

# Global Supply Chain Stress and Inflation-Unemployment Dynamics

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## Abstract

Economists have long debated whether the slope of the Phillips Curve has shifted over time, particularly in advanced economies. Prior to COVID-19, a growing body of research pointed to a flatter curve, often linked to prolonged periods of low interest rates and stable inflation expectations. With the onset of the pandemic, severe supply chain disruptions drove prices sharply upward, prompting renewed questions about whether the Phillips Curve may have steepened. This paper examines that question using cross-country data from before, during, and after the COVID-19 period. Using a two-way fixed-effects panel regression model with an interaction between unemployment and the Global Supply Chain Pressure Index (GSCPI), the study tests whether supply chain stress altered how inflation responds to unemployment. The findings indicate that supply disruptions raised inflation levels but did not substantially change the slope of the Phillips Curve. Instead, the evidence suggests that these shocks temporarily shifted the curve upward, consistent with standard macroeconomic theory.

*Keywords: Economics, Macroeconomics, Phillips curve, Supply chain disruptions, Panel data regression*

## 1. Introduction

The COVID-19 pandemic created economic conditions that challenged the conventional understanding of the relationship between inflation and unemployment. Before 2020, many advanced economies showed a flattening of the Phillips Curve, where unemployment reached historically low levels without causing strong inflation. This pattern is consistent with the view that the Phillips Curve was “hibernating,” with low and well-anchored inflation muting the response of prices to labor-market slack even in high-pressure economies (Hooper et al., 2020). This led economists to question whether labor-market slack still played an important role in explaining price movements.

During the pandemic, however, inflation rose sharply even though labor markets had not fully recovered. For instance, according to the FRB report (June 2022), U.S. CPI inflation hit 7% in late 2021 while unemployment stood at 5.8%, well above pre-pandemic lows. This suggested that traditional demand-driven explanations were not sufficient to account for the sudden rise in inflation. A key feature of the pandemic period was the severity of global supply-chain disruptions, including shipping delays, logistical bottlenecks, and shortages of key inputs. These supply shocks pushed prices upward independently of domestic labor-market conditions, raising the possibility that the pandemic may have altered the slope of the Phillips Curve.

Understanding whether the pandemic caused a structural change in the inflation–unemployment relationship is important for economic policy. If supply-side disturbances flatten or shift the Phillips Curve, central banks may need to reconsider inflation-targeting strategies that rely heavily on domestic demand conditions. If, instead, the Phillips Curve was only temporarily distorted by supply-chain stress, inflation may return to normal as global logistics stabilize. Comparing the pre- and post-pandemic periods can therefore help determine whether changes in unemployment continue to be linked to price dynamics or whether this relationship weakened during a time of extraordinary global shocks.

The Phillips Curve refers to the observed relationship between inflation and unemployment. In its traditional form, it suggests that when unemployment is low, inflation tends to be higher, and when unemployment is high, inflation tends to be lower. Economists consider this relationship important because it highlights a potential trade-off faced by policymakers: efforts to reduce unemployment may lead to higher inflation, while efforts to control inflation may slow economic activity. When the Phillips Curve is described as “steep,” small changes in unemployment are associated with large changes in inflation. A “flat” Phillips Curve, in contrast, implies that inflation responds only weakly to changes in unemployment. Understanding whether the curve has become flatter or steeper is central to debates about how effective monetary policy is in stabilizing the economy.

The Phillips Curve was first introduced by A. W. Phillips (1958), who documented an empirical inverse relationship between wage inflation and unemployment. Later, economists such as Phelps (1967) and Friedman (1968) argued that inflation expectations must be incorporated into the analysis, emphasizing that the relationship could shift over time as workers and firms adjust their expectations. More recently, the New Keynesian Phillips Curve (NKPC), developed by Galí and Gertler (1999), formalized this idea in a forward-looking framework in which firms set prices based on expected future conditions and marginal costs. Recent extensions incorporate global production networks and intermediate input costs, showing how supply-chain disruptions can transmit shocks to inflation dynamics (Cerrato and Gitti, 2022).

This study estimates a reduced-form Phillips Curve specification rather than a fully structural New Keynesian model. The empirical approach examines how inflation responds to unemployment and whether this relationship is modified by global supply-chain stress. While the regression does not structurally estimate the New Keynesian Phillips Curve, it is consistent with its intuition: if supply shocks primarily shift marginal costs without altering the responsiveness of inflation to labor-market slack, the slope of the reduced-form Phillips Curve should remain stable. The analysis therefore tests whether global supply disruptions changed the inflation–unemployment trade-off during the COVID-19 period.

While prior research has documented the flattening of the Phillips Curve in advanced economies and the inflationary effects of supply disruptions during COVID-19, fewer studies directly test whether global supply-chain stress altered the slope of the Phillips Curve within a cross-country panel framework. Most existing studies focus either on domestic labor-market conditions or on aggregate supply shocks separately. This study contributes by integrating both elements in a unified empirical specification, allowing for a direct test of whether global supply stress modifies the inflation–unemployment relationship.

The goal of this research is to examine whether the COVID-19 pandemic and the related supply-chain disruptions caused a lasting change in the Phillips Curve, or whether the unusual inflation and unemployment patterns during this period were temporary. The Methods section explains the data sources, variables, and regression approach. The Results and Discussion sections then present the main findings, examining differences between advanced and emerging economies and evaluating whether supply-chain stress significantly altered the slope of the Phillips Curve.

## 2. Materials and Methods

The variables needed to construct the Phillips Curve are inflation and unemployment. Inflation is measured as the annual percentage change in the Consumer Price Index (CPI), reported by the International Monetary Fund’s World Economic Outlook (WEO) database. Specifically, the variable represents year-over-year CPI inflation expressed in percent. Unemployment is measured as the total unemployment rate (percent of the labor force) from the World Bank’s World Development Indicators (WDI).

Countries are classified into advanced and emerging categories following the World Bank’s income classification system, enabling analysis of differences across economies at varying levels of development.

To capture supply-side pressures, this study employs the Global Supply Chain Pressure Index (GSCPI) published by the Federal Reserve Bank of New York. The GSCPI aggregates multiple indicators of global logistical stress—including shipping costs, delivery times, and freight rates—into a single standardized monthly measure. Because the regression analysis is conducted at the annual country-year level, the monthly GSCPI values are converted into annual observations by taking the simple average of monthly values within each calendar year. This annual average reflects

the overall intensity of global supply-chain stress during a given year.

To compare changes associated with the COVID-19 period, the sample is conceptually divided into two periods: Pre-COVID (1998–2019) and Post-COVID (2020–2024). The full regression sample covers 1998–2024, determined by the availability of the GSCPI series, which begins in 1998. While the regression analysis uses the entire panel to maximize statistical power, the scatterplots presented in the Results section focus on 2010–2019 and 2020–2024 to provide a clearer visual comparison of the inflation–unemployment relationship before and after the pandemic. This distinction allows for both long-run statistical estimation and transparent short-run visual interpretation.

To estimate the Phillips Curve relationship across countries while isolating within-country variation over time, this study employs a two-way fixed-effects panel regression model:

$$\pi_{it} = \alpha_i + \gamma_t + \beta_1 u_{it} + \beta_2 (u_{it} \times GSCPI_t) + \epsilon_{it},$$

where  $\pi_{it}$  represents annual CPI inflation in country  $i$  in year  $t$ , and  $u_{it}$  denotes the unemployment rate in country  $i$  in year  $t$ . The term  $GSCPI_t$  represents the annual average Global Supply Chain Pressure Index, which is common across countries in each year. The interaction term  $u_{it} \times GSCPI_t$  tests whether global supply-chain stress modifies the responsiveness of inflation to domestic labor-market slack. The error term  $\epsilon_{it}$  captures other unobserved factors affecting inflation.

Country fixed effects ( $\alpha_i$ ) control for time-invariant characteristics such as institutional structures, long-run inflation regimes, or geographic features that differ across countries. Year fixed effects ( $\gamma_t$ ) absorb global shocks affecting all countries in a given year, including worldwide macroeconomic conditions and broad pandemic-related disturbances.

The direct effect of GSCPI is omitted to avoid perfect collinearity with year fixed effects, since GSCPI does not vary across countries within a given year. However, the interaction term  $\beta_2$  remains identified through country-specific unemployment fluctuations interacting with common global supply pressures. Thus,  $\beta_1$  captures the baseline Phillips Curve slope, while  $\beta_2$  tests whether global supply-chain stress modifies the inflation response to unemployment.

All regressions are estimated using Python with standard errors clustered at the country level to account for potential serial correlation within countries over time.

In this study, statistical significance refers to whether the estimated coefficients—particularly the unemployment coefficient and its interaction with GSCPI—are sufficiently precise relative to their standard errors to indicate a systematic relationship rather than random variation in the sample. A statistically significant coefficient suggests that changes in unemployment or supply-chain stress are consistently associated with changes in inflation within countries over time, after controlling for fixed country characteristics and common global shocks.

### 3. Results

#### 3.1 Descriptive Patterns

When all countries are combined into a single scatterplot, as shown in Figure 1, the Phillips Curve relationship appears highly dispersed. The scatterplots compare the pre-COVID period (2010–2019) with the post-COVID period (2020–2024). A simple pooled OLS fitted line shows a slightly positive slope, increasing from approximately 0.07 in the pre-COVID period to 0.10 in the post-COVID period. The corresponding correlation coefficients are 0.16 before COVID and 0.21 afterward, indicating a weak positive association between unemployment and inflation. However, the 95% confidence intervals for the fitted slopes (pre-COVID:  $-0.14$  to  $0.28$ ; post-COVID:  $-0.13$  to  $0.32$ ) both include zero and overlap substantially, suggesting that the apparent difference in slopes is not statistically meaningful in this

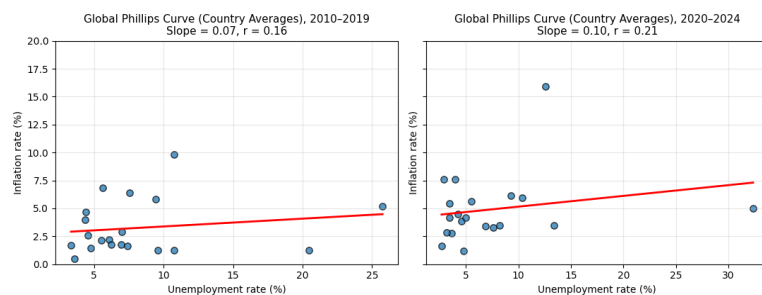


Figure 1. Global Phillips Curve scatterplots (Pre- and Post-COVID, sample period: 2010-2024).

descriptive comparison. Although the strength of the relationship increases modestly in the post-pandemic period, the overall magnitude remains small and does not provide strong support for a clear inverse Phillips Curve trade-off. The dispersion of observations relative to the fitted lines further suggests that cross-sectional patterns are limited.

Figure 2 disaggregates the sample by development level. In advanced economies, the pre-COVID correlation between unemployment and inflation is  $-0.17$ , consistent with a modest inverse Phillips Curve relationship. In the post-COVID period, however, the correlation turns slightly positive ( $0.12$ ), indicating that the simple cross-sectional trade-off weakens.

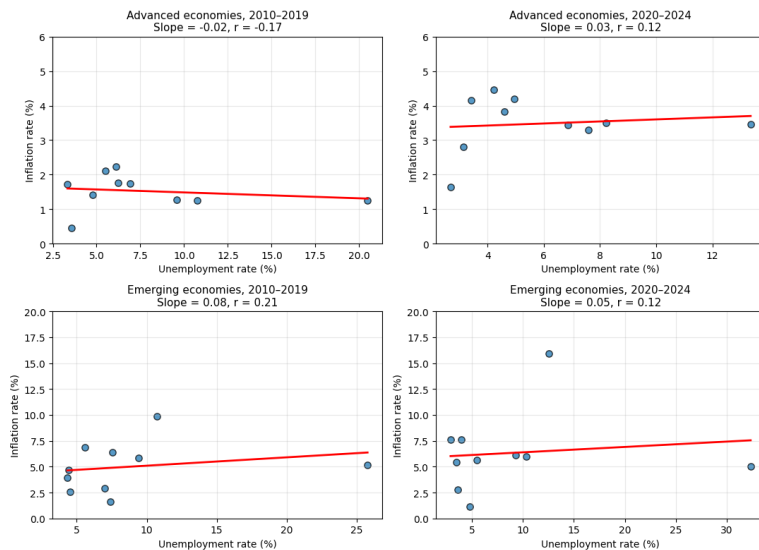


Figure 2. Phillips Curve by country group (advanced vs. emerging, sample period: 2010-2024).

(Ye and Abe, 2012). After this event, the index returned to relatively stable levels until 2020. Beginning in early 2020, however, the pattern changed dramatically. The index rises sharply with the onset of COVID-19 lockdowns, reflecting factory shutdowns, port delays, and transportation bottlenecks around the world. The GSCPI reached its highest recorded values in late 2021, which corresponds to severe port congestion and container shortages. The elevated pressure continues into early 2022 following the Russia–Ukraine conflict. Overall, the post-COVID period is marked by persistent and historically high levels of supply-chain stress, indicating that global production networks did not return to normal immediately after the initial shock.

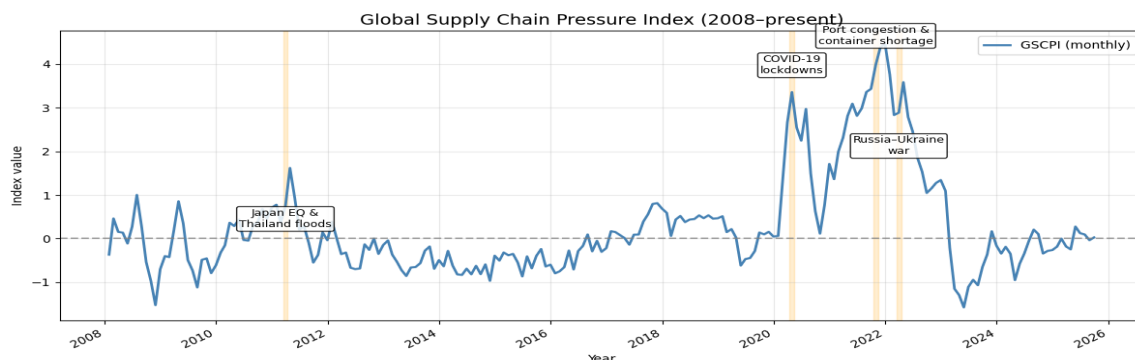


Figure 3. Global Supply Chain Pressure Index (2008-2024).

Figure 3 demonstrates that supply-chain disruptions were historically large and persistent post-COVID, raising the possibility that GSCPI spikes contributed to the inflation surge observed during this period. However, these patterns alone cannot distinguish whether supply pressures simply shifted inflation levels upward, or whether they

In emerging economies, the correlation is positive in both periods ( $0.21$  pre-COVID and  $0.12$  post-COVID), suggesting little evidence of a conventional inverse relationship in raw cross-sectional data. Although the magnitude of correlations varies across periods and groups, the overall strength of these relationships remains modest.

The time series of the Global Supply Chain Pressure Index (GSCPI) in Figure 3 shows several major episodes of global supply disruptions. One of the most visible increases occurred in 2011, when the Japan earthquake and the Thailand floods disrupted manufacturing and transportation networks across Asia

changed how inflation responds to unemployment.

Benigno et al. (2022) provide key motivation, showing that GSCPI increases are strongly associated with higher inflation across countries, validating the index as a summary measure of global supply shocks. The following panel regressions test whether elevated GSCPI flattens or steepens the Phillips Curve by modifying the interaction between domestic unemployment and inflation.

### 3.2 Baseline Regression

Table 1 reports the two-way fixed-effects regression estimates for the full sample, as well as for advanced and emerging economies separately. The model controls for country-specific fixed effects and common year shocks.

For advanced economies, the unemployment coefficient is  $-0.1088$  and statistically significant at the 1% level. Economically, this implies that a one-percentage-point increase in unemployment is associated with approximately a 0.11 percentage-point decrease in inflation, holding constant country characteristics and global shocks. This finding is consistent with the traditional Phillips Curve trade-off.

In contrast, the unemployment coefficient for emerging economies ( $-0.0604$ ) is not statistically significant, and the full-sample estimate is likewise insignificant. These results indicate that a systematic inflation–unemployment relationship is statistically detectable only within advanced economies in this sample.

The within  $R^2$  values are relatively low, particularly for the full and emerging samples. This suggests that while unemployment contributes to inflation dynamics in some groups, a substantial portion of inflation variation is driven by additional macroeconomic factors not explicitly included in the model.

### 3.3 Does Supply Pressure Change the Slope?

Table 2 presents estimates including the interaction between unemployment and the Global Supply Chain Pressure Index (GSCPI). This specification tests whether global supply stress modifies the slope of the Phillips Curve.

Table 2. Interaction model: Supply chain stress and the Phillips Curve.

Variable	Full Sample	Advanced	Emerging
Unemployment(u)	-0.1226 (0.3284)	-0.1037*** (0.0234)	-0.0922 (0.5606)
$u \times \text{GSCPI}$	0.0249 (0.0470)	0.0211 (0.0175)	0.0368 (0.0795)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	540	270	270
$R^2(\text{within})$	0.001	0.074	0.000

Notes: Standard errors in parentheses. \*, \*\*, \*\*\* =  $p < 0.10, 0.05, 0.01$ , sample period: 1998-2024

Across all samples, the interaction coefficient is positive but not statistically significant. In the full sample, the estimate is 0.0249 with a standard error of 0.0470. Similar patterns appear in both advanced (0.0211) and emerging (0.0368) economies. The magnitudes of these interaction terms are small relative to their associated standard errors, indicating that statistically detectable changes in the Phillips Curve slope during periods of elevated supply-chain stress are not observed in the data.

Although the interaction coefficients are positive, the lack of statistical significance implies that the data do not provide strong evidence that global supply disruptions systematically altered the responsiveness of inflation to unemployment over the sample period.

To further assess statistical power, consider the magnitude of the interaction effect required for statistical significance in the full sample. Given a standard error of 0.0470, the coefficient would need to exceed approximately 0.09 in absolute value ( $1.96 \times 0.0470$ ) to be statistically distinguishable from zero at conventional 5% significance levels. The estimated interaction coefficient of 0.0249 is substantially smaller than this threshold, suggesting that any

potential slope modification is modest relative to the statistical uncertainty in the data.

#### 4. Discussion

The empirical results suggest that global supply-chain disruptions during the COVID-19 period raised inflation levels but did not significantly alter the slope of the Phillips Curve. In advanced economies, the baseline inflation–unemployment trade-off remains statistically detectable, whereas in emerging economies the relationship appears weaker and statistically indistinguishable from zero. Importantly, the interaction between unemployment and GSCPI is not statistically significant across specifications, indicating no reliable evidence that supply-chain stress changed the responsiveness of inflation to labor market slack.

These findings are consistent with the New Keynesian Phillips Curve framework, in which inflation depends on marginal costs and expectations in addition to economic slack (Galí and Gertler, 1999). Supply-chain disruptions during COVID-19 increased production costs through shipping delays, input shortages, and transportation bottlenecks, thereby raising inflation at given levels of unemployment. However, such shocks need not change the structural sensitivity of inflation to slack.

This interpretation aligns with Ball and Mankiw (1995), who argue that supply shocks can generate temporary price-level adjustments without permanently altering the inflation–output trade-off. More recent empirical studies similarly find that pandemic-related supply disturbances primarily shifted Phillips Curves upward rather than steepening them (Crump et al., 2024). In this context, the insignificant interaction term suggests that global supply shocks operated mainly through level effects rather than slope effects.

Several empirical considerations may also contribute to the absence of detectable slope changes. First, the post-COVID sample (2020–2024) is relatively short, limiting statistical power to identify interaction effects. Second, the GSCPI is a global index and may not fully capture country-specific supply disruptions. As Bańbura and Bobeica (2020) note, global measures can obscure heterogeneous domestic conditions when estimating Phillips Curve relationships.

Institutional factors may further explain why the slope remains stable in advanced economies. Inflation-targeting regimes and credible central bank policies help anchor inflation expectations, reducing the likelihood that temporary supply shocks translate into persistent changes in inflation dynamics. As a result, supply disturbances may manifest as temporary upward shifts in inflation rather than structural changes in the inflation–unemployment relationship.

Overall, the evidence suggests that while COVID-era supply shocks were historically large, they did not fundamentally reshape the Phillips Curve slope across countries. Instead, the traditional inflation–unemployment trade-off—particularly in advanced economies—appears structurally stable, even amid substantial global supply stress.

#### 5. Conclusion

This study examined whether the COVID-19 pandemic and global supply-chain disruptions caused a structural change in the Phillips Curve. Using panel data across advanced and emerging economies, the results show that supply-chain pressure significantly raised inflation levels but did not lead to a clear change in the slope of the Phillips Curve. In advanced economies, unemployment remains negatively related to inflation, while no consistent relationship is observed in emerging economies.

The findings suggest that the unusual inflation patterns observed after COVID-19 are better explained by temporary supply-side shocks rather than a permanent breakdown of the inflation–unemployment relationship. Supply-chain disruptions appear to shift the Phillips Curve upward by increasing production costs, but they do not fundamentally change how inflation responds to changes in unemployment.

This result is important because it implies that the Phillips Curve remains a useful framework, especially for advanced economies, when global supply conditions are taken into account. However, the analysis is limited by the short post-pandemic period and the use of a global supply-chain index that may not capture country-specific disruptions.

Future research could extend this study by using longer post-COVID data, incorporating country-level supply shock measures such as energy prices, or examining how institutional factors influence inflation dynamics. These

extensions would help further clarify how global shocks affect the Phillips Curve in different economic environments.

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