Population Projection assumes that the fertility rate in the late 2040s will be 0.25 lower than the baseline projection. Reflecting this scenario, potential growth in the late 2040s is projected to be about 0.1 percentage points lower than the baseline (red dashed line in Figure 25). Similarly, since it takes time for newborns to enter the working-age population, the negative effects of the declining fertility rate are expected to gradually worsen after the 2040s.

[Figure 25] Potential Growth by Fertility Rate Scenario¹⁾²⁾



Notes: 1) Production function model, 5-year average of annual growth rates
 2) Positive scenario is based on the OECD average fertility rate scenario from Population Projections for Korea; Negative scenario is based on the low fertility rate scenario.
 Sources: Population Projections for Korea (Statistics Korea), Authors' estimations

2.3 Scenarios for Labor Quality

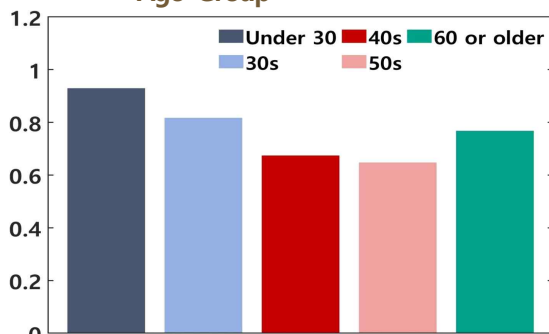
Lastly, we consider scenarios for the labor productivity of women and the elderly, which affect the overall labor quality of the economy. These scenarios reflect labor

27) It is important to note that the increase in potential growth due to the recovery of fertility rates is slightly smaller than the increase in population growth. This is because, within our projection horizon (2040s), most of the increased population will be under 30, a group with lower employment rates and labor productivity compared to other age groups.

market reforms aimed at enhancing the productivity of women and the elderly, who typically exhibit lower productivity, as measured by hourly wages, compared to other groups.²⁸⁾

(1) **[Scenario: Improvement in Women's Productivity]** For the first scenario, we consider an improvement in women's labor productivity. **Figure 26** illustrates women's relative productivity compared to men by age. It shows that women's productivity is similar to men's for those under 30 but gradually declines with age, falling to about 60 percent of men's productivity in their 50s.

[Figure 26] Relative Productivity of Women by Age Group¹⁾²⁾



Notes: 1) Compared to men in the same age group
 2) Based on average hourly wages by group (2010-2023 data)
 Sources: Local Area Labour Force Survey microdata (Statistics Korea), Authors' estimations

Specifically, we assume that the productivity of women aged 30 and older will gradually improve to levels similar to those of men within the same education levels and age by the late 2040s.²⁹⁾ This scenario assumes that the structural wage gap between men and women, caused by disadvantages related to

marriage and childbirth, will be significantly reduced through various policy efforts, such as promoting work-life balance (Kim et al., 2021; Lee, 2022).

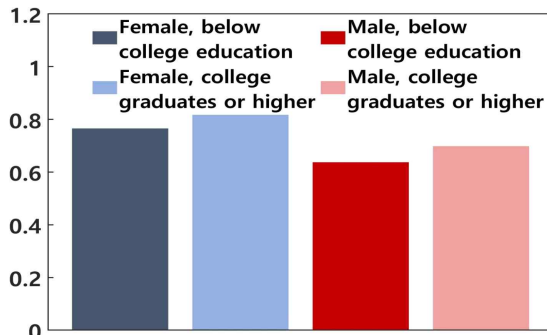
(2) **[Scenario: Improvement in Productivity of Older Workers]** The second scenario considers improvements in labor productivity of elderly workers. **Figure 27** illustrates the relative productivity of this group compared to those in their 50s. While there are some variations by gender and education, the labor productivity of workers aged 60 and above is about 60-80% that of those in their 50s.

Based on this observation, the second scenario assumes that the productivity of the elderly will gradually improve by the late 2040s. Specifically, we assume that the productivity gap between those aged 60 and above and those in their 50s will narrow to about half of the current level within the same gender and educational attainment groups. This scenario reflects improvements in health and better labor market conditions for the elderly (Lee, 2022; Kim, 2024; Lee J. et al., 2024).

The two scenarios, combined together, shift the future path of potential growth upward: the potential growth rate in the late 2040s is projected to increase by nearly 0.1 percentage points compared to the baseline projection (green dashed line in **Figure 28**).³⁰⁾

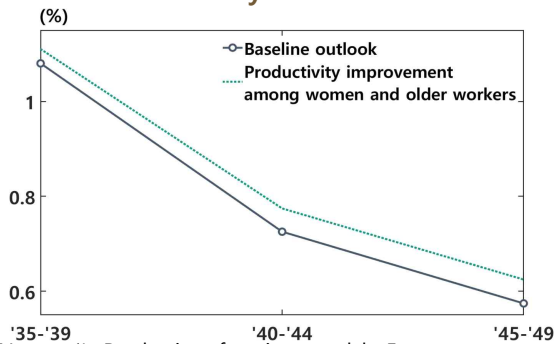
28) We use the group average hourly wage as a proxy for labor productivity by group.
 29) More specifically, we assume that the gender productivity gap by age and education group gradually narrows to the level observed for those under 30 in each education group.
 30) Additionally, a non-negligible part of the gender productivity gap may be attributable to women's career breaks. To reflect the improvement in women's productivity by addressing these career breaks

[Figure 27] Relative Productivity of Older Workers by Gender and Education¹⁾²⁾



Notes: 1) Relative productivity of those aged 60 or older compared to those in their 50s
 2) Based on average hourly wages by group (data from 2010 and onward)
 Sources: Local Area Labour Force Survey by Statistics Korea, Authors' estimations

[Figure 28] Potential Growth by labor Productivity Scenario¹⁾²⁾



Notes: 1) Production function model, 5-year average of annual growth rates
 2) This scenario assumes women's productivity would improve gradually relative to that of men with the same education and age, and the productivity of those aged 60 or older would improve gradually compared to those in their 50s with the same gender and education.
 Source: Authors' estimations

IV. Conclusion

This paper estimates Korea's potential growth rate by improving estimation methods to better account for structural changes. The results show that potential growth has been steadily declining, reaching

around 2 percent on average during 2024-2026. The long-term projection indicates that if this trend continues, potential growth is expected to fall below 1 percent by the 2040s. The decline in potential growth is attributed to shrinking labor force growth, along with a slowdown in the growth of total factor productivity and capital services.

However, this is not a given condition; it depends on how our economy responds through structural reforms and other measures. The scenario analysis shows that if productivity and fertility rates improve beyond the baseline projections due to structural reforms, the future potential growth rate is expected to rise significantly compared to the baseline.

Regarding the fertility rate, although it may gradually recover due to policy efforts, it will take considerable time for newborns to enter the labor market. Therefore, it is essential to implement policies with both urgency and consistency. In addition, it is also necessary to consider other policy options such as utilizing elderly labor and foreign labor (Lee et al., 2024; Kim et al., 2022).

Furthermore, it is essential to enhance productivity through structural reforms across the economy while proactively responding to anticipated changes in the future economic structure. To boost productivity, efforts should focus on improving labor market efficiency, promoting the efficient allocation

in scenario analysis, we need an alternative scenario where both women's relative productivity and employment rates improve. In such a scenario, the improvement in long-term potential growth could be more pronounced. We leave this analysis for future work.

of resources, enhancing the business environment for corporate investment, and nurturing innovative firms. Additionally, multifaceted policy efforts to boost the productivity of women and older workers are necessary.

Finally, since potential GDP is inherently an unobservable variable, we must consider the limitations and uncertainties of the estimate. Moving forward, it is essential to continuously improve the methods for estimating potential GDP while closely examining the impact of changes in domestic and global economic conditions—such as digital transformation, artificial intelligence, supply chain restructuring, and climate change—on growth potential.

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