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# Flattening Phillips Curve in Korea: The Role of Median Inflation

Young Se Kim*, Sanghwa Moon**

This paper examines the flattening of the Phillips curve in Korea and investigates the factors underlying the weak relationship between inflation and aggregate real activity. Using a standard expectations-augmented Phillips curve framework, the empirical analysis provides robust evidence of a flattening Phillips curve across various measures of inflation and real activity. However, when median inflation is used as the inflation measure, rather than traditional core inflation measures that exclude specific items, the evidence of flattening becomes notably weaker. Median inflation filters out the transitory effects of supply shocks on headline inflation across sectors, which traditional core inflation measures fail to do. These findings suggest that the Phillips curve relationship may still hold in Korea.

JEL Classification: C53, E31, E32
Keywords: Phillips curve, inflation, real activity, monetary policy

* 53 Myeongnyun-dong 3-ga, Jongno-gu, Seoul, 03063, Korea; E-mail: youngsekim@skku.edu.
** 1945 N. High St., Columbus, OH 43210; E-mail: moon.518@osu.edu.

## 1. INTRODUCTION

This paper examines the empirical relationship between inflation and aggregate economic activity, commonly referred to as the Phillips curve, in Korea. Special emphasis is placed on the possibility of structural changes in the slope of the Phillips curve in Korea, as the relationship between real activity and inflation has appeared significantly weaker since the Great recession across many countries. Recent empirical studies have explored various explanations for the flattening of the Phillips curve, emphasizing its importance for monetary policy.[1)] Understanding the forces driving this empirical regularity is critical, as policy implications depend on the underlying causes (Occhino, 2019). Accordingly, this study investigates the dominant factors contributing to the weak relationship between inflation and aggregate real activity in Korea.

Using a standard expectations-augmented Phillips curve framework, we first provide clear empirical evidence of the flattening Phillips curve in Korea over the sample period spanning from 2011 to 2019. This finding is robust across various inflation and real activity measures commonly used in the literature. Next, we explore potential factors behind the weakened Phillips correlation, a task that, to our knowledge, has not been undertaken for the case of Korea. Our results suggest that measurement errors in inflation may be a primary cause of the apparent breakdown. Lastly, by constructing median inflation which removes transitory supply shock effects from headline inflation, we argue that a stable relationship exists between inflation and real activity in Korea. This indicates that the traditional Phillips correlation may still hold in Korea when measurement issues are carefully addressed.

The question of how the inflation rate responds when aggregate economic activity changes is among the oldest and most significant in macroeconomics. Since the introduction of Friedman's expectations-augmented Phillips curve, where inflation depends on expected inflation and aggregate economic activity gap, monetary authorities have paid much attention to this traditional Phillips correlation. Yet this conventional wisdom has faced growing skepticism among economists, particularly after the Global Financial Crisis in the late 2000s. During the Great Recession, inflation appeared to deviate from the Phillips curve framework, as seen in many industrial countries, like the U.S., which experienced jobless recovery.

In recent decades, research by Ball and Mazumder (2019a), Coibion and Gorodnichenko (2015), and Stock and Watson (2020), among others, has documented that inflation rates have remained notably stable, while real activity measures such as output and unemployment have displayed relatively large variations — a phenomenon now termed the flattening Phillips curve. While there is no consensus on the precise cause, several plausible explanations have been proposed on why the Phillips curve has flattened. One view is that well-anchored inflation expectations since the Great Moderation of the

[1)] For an excellent survey on this, see Kuttner and Robinson (2010).

mid-1980s have kept inflation near central banks' targets, dampening its sensitivity to economic fluctuations. Another line of research suggests that the Phillips correlation does well exist, but due to measurement errors in either inflation or real activity measures, the flattening Phillips curve may be statistically an artifact (Ball and Mazumder, 2019a; Gordon, 2013; Stock and Watson, 2020).

To investigate potential structural shifts in the Phillips correlation in Korea, this study employs a simple expectations-augmented Phillips curve (Ball and Mazumder, 2019b).[2] Using conventional measures of inflation and aggregate economic activity, such as output gap, the empirical results provide clear evidence of the flattening Phillips curve in Korea, while the unemployment gap has little predictive power in accounting for inflation variations. Further investigation into potential measurement errors suggests that inaccuracies in inflation measurement may play a significant role in explaining why the Phillips correlation appears to break down. As in Ball and Mazumder (2019a), the introduction of median inflation as core inflation measure successfully shows an empirically stable relationship between inflation and real activity in Korea, consistent with the traditional Phillips correlation.

The remainder of the paper is organized as follows. Section 2 reviews the empirical aspects of the expectations-augmented Phillips curve, with a special emphasis its slope and potential causes of the flattening. Section 3 describes the standard model for the relationship between inflation and real activity and then presents evidence of the Phillips correlation in Korea using traditional measures. Section 4 explores alternative explanations of the flattening Phillips curve by utilizing reasonable alternative measures of inflation and unemployment. Concluding remarks are presented in Section 5.

## 2. INFLATION AND ECONOMIC ACTIVITY: THE PHILLIPS CORRELATION

In this section, we begin by reviewing stories about the relationship between inflation and aggregate economic activity, commonly referred to as the Phillips curve. A special emphasis is placed on measures of inflation and aggregate activity to evaluate the empirical validity of the Phillips correlation. We are particularly interested in scrutinizing systematic shifts in the relationship and their potential causes.

### 2.1. The Phillips Correlation

Ever since Friedman (1968) postulated that the causes of inflation are expected inflation, activity gap, and supply shock, the expectations-augmented Phillips curve has

[2] For some relevant studies, see Jung (2021), Lee, Chang, and Choi (2022), and Song and Bae (2022), among others.

been widely used as a key building block in macroeconomic models. This can be expressed as

$$\pi_t = E\pi_t + \kappa(u_t - u_t^n) + \varepsilon_t, \quad (1)$$

where $\pi$ is inflation rate, $E\pi$ is inflation expectations, $\kappa$ is Phillips correlation or the slope of the Phillips curve, $u$ is unemployment, $u^n$ is the natural rate of unemployment, and $\varepsilon$ is an error term, regularly interpreted as an aggregate supply shock. It is worth noting that the dynamic patterns of the Phillips correlation may depend on the behavior of expectations. When the expected inflation can be best represented by past inflation, $E\pi_t = \pi_{t-1}$, Eq. (1) becomes the well-known accelerationist Phillips curve, which has been a standard reduced-form model of inflation (Stock and Watson, 1999; Williams, 2006; Ball and Mazumder, 2011; Gordon, 2013).[3] Since unemployment below its natural level leads to a higher rate of inflation, accelerating the price level, the Phillips curve presents a negative correlation, or $\kappa < 0$. This fundamental aspect of the Phillips curve had been paid considerable attention as it picks up a broad empirical regularity up until the Great Recession. However, from recent episodes of unemployment and inflation, the traditional relationship seems to have collapsed as there is no longer the disinflationary effect of recessions (Stock and Watson, 2010). Following Ball, Leigh, and Loungani (2017), the Okun's law implies that the Phillips correlation can be alternatively written as

$$\pi_t = E\pi_t + \tilde{\kappa}(y_t - y_t^n) + \varepsilon_t, \quad (2)$$

where $y_t - y_t^n$ is output or activity gap and $\tilde{\kappa} > 0$ is also Phillips correlation or the slope of the Phillips curve.

### 2.2. Measures of Inflation and Real Activity

In empirical studies seeking to explain the dynamic behavior of inflation and its relationship with slack, there clearly is no consensus about how best to measure inflation and the slack. Nonetheless, there exist popular measures of inflation and economic activity, and, in this paper, we utilize those measures to study the Phillips correlation in Korea without increasing the statistical complication.[4]

First, common measures of inflation, the growth rate of the price level, include headline inflation and core inflation. The former encompasses all components or sectors that are used to calculate an index of inflation, for example, Consumer Price Index (CPI), while

[3] In much empirical research seeking to explain quarterly data on inflation, the accelerationist Phillips curve customarily involves past inflation and unemployment with four or more lags.

[4] Stock and Watson (2020) document widely used measures of inflation involve components having weak and/or unstable correlation with cyclical activity and suggest a new measure of inflation weighting the components by their joint cyclical covariance with real activity.

the latter filters out movements in headline inflation caused by large variations in relative prices to pitch into an underlying trend in the headline inflation.[5] Among various core inflations, an excluding-item measure of core inflation, such as headline inflation excluding food and energy, is most commonly used in the literature. In this study, we consider both CPI excluding food and energy (XFE) inflation and CPI excluding agricultural products and oil (XAO) inflation.[6] Next, for measures of economic activity, both unemployment gap and output gap are widely used. Despite the fact that unemployment gap is ideally the spread between actual unemployment rate and natural rate of unemployment, the rate of natural unemployment depends on an economic model and thus is not officially reported by a statistical agency. Following the tradition, we apply the Hodrick-Prescott (HP) filter with the smoothing parameter of 1600 to remove the cyclical component of the quarterly unemployment rate series. Another equally popular measure of real activity is output gap defined as the log difference between the actual output and the potential output. For aggregate output measures, depending on the frequency of the data, either real GDP or Industrial Production Index is regularly used. Due to the availability of potential output data, the trend component of actual output measure obtained through the HP filter is served as the potential output.

### 2.3. Flattening Phillips Curve

A Phillips curve can be an important theoretical background for monetary policy as the monetary authority utilizes it to understand what happens to inflation when aggregate economic activity changes.[7] In both theoretical and empirical studies, the slope of Phillips curve, $\kappa$ or $\tilde{\kappa}$ in the equations (1) and (2), has been paid much attention since it can be interpreted as the sensitivity of inflation to variations in aggregate economic activities.

A number of studies have documented that since the Great Moderation period began in the mid 1980s, the traditional relationship between inflation and real activity has collapsed, which becomes to be known as "the Flattening Phillips curve." This commonly refers to the case that there is no longer the conventional tradeoff between inflation and real activity as the slope coefficient of the Phillips curve is not statistically different from zero.[8] As presented in Stock and Watson (2020), among others, Fig. 1 demonstrates the

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[5] No consensus about how best to construct a measure of core inflation has been made. In practice, a core inflation is basically calculated using either a cross-sectional or a time-series filter. For an excellent survey on alternative measures of core inflation, see Kim and Kim (2015).

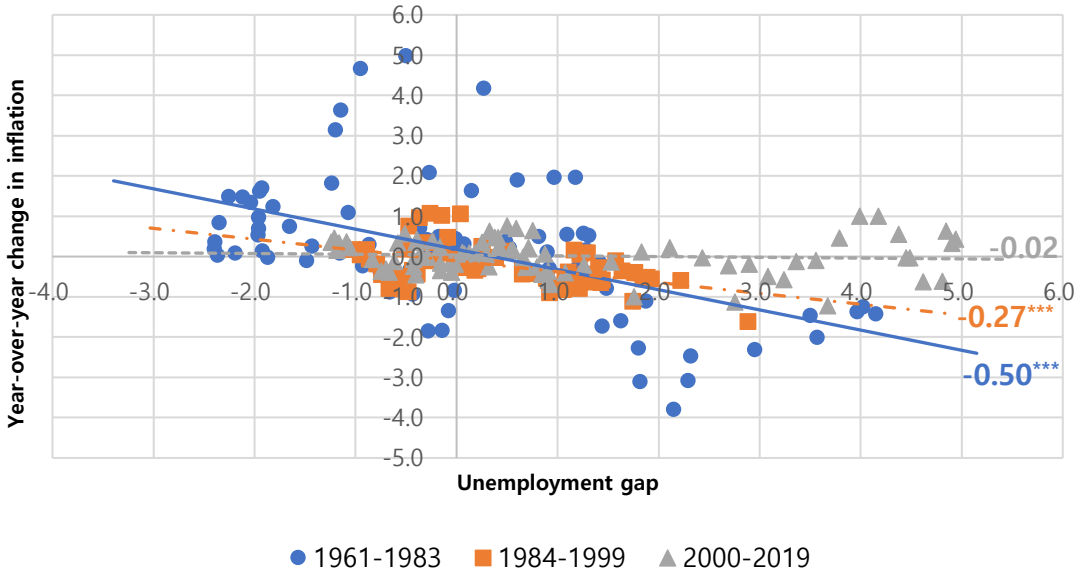
[6] While "food and energy" includes a larger set of items than "agricultural products and oil" does, the discrepancy between those measures of core inflation is usually minor (Kim and Kim, 2015).

[7] For instance, the Bank of Korea Act makes clear that the purpose of the Act is "to contribute to the sound development of the national economy by pursuing price stability through the formulation and implementation of efficient monetary policy."

[8] The flattening Phillips curve also includes a situation that, even when its slope coefficient is statistically significant, it has the wrong sign that is not consistent with the conventional beliefs.

evidence of the flattening Phillips correlations in the U.S. The statistically significant negative relationship between core PCE inflation rate and unemployment gap was found during the sample of 1961-1983. After the Great Moderation period began in the mid 1980s, the Phillips correlation appears to be weaker, but the relationship seems to be alive. However, during the Great Recession period, 2000-2019, the Phillips correlation evidently disappears as the estimate of slope coefficient, $\tilde{\kappa} = -0.02$ is not statistically different from zero.

**Figure 1 U.S. Phillips Correlations**




**Note:** Year-over-year change in inflation is $\Delta\pi_t = \pi_t - \pi_{t-4}$, where $\pi$ is four-quarter moving average inflation rate. The unemployment gap is calculated as the difference between unemployment rate and natural rate of unemployment obtained from the CBO.

## 2.4. Driving Forces of the Flattening Phillips Curve

When the Phillips correlation breaks down, it becomes very difficult for the central bank to understand the dynamic behavior of inflation making effective monetary policies controlling inflation based on the Phillips correlation challenging. Moreover, as the Phillips curve is a key building block in a New Keynesian model, it inevitably can make model implications less reliable. Some studies contend that the Phillips curve is dead, so the Phillips curve is no longer a useful tool for a monetary authority. However, most economists keep the faith that the Phillips correlation is still alive but is masked by a variety of reasons.

One plausible explanation on why the Phillips curve flattened is a measurement error. First, the traditional measure of unemployment rate is calculated as the number of unemployed divided by the labor force. However, the duration of the unemployment matters in the period of upward pressure on wage growth. The long-term unemployed

individuals are on the margins of the labor force (Krueger, Cramer, and Cho, 2014), and only the short-term unemployed, which is generally defined as the share of the labor force unemployed for less than twenty-seven weeks, put downward pressure on wage growth. On this ground, Ball and Mazumder (2019b) suggests the short-term unemployment rate as an economic activity measure.[9] In addition, a mismeasurement of inflation can be a potential source of the flattening Phillips curve. Conventional measures of inflation, such as CPI, PCE, and core inflation rates, may not be proper measures of inflation since the prices of all market baskets do not respond to a change in real activity. Stock and Watson (2020) considers 17 subcategories of PCE inflation and demonstrates price variations for each subcategory behave very differently in terms of cyclicality.[10] By placing a greater weight on sectors with high cyclicality, they construct Cyclically Sensitive Inflation (CSI) index and show that the Phillips curve based on the CSI has not flattened.

Next, another possible story behind the flattening Phillips curve comes from structural changes in the behavior of inflation expectations. Since inflation expectations have been anchored at a constant level close to the Fed's 2% inflation target, most economists attribute the flattening Phillips curve to the anchored inflation expectations.[11] Being consistent with this story, an expectations-augmented Phillips curve with $E\pi_t = \pi_{t-1}$ takes the form,

$$\pi_t - \pi_{t-1} = \kappa(u_t - u_t^n) + \varepsilon_t. \tag{3}$$

According to this accelerationist Phillips curve, if the unemployment rate exceeds its natural rate, inflation is expected to fall further to the degree that may trigger deflation. However, if the expected inflation is anchored at some level, i.e., $E\pi_t$ = 2%, the accelerationist Phillips curve no longer exists. That is, the Phillips curve becomes a relationship between the unemployment gap and the level of inflation, not the change in inflation.[12]

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9) In the late 2000s in the U.S., the share of the short-term unemployed dramatically fell while the long-term component dramatically rose without a downward pressure on wage growth causing flattening Phillips curve.

10) The sectors whose prices are determined in local markets display large cyclicality.

11) For instance, in his speech in 2010, Ben Bernanke mentioned that "The public's expectations for inflation also importantly influence inflation dynamics. Indicators of longer-term inflation expectations have generally been stable in the wake of the financial crisis."

12) In the U.S., expected inflation appears to be backward-looking until the late 1990s. Since 1998, inflation expectations do not seem to be formed based on past inflation observation as the long-term inflation expectations are firmly anchored at the level of 2.5%. Ball and Mazumder (2019b) pointed out that the inclusion of anchored inflation expectations in the expectations-augmented Phillips curve model better explains the dynamic patterns of U.S. inflation.

## 3. EVIDENCE OF THE FLATTENING PHILLIPS CURVE IN KOREA

To examine whether there has been structural change in the Phillips correlation, this section employs popular empirical specifications as in Ball and Mazumder (2019a, b). In particular, a special emphasis is placed on the measures of inflation and real activity. We evaluate whether empirical results regarding the presence of the Phillips curve in Korea is robust to the choice of those measures.

### 3.1. Empirical Specifications

A simple variant of the expectations-augmented Phillips curve employed in our empirical analysis takes the form,

$$\pi_t = E\pi_t + \kappa x_t + \varepsilon_t, \tag{4}$$

where $\pi_t$ is the rate of quarterly inflation at time $t$, $E\pi_t$ is inflation expectations formed in period $t-1$, $x_t \in \{y_t - y^n,\ u_t - u^n\}$ is a measure of economic real activity at time $t$, and $\kappa$ is the slope of the Phillips curve. Following Ball and Mazumder (2011), a backward-looking type of inflation expectations,

$$E\pi_t = \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}), \tag{5}$$

which is the average of inflation over the past four quarters. In addition, the real activity measure, $\tilde{x}$, is calculated by the average of its past three observations (Ball and Mazumder, 2019a; Stock and Watson, 2020). For the choice of $x$, we consider output gap using real GDP or Index of All Industrial Production (IAIP) and unemployment gap. That is, the empirical specifications of the Phillips curve are given by

$$\pi_t - \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) = \kappa(\tilde{y}_t - \tilde{y}_t^n), \tag{6}$$

$$\pi_t - \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) = \kappa(\tilde{u}_t - \tilde{u}_t^n), \tag{7}$$

where $\tilde{y}_t^n$ and $\tilde{u}_t^n$ are the average log potential output and natural rate of unemployment from $t-3$ through $t$, respectively.

The data spanning from 2000 to 2019 used to measure inflation and real activity are as follows. First, for the measures of inflation, we utilize two measures of core inflation, CPI excluding food and energy (XFE) and CPI excluding agricultural products and oil (XAO), obtained from the Bank of Korea.[13] To calculate the annualized rate of quarterly inflation, we use $g_q = [(P_q/P_{q-1})^4 - 1] \times 100$, where $g_q$ is the annualized percentage change

[13] Note that both core inflation measures are seasonally-adjusted and annualized.

in quarterly price levels between quarter $q$ and $q-1$. Next, real GDP and Index of All Industrial Products (IAIP) that are from OECD data set are utilized to measure output gap. Due to the data availability, the HP filtered output is used as the measure of potential or natural level of output, $y^n$. Similarly, the cyclical component of unemployment is calculated by subtracting the natural rate of unemployment obtained by the HP filter from actual unemployment.

### 3.2. Empirical Findings

To investigate the possibility of the flattening Phillips curve in Korea, the equations (6) and (7) are estimated not only for the full sample period, 2000-2019, but also for two subsample periods, 2000-2010 and 2011-2019. Table 1 presents correlation coefficient between inflation gap defined as the deviation of a core inflation from expected inflation, $\pi_t - E\pi_t$, and output gap, $x_t \in \{y_t - y^n, u_t - u^n\}$, and point estimates from the regression in the equations (6) and (7) for each sample period. For the core inflation measure, both CPI excluding food and energy (XFE) inflation rate and CPI excluding agricultural products and oil (XAO) inflation are considered.

Some important findings directly emerge from the empirical results. During the sample period, 2000-2019, there appears to be moderately positive relationship between inflation and real activity measured by output gap in Korea as the correlation coefficients are regularly positive and point estimates for the slope coefficient are statistically different from zero with the right sign. This implies that the Phillips curve seems to be alive and well. However, this evidence of Phillips correlation drastically changes in the subsample analysis. In the first subsample, 2000-2010, both correlation and slope coefficient are consistently positive, and the relationships appear to be much stronger than those in the full sample period. On the contrary, in the second subsample, 2011-2019, the Phillips correlation virtually breaks down. That none of correlation and slope coefficient estimates is statistically different from zero suggests that the relationship between economic activity and inflation may not exist. It is worth noting that this finding is quite robust to measures of inflation and output gap.[14] Finally, Figures 2 and 3 visually support the evidence of the flattening Phillips curve in Korea.[15]

[14] The sole exception comes up with unemployment gap measure. The relationship between inflation and unemployment gap is found to be either insignificant or counterintuitive. This motivated us to investigate whether the unemployment gap is an incomplete estimate of aggregate economic activity, which will be discussed in Section 4.

[15] To conserve on space, we did not report scatter diagrams for the case of XFE inflation which are available from the authors upon request.

**Table 1 Estimated Phillips Correlations and Slope Coefficients of the Phillips Curve**

| | Correlation | | | Slope Coefficient | | |
|---|---|---|---|---|---|---|
| | 2000-2019 | 2000-2010 | 2011-2019 | 2000-2019 | 2000-2010 | 2011-2019 |
| | | | Panel A: XFE Inflation | | | |
| $y - y^n$ (GDP) | 0.40 | 0.57 | 0.01 | 0.49*** | 0.60*** | 0.01 |
| $y - y^n$ (IAIP) | 0.43 | 0.62 | −0.01 | 0.16*** | 0.20*** | −0.01 |
| $u - u^n$ | −0.15 | −0.21 | 0.06 | −0.67 | −0.84 | 0.43 |
| | | | Panel B: XAO Inflation | | | |
| $y - y^n$ (GDP) | 0.53 | 0.73 | 0.06 | 0.76*** | 0.90*** | 0.13 |
| $y - y^n$ (IAIP) | 0.52 | 0.74 | 0.02 | 0.23*** | 0.28*** | 0.01 |
| $u - u^n$ | −0.19 | −0.28 | 0.08 | −1.01* | −1.28** | 0.67 |

**Notes:** Correlation coefficients between inflation gap and output gap and point estimates from the regression in Eqs. (6) and (7) are reported. *, **, *** indicate that the slope of Phillips curve is statistically different from the null of zero at the 10%, 5%, and 1% significance level, respectively.

**Figure 2 Flattening Phillips Curve in Korea: RGDP for Real Activity**

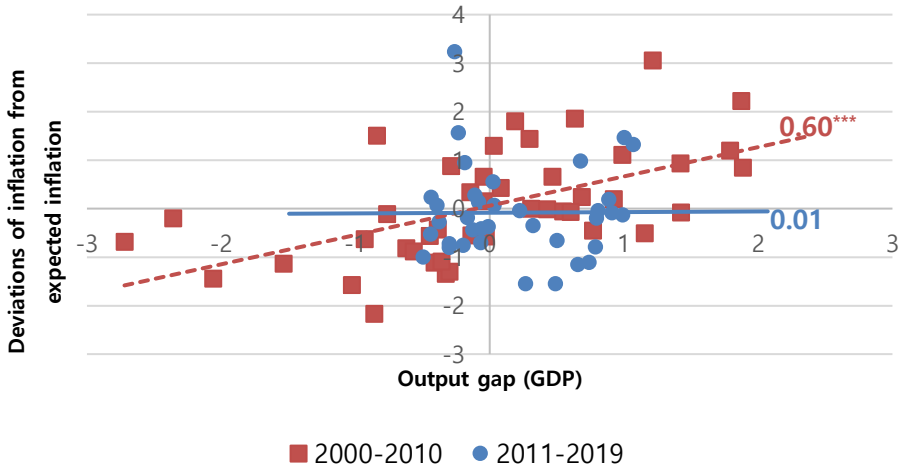
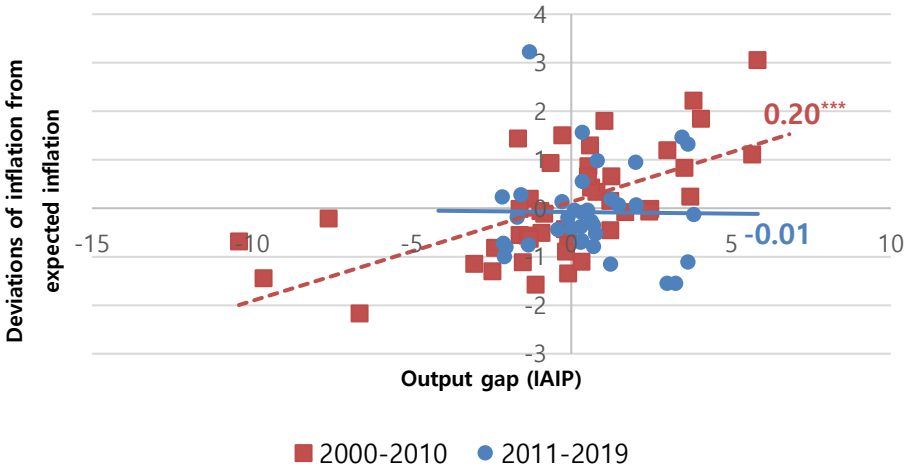



**Figure 3 Flattening Phillips Curve in Korea: IAIP for Real Activity**



### 3.3. Robustness Check

Following Stock and Watson (2020), we consider a different version of an expectations-augmented Phillips curve to examine whether the evidence of the flattening Phillips curve in Korea is robust to either the specification of Phillips correlation or inflation and output gap measures. By assuming that $E\pi_t = \pi_{t-4}$, a variant model from Eq. (4) is

$$\pi_t - \pi_{t-4} = \kappa x_t + \varepsilon_t. \tag{8}$$

To scrutinize contemporaneous relationship between inflation and real economic activity, instead of examining the lagged effects of real activity on current inflation, four-quarter moving average (4QMA) data for both inflation and real activity are commonly recommended. That is,

$$\Delta\pi_t^{MA} = \pi_t^{MA} - \pi_{t-4}^{MA} = \kappa x_t^{MA} + \nu_t, \tag{9}$$

where $\pi^{MA}$ and $x^{MA}$ are four-quarter backward moving average of inflation and real activity measures, respectively, and $x_t^{MA} \in \{(y_t - y^n)^{MA}, (u_t - u^n)^{MA}\}$.

Empirical results for the robustness check presented in Table 2 are qualitatively similar to those from our baseline models, equations (6) and (7). That is, there exists a Phillips correlation in the full sample that is statistically significant. The subsample analysis demonstrates that the flattening relationship drastically appears in the sample starting from the early 2010s.[16] Figures 4 and 5 display apparent change in the slope coefficients between the two subsamples.

**Table 2 Estimated Phillips Correlations and Slope Coefficients of the Phillips Curve**

| | Correlation | | | Slope Coefficient | | |
|---|---|---|---|---|---|---|
| | 2000-2019 | 2000-2010 | 2011-2019 | 2000-2019 | 2000-2010 | 2011-2019 |
| | Panel A: XFE Inflation | | | | | |
| $(y-y^n)^{MA}$ (GDP) | 0.44 | 0.56 | 0.04 | 0.51*** | 0.63*** | 0.05 |
| $(y-y^n)^{MA}$ (IAIP) | 0.43 | 0.57 | −0.02 | 0.15*** | 0.20*** | −0.01 |
| $(u-u^n)^{MA}$ | −0.41 | −0.54 | 0.25 | −1.75*** | −2.21*** | 1.25 |
| | Panel B: XAO Inflation | | | | | |
| $(y-y^n)^{MA}$ (GDP) | 0.49 | 0.56 | 0.3 | 0.70*** | 0.76*** | 0.52** |
| $(y-y^n)^{MA}$ (IAIP) | 0.41 | 0.49 | 0.19 | 0.17*** | 0.20*** | 0.09 |
| $(u-u^n)^{MA}$ | −0.38 | −0.53 | 0.26 | −2.01*** | −2.62*** | 1.75 |

**Notes:** Correlation coefficients between inflation gap and output gap and point estimates from the regression in Eq. (9) are reported. *, **, *** indicate the slope of Phillips curve is statistically different from the null of zero at the 10%, 5%, and 1% significance level, respectively.

[16] Note that empirical results with unemployment gap are not consistent with what the Phillips correlation implies since unemployment gap has some predictive power in explaining inflation changes but with the wrong sign.

**Figure 4 Flattening Phillips Curve in Korea: RGDP for Real Activity**

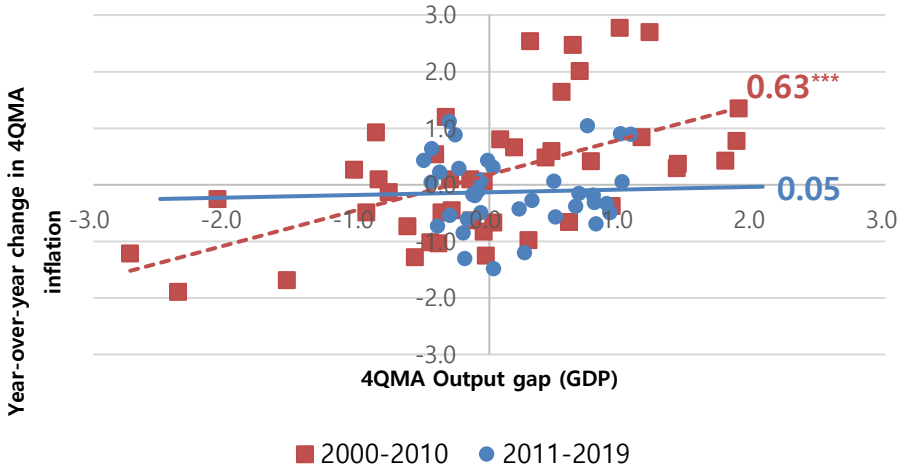
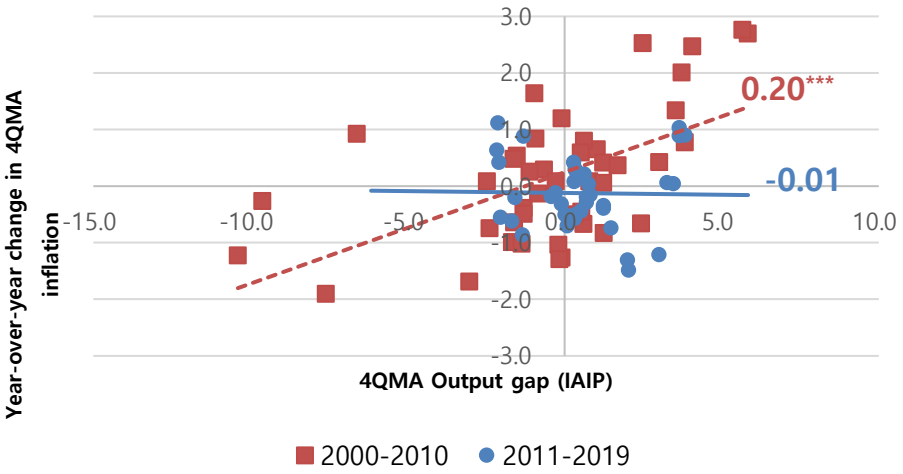



**Figure 5 Flattening Phillips Curve in Korea: IAIP for Real Activity**




## 4. POTENTIAL SOURCES OF THE FLATTENING PHILLIPS CURVE

In this section, we briefly offer some possible explanations of why the Phillips curve in Korea has flattened since the early 2010s. By employing alternative measures of real economic activity and inflation, we explore potential sources driving the flattening Phillips correlation.

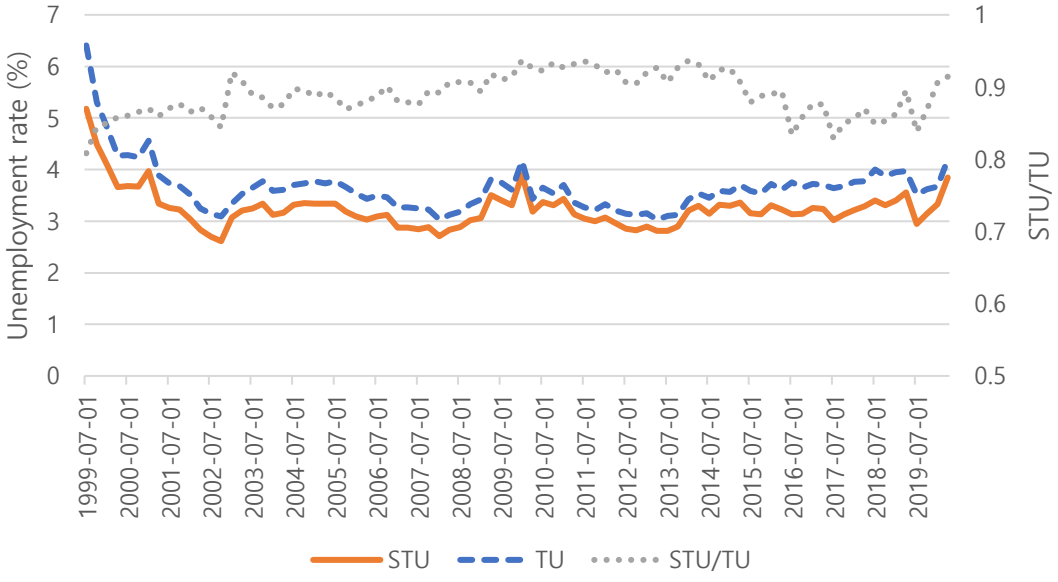
### 4.1. Alternative Measure of Unemployment Gap

When calculating unemployment gap, the conventional unemployment rate is defined as “those who are (i) without work; (ii) available to start work within two weeks; (iii) and

actively engaged in job searching activities." However, in this definition, which we call total unemployment rate, the duration of unemployment is not taken into account. Furthermore, the total unemployment involving discouraged and involuntary part-time workers may not be proper measure of real activity in the context of the Phillips correlation. To overcome potential measurement errors in real activity, we alternatively utilize Labor Underutilization Indicators (LUI). Due to the data availability, an extended measure of unemployment rate including discouraged workers is constructed using the method proposed by Hansen, Mongardini, and Zhang (2019).[17] During our sample period, the ratio of the total unemployment to the sum of discouraged workers and total unemployment in Korea has been largely stable within the range of 0.8 ~ 0.9. Therefore, we concluded that the inclusion of discouraged workers in calculating unemployment helps little to understand structural changes in the Phillips correlation.

Another possible solution to explain the flattening Phillips curve is to utilize short-term unemployment because the duration of unemployment can have different effects on wage growth, and thus inflation (Ball and Mazumder, 2019a). Figure 6 presents short-term unemployment along with total unemployment rate. In general, the ratio of the short-term unemployment to the total unemployment in Korea has been stable within the range of 0.8 ~ 0.9, which is quite different from the U.S. labor market as the ratio declines to 0.5 during the Global Recession period. This also suggests that the introduction of short-term unemployment may not be a constructive direction to pursue.

**Figure 6 Short-Term Unemployment (STU) and Total Unemployment (TU) Rates**



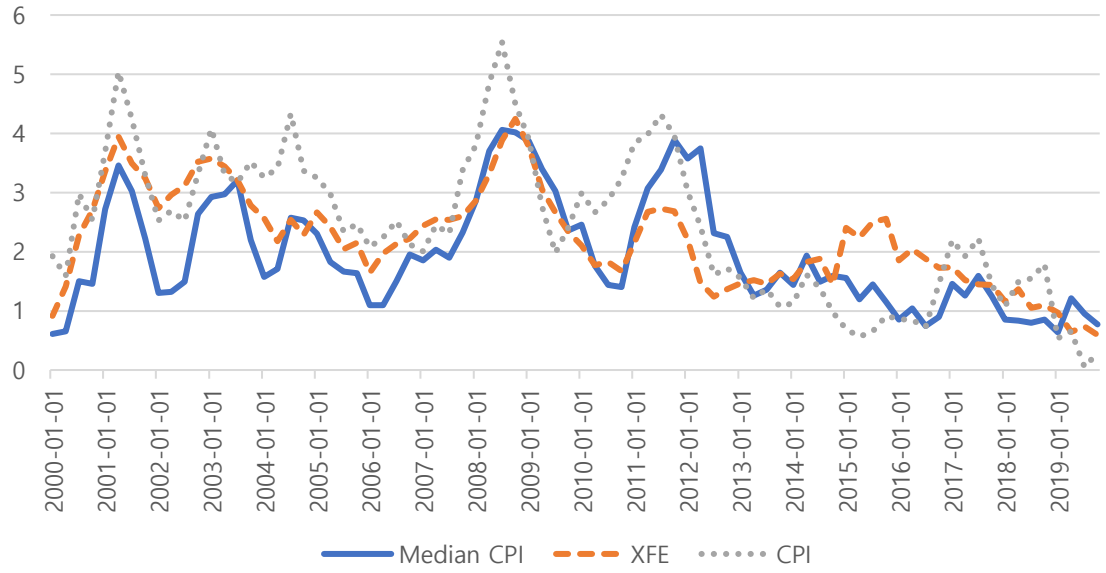

[17] This measure is obtained by augmenting the traditional measure of unemployment along the extensive margin by adding discouraged workers to the traditional unemployment measure, expressed in percent of the labor force plus discouraged workers.

### 4.2. Alternative Measure of Inflation

Excluding some specific items to measure the underlying trend in inflation, such as CPI excluding food and energy (XFE) and CPI excluding agricultural products and oil (XAO), is based on the idea that large relative-price changes in those items may be essential aspects of supply shocks, and hence inflation. Ball and Mazumder (2019b) mentioned that "measures of core inflation are intended to filter out the effects on headline inflation of unusual relative price changes, thereby isolating the component of inflation explained by the Phillips curve," and suggested using a weighted median of price changes (Bryan and Cecchetti, 1994), such as median CPI inflation rate, to understand the Phillips correlation.

In Korea, the median CPI inflation rate is not publicly available. Thus, using the method by Kim and Kim (2015), we construct the median CPI inflation rate and present it together with the headline CPI and the XFE inflation rate in Figure 7.[18] The median CPI inflation displays the similar pattern with the XFE inflation until the late 2000s, but the discrepancy between the two measures of inflation becomes larger and shows somewhat different comovement patterns in the mid 2010s. This motivates us to revisit the empirical analysis in Section 3 with this alternative measure of core inflation, and the empirical results are presented in Table 3.

**Figure 7 Annualized Quarterly Median CPI and XFE Inflation Rates**




[18] Following Kim and Kim (2015), 67 disaggregate CPI components with the same expenditure share on each component are used to construct the median CPI inflation rate. Note that the introduction of a weight based on expenditure share for each component, weighted median CPI inflation rate, does not offer a qualitatively different implication on the Phillips correlation.

**Table 3 Estimated Phillips Correlations and Slope Coefficients of the Phillips Curve**

| | Correlation | | | Slope Coefficient | | |
|---|---|---|---|---|---|---|
| | 2000-2019 | 2000-2010 | 2011-2019 | 2000-2019 | 2000-2010 | 2011-2019 |
| | Median Inflation | | | | | |
| $y - y^n$ (GDP) | 0.58 | 0.62 | 0.55 | 0.53*** | 0.52*** | 0.71*** |
| $y - y^n$ (IAIP) | 0.45 | 0.52 | 0.36 | 0.13*** | 0.13*** | 0.13** |
| $u - u^n$ | −0.29 | −0.50 | 0.48 | −0.99** | −1.55*** | 2.42*** |

**Notes:** Correlation coefficients between inflation gap and output gap and point estimates from the regression in Eqs. (6) and (7) are reported. *, **, *** indicate the slope of Phillips curve is statistically different from the null of zero at the 10%, 5%, and 1% significance level, respectively.

As shown in Tables 1 and 2 in Section 3, there appears to be the indisputable difference in the relation of a real activity measure with an excluding-item core inflation measure between the two subsamples, which can be used as the evidence of the flattening Phillips curve in Korea. However, when we adopt median inflation instead of XFE or XAO inflation, the Phillips correlation result shifts drastically. That is, the Phillips correlation survives well even in the second subsample period, 2011-2019, while maintaining the validity of other empirical findings in both the full sample and the first subsample periods. It is worth emphasizing that the traditional unemployment gap measure has now some in-sample predictive power to account for short-term variations in inflation, when median inflation is used. Figures 8 and 9 evidently support these important findings. Despite the empirical evidence of the flattening Phillips curve with excluding-item core inflation measures, it does not necessarily imply that the Phillips curve is all dead. Therefore, we conclude that the flattening Phillips curve appears to be found in Korea mainly due to measurement errors in inflation.

**Figure 8 Phillips Curve in Korea: RGDP for Real Activity**

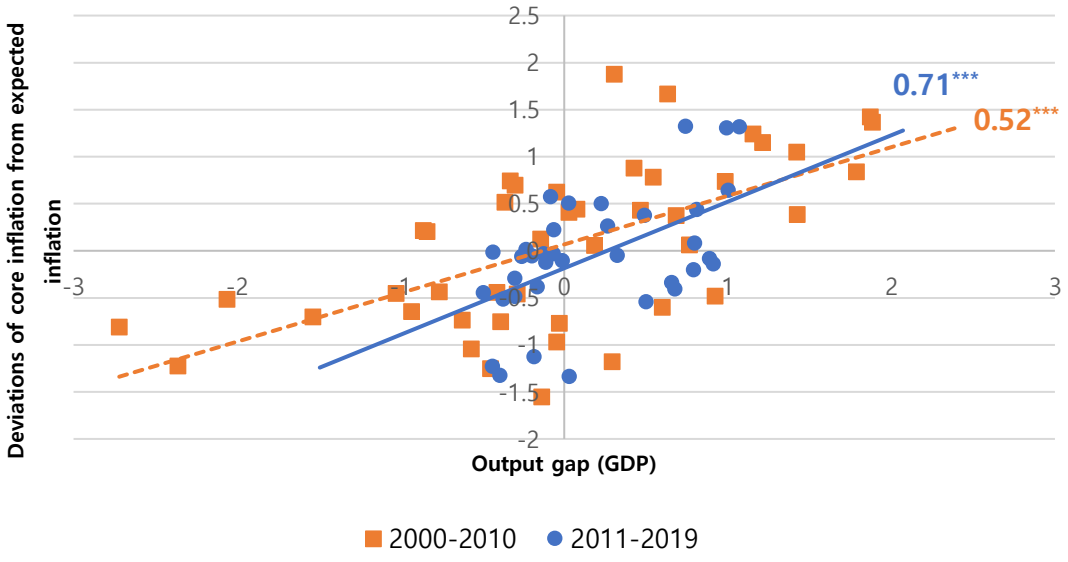
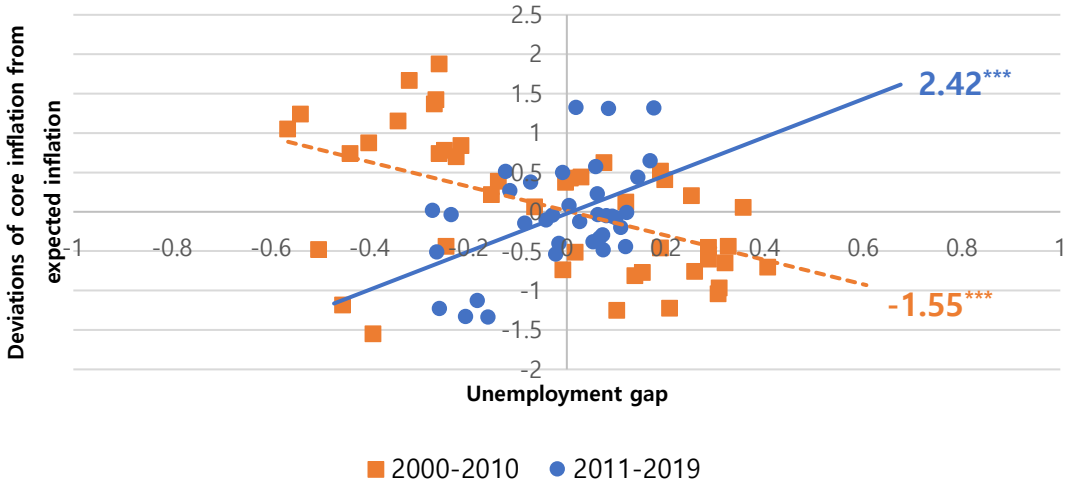


**Figure 9 Phillips Curve in Korea: Unemployment for Real Activity**




## 5. CONCLUDING REMARKS

In this paper, we investigate the possibility of the flattening Phillips curve in Korea and explore the factors driving the weak relationship between inflation and aggregate real activity. While numerous studies exist documenting ample evidence of the flattening Phillips curve during the Great recession across many countries, little attempt has been made to examine structural changes in this relationship for Korea. Given the Phillips curve's critical role in both theoretical and practical frameworks for designing effective monetary policy, it is crucial to evaluate whether it continues to accurately describe the relationship between inflation and economic activity.

Using a standard expectations-augmented Phillips curve framework, our empirical analysis provides clear evidence of the flattening Phillips curve in Korea over the sample period spanning from 2011 to 2019. This empirical finding is robust across various inflation and real activity measures commonly used in the literature. Pushing further, we explore potential factors behind the weakened Phillips correlation, a task that, to our knowledge, has not been undertaken for the case of Korea. Our results suggest that measurement errors in inflation may be a primary cause of the apparent breakdown. Specifically, adopting median inflation, which removes transitory supply shock effects from headline inflation, supports the existence of a stable Phillips curve. This indicates that the traditional Phillips correlation may still hold in Korea when measurement issues are carefully addressed.

Our findings open avenues for further research. One promising direction would be to utilize disaggregated inflation and real activity data.[19] Industry-level or disaggregated

[19] For a relevant research, see Luengo-Prado, Rao, and Sheremirov (2017).

expenditure data could provide more detailed insights into the mechanisms underlying the flattening Phillips curve, offering clearer explanations and better policy implications. Another interesting avenue is to extend this analysis to include the recent periods from 2020 to 2024 and see how the Phillips correlation changes across various measures of inflation and real activity.

## REFERENCES

Ball, L., D. Leigh, and P. Loungani, "Okun's Law: Fit at 50?," *Journal of Money, Credit and Banking*, 49(7), 2017, pp. 1413-1441.

Ball, L. and S. Mazumder, "Inflation Dynamics and the Great Recession," *Brookings Papers on Economic Activity*, 42(1), 2011, pp. 337-405.

_____, "The Nonpuzzling Behavior of Median Inflation," Working Papers Central Bank of Chile 843, Central Bank of Chile, 2019a.

_____, "A Phillips Curve with Anchored Expectations and Short-Term Unemployment," *Journal of Money, Credit and Banking*, 42(1), 2019b, pp. 111-137.

Bryan, M. F. and S. G. Cecchetti, "Measuring Core Inflation," in *Monetary Policy*, ed. by N. G. Mankiw, vol. 29 of *National Bureau of Economic Research Studies in Business Cycles*, The University of Chicago Press, 1994, pp. 194-215.

Coibion, O. and Y. Gorodnichenko, "Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts," *American Economic Review*, 105(8), 2015, pp. 2644-2678.

Friedman, M., "The Role of Monetary Policy," *American Economic Review*, 58(1), 1968, pp. 1-17.

Gordon, R., "The Phillips Curve is Alive and Well: Inflation and the NAIRU during the Slow Recovery," NBER Working Paper 6797, National Bureau of Economic Research, 2013.

Hansen, H. N.-J., J. Mongardini, and F. Zhang, "Labor Market Slack and the Output Gap: The Case of Korea," IMF Working Paper 19/167, International Monetary Fund, 2019.

Jung, K.-C., "Korea's Inflation Expectations with regard to the Phillips Curve and Implications of the COVID-19 Crisis," *KDI Journal of Economic Policy*, 43(2), 2021, pp. 81-101.

Kim, H. J. and Y. S. Kim, "Disaggregated Approach to Measuring Core Inflation," *The Korean Economic Review*, 31(1), 2015, pp. 145-176.

Krueger, A., J. Cramer, and D. Cho, "Are the Long-Term Unemployed on the Margins of the Labor Market?," *Brookings Papers on Economic Activity*, 45, 2014, pp. 229-280.

Kuttner, K. and T. Robinson, "Understanding the flattening Phillips curve," *The North American Journal of Economics and Finance*, 21(2), 2010, pp. 110-125.

Lee, J., Y. Chang, and Y. Choi, "Changes in the Macroeconomic Relationships among Output, Employment and Prices," *The Korean Journal of Economic Studies*, 70(1), 2022, pp. 33-51.

Luengo-Prado, M. J., N. Rao, and V. Sheremirov, "Sectoral Inflation and the Phillips Curve: What Has Changed since the Great Recession?," Current Policy Perspectives 17-5, Federal Reserve Bank of Boston, 2017.

Occhino, F., "The Flattening of the Phillips Curve: Policy Implications Depend on the Cause," Economic Commentary EC2019-11, Federal Reserve Bank of Cleveland, 2019.

Song, S. and G. Bae, "Estimation of the Phillips Curve Using Regional Data," BOK Issue Note 2022-47, Bank of Korea, 2022.

Stock, J. H. and M. W. Watson, "Forecasting Inflation," *Journal of Monetary Economics*, 44(2), 1999, pp. 293-335.

_____, "Modeling Inflation After the Crisis," NBER Working Paper 16488, National Bureau of Economic Research, 2010.

_____, "Slack and Cyclically Sensitive Inflation," *Journal of Money, Credit and Banking*, 52, 2020, pp. 393-428.

Williams, J. C., "The Phillips Curve in an Era of Well-Anchored Inflation Expectations," FRBSF Economic Letter 2006-27, Federal Reserve Bank of San Francisco, 2006.