



# UNEMPLOYMENT, INFLATION AND EXOGENOUS SHOCKS IN BRAZIL AND THE UNITED STATES: A PHILLIPS CURVE ANALYSIS\*

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## ABSTRACT

This study aims to assess the relationship between unemployment and the performance of inflationary indicators by estimating the New Keynesian Phillips Curve (NKPC) for Brazil and the United States. Various macroeconomic variables were considered, such as unemployment rates, inflation, expected inflation, interest rates, exchange rates, and commodities prices in the two economies, from January 2010 to December 2023. A specific proxy was used to identify exogenous shocks affecting both Brazil and the United States. The results were estimated using instrumental variables methods and the generalized method of moments (GMM), as well as statistical significance tests to assess the effectiveness of the instruments used. The findings indicate the presence of a trade-off between the inflation rate and the unemployment rate in the Brazilian and American economies. In addition, the economic and health shocks that have occurred recently have exerted a positive effect on inflation in the countries analyzed.

## KEYWORDS

Phillips Curve, Unemployment, Inflation, Exogenous Shocks.

## JEL CLASSIFICATION

E12, E24, E31

## CONTENTS

Introduction; 1. Theoretical model of the New-Keynesian Phillips curve; 2. Methodologies; 3. Results and discussions; 4. Final considerations; Bibliography

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## DESEMPLEO, INFLACIÓN Y SHOCKS EXÓGENOS EN BRASIL Y ESTADOS UNIDOS: UN ANÁLISIS DE LA CURVA DE PHILLIPS

### RESUMEN

El objetivo de este estudio es evaluar la relación entre el desempleo y el comportamiento de los indicadores inflacionarios mediante la estimación de la Curva de Phillips nekeynesiana (NKPC) para Brasil y Estados Unidos. Se tuvieron en cuenta diversas variables macroeconómicas, como las tasas de desempleo, la inflación, la inflación esperada, los tipos de interés, los tipos de cambio y los precios de las materias primas en ambas economías, desde enero de 2010 hasta diciembre de 2023. Se utilizó un indicador específico para identificar las crisis exógenas que afectan tanto a Brasil como a Estados Unidos. Los resultados se estimaron utilizando métodos de variables instrumentales y el método generalizado de momentos (GMM), así como pruebas de significación estadística para evaluar la eficacia de los instrumentos utilizados. Los resultados indican la existencia de una relación de compensación entre la tasa de inflación y la tasa de desempleo en las economías brasileña y estadounidense. Además, las perturbaciones económicas y sanitarias que se han producido recientemente han ejercido un efecto positivo sobre la inflación en los países analizados.

### PALABRAS CLAVE

Curva de Phillips, desempleo, inflación, choques exógenos.

### CLASIFICACIÓN JEL

E12, E24, E31

### CONTENIDO

Introducción; 1. Modelo teórico de la curva de Phillips nekeynesiana; 2. Metodologías; 3. Resultados y discusiones; 4. Consideraciones finales; Referencias.

## DESEMPREGO, INFLAÇÃO E CHOQUES EXÓGENOS NO BRASIL E NOS ESTADOS UNIDOS: UMA ANÁLISE DA CURVA DE PHILLIPS

### RESUMO

Este estudo tem como objetivo avaliar a relação entre o desemprego e o desempenho dos indicadores inflacionários, estimando a Curva de Phillips Nekeynesiana (NKPC) para o Brasil e os Estados Unidos. Foram consideradas diversas variáveis macroeconômicas, como taxas de desemprego, inflação, inflação esperada, taxas de juros, taxas de câmbio e preços de commodities nas duas economias, de janeiro de 2010 a dezembro de 2023. Um proxy específico foi utilizado para identificar choques exógenos que afetam tanto o Brasil quanto os Estados Unidos. Os resultados foram estimados utilizando métodos de variáveis instrumentais e o método generalizado dos momentos (GMM), bem como testes de significância estatística para avaliar a eficácia dos instrumentos utilizados. Os resultados indicam a presença de um trade-off entre a taxa de inflação e a taxa de desemprego nas economias brasileira e americana. Além disso, os choques econômicos e sanitários que ocorreram recentemente exerceram um efeito positivo sobre a inflação nos países analisados.

### PALAVRAS-CHAVE

Curva de Phillips, desemprego, inflação, choques exógenos.

### CLASSIFICAÇÃO JEL

E12, E24, E31

### CONTEÚDO

Introdução; 1. Modelo teórico da curva de Phillips nekeynesiana; 2. Metodologias; 3. Resultados e discussões; 4. Considerações finais; Referências.

## INTRODUCTION

The Phillips Curve is a theory proposed by Phillips (1958), in which he estimated a negative relationship between unemployment and the rate of wage growth in the United Kingdom. According to Phillips (1958), when labor demand is high and there are few unemployed workers, employers are expected to increase wage rates rapidly, as each company and sector is continuously tempted to offer slightly above the prevailing rates to attract the most suitable workforce from other companies and sectors. On the other hand, it seems that workers tend to be resistant to accepting lower pay than the current rates, especially in scenarios of low demand for labor and high unemployment rates, resulting in a rather slow fall in wage rates.

Over time, the Phillips Curve has been refined with the introduction of models that could better explain this trade-off. Samuelson and Solow (1960) presented a study that estimated this relationship for the United States, replacing the rate of wage growth with the average increase in prices. In the studies of Phelps (1967), Friedman (1968), and Sargent and Wallace (1975), the proposal of a long-term trade-off between wage rates and unemployment was rejected.

According to Blanchard (2007), when unemployment remains above the natural rate of unemployment over time, inflation generally decreases; however, when unemployment is below the natural rate, it leads inflation to rise. This dynamic results in a trade-off between inflation and unemployment.

Gremaud et al. (2014) state that it is not possible to maintain indefinitely a lower unemployment rate with the same inflation level. If the government aims to keep unemployment below the natural rate, it will require greater monetary expansion and higher inflation rates. Once inflation accelerates, the inflation-unemployment trade-off will only hold in the short term. In the long term, the government will not be able to sustain inflation above expected levels, since economic agents learn from past policy mistakes.

From this perspective, Mendonça et al. (2012) affirm that an equation like the Phillips curve, but augmented with expectations, forms the basis of the more recent dynamic stochastic general equilibrium models known as the New Keynesian framework. In these models, where prices do not adjust immediately, there is a positive relationship between the inflation rate and output and, therefore, a negative relationship between the inflation rate and the unemployment rate. This relationship is known in literature as the New Keynesian Phillips Curve (NKPC).

The Brazilian economy has been marked by recent and consecutive crises that have consequently affected various macroeconomic variables, such as the economic growth crisis of 2014, the unemployment crisis of 2017, and the COVID-19 health crisis of 2020. The 2014/2016 crisis, referred to as the "Global South Crisis," led to a nominal decline in global GDP due to falling commodity prices. This crisis had a strong impact on the Brazilian economy, contributing to the accelerated decline of the coalition government and culminating in the impeachment of Dilma Rousseff. Subsequently, a new phase of the Brazilian economy began, characterized by a relative decoupling of domestic economic activity from nominal global GDP. This decoupling occurred on the downside, indicating that the apparent recovery of the local economy was below the potential of the existing economic model. In this new phase, there was a sharp rise in unemployment and a restructuring of Brazil's major economic sectors toward industry. Despite the economic recovery, it failed to generate employment and income at the same level as population growth (Cosenza and Grabois, 2021).

According to the Central Bank of Brazil (BCB, 2020), the impacts of COVID-19 on the Brazilian economy include a decline in domestic demand across various sectors, reduced economic activity leading to GDP contraction, an increase in the Extended National Consumer Price Index (IPCA) —particularly for food products— a decrease in exports and commodity prices, a rise in the number of unemployed individuals, and a reduction in labor income, among other effects. Overall, there were shocks in supply and demand, with a challenging scenario of economic contraction and perceptible short-term consequences.

The world's largest economy was also affected by recent economic instabilities. The 2008 U.S. financial system crisis led to a reduction in total revenues as a proportion of GDP, an increase in demand for U.S. Treasury securities, and a consequent reduction in policy interest rates. The rise in liquidity preference reduced household consumption, causing GDP and investment levels to drop significantly, while unemployment rates remained very high (Pinto, 2011). Similarly to other countries, the COVID-19 health crisis impacted the U.S. economy by reducing labor supply due to decreased employment and working hours, lowering labor productivity as a result of reduced economic activity and increased unemployment—factors that negatively affected consumer income and household demand—disrupting the flow of inputs between sectors, contracting private investments due to declining profitability and reduced demand, slowing international trade, among other effects (Amitrano et al., 2020).

Based on the previously highlighted information, this study aims to measure the relationship between the unemployment rate and the inflation rate using the NewKeynesian Phillips Curve for the economies of Brazil and the United States,

as well as to analyze the recent exogenous shocks to the economy and the COVID-19 pandemic.

In addition to this introduction, the paper is divided into six sections. It begins with the theoretical model that underpins the New Keynesian Phillips Curve. This is followed by a review of empirical studies on the Phillips Curve, then the methodological elements, which set out the empirical models used in the arguments on which the study is based. Finally, the results and their respective analyses are presented, followed by the concluding remarks and references.

## 1. THEORETICAL MODEL OF THE NEW-KEYNESIAN PHILLIPS CURVE

The present study employs the New Keynesian Phillips Curve (NKPC) model proposed by Blanchard and Galí (2007), which is based on the rigidity of real wages (a natural source of inflationary inertia that helps the good empirical fit of traditional Phillips curve equations) in a closed economy. Blanchard and Galí (2007) assume the existence of a continuous set of companies in monopolistic competition, where each one offers a unique product and faces demand with constant elasticity. Gonçalves et al. (2020) argue that the model represents an economy composed solely of firms and households.

From the perspective of firms, Blanchard and Galí (2007) describe the production function of each firm as:

$$Y = M^\alpha N^{1-\alpha}, \alpha \in (0,1) \quad [1]$$

Where  $Y$  denotes output,  $M$  represents the non-produced input subject to supply shocks, and  $N$  denotes employment. Assuming that lowercase letters represent the natural logarithms of the original variables, the real marginal cost is obtained as:

$$mc = \omega - mpn = \omega - (y - n) - \log(1 - \alpha) \quad [2]$$

In this context,  $\omega$  is taken to be the logarithm of the real wage, which is treated as a fixed by each firm. From the point of view of households, it is assumed that there are many homogeneous households, with preferences that can be separated over time, a fixed discount factor  $\beta$  and a utility per period defined as follows:

$$U = (C, N) = \log(C) - \exp\{\Psi\} \frac{N^{1+\varphi}}{1+\varphi} \quad [3]$$

In these circumstances,  $C$  denotes aggregate consumption (with an elasticity of substitution between goods equal to  $\epsilon$ ),  $N$  corresponds to employment,  $\varphi$  denotes the slope of the labor supply curve, and  $\psi$  is a preference parameter that can vary over time. The implied marginal rate of substitution  $- (MRS)$  in logs is given by:

$$MRS = c + \varphi n + \psi \quad [4]$$

### 1.1 Efficient Allocation (First Best)

According to Gonçalves et al. (2020), the first best outcome corresponds to efficient allocations of all production factors and the absence of involuntary unemployment. For this to occur, the economy must operate under perfect competition to generate the highest possible level of output.

Thus, Blanchard and Galí (2007) assume that the goods and labor markets operate under conditions of perfect competition. From this perspective, for firms:

$$\omega = mpn = (y - n) + \log(1 - \alpha) \quad [5]$$

On the other hand, from the perspective of the consumer-worker:

$$\omega = MRS = y + \varphi n + \psi \quad [6]$$

At this juncture, the market equilibrium condition is established, where  $c = y$ . The combination of the two expressions results in the following formulation for the optimal employment level  $n_1$  (the subscript "1" being used to indicate the values of the variables referring to the efficiency allocation, or first best outcome).

$$(1 + \varphi)n_1 = \log(1 - \alpha) - \psi \quad [7]$$

The optimal level of employment, known as the first best outcome, is not influenced by the endowment of the non-produced input, due to the exact balance between income and substitution effects provided by logarithmic utility and Cobb-Douglas technology. However, it has an inverse relationship with the preference parameter  $\psi$ . Starting from the optimal employment level, the corresponding income, represented by  $y_1$ , is determined by:

$$y_1 = am + (1 - \alpha)n_1 \quad [8]$$

As anticipated, this is conditional on the influence of both shocks.

## 1.2 Equilibrium with Flexible Prices (Second Best)

According to Blanchard and Galí (2007), while maintaining the assumptions that prices and wages are flexible but allowing for the monopoly power of the firms in the commodities market. From the point of view of the firms, the definition of the ideal price implies  $mc + \mu^p = 0$ , where  $\mu^p \equiv \log(\epsilon/(\epsilon - 1))$  is the markup of the price over the cost, arising from the monopoly power of firms.

Therefore, using equation [2], we have:

$$\omega = \Psi - n + \log(1 - \alpha) - \mu_p \quad [9]$$

By adopting  $n_2$  as a reference for the second-best level of a variable (or natural level), associated with equilibrium in a flexible price scenario, it is possible to determine the value of  $n_2$  by combining equations [6] and [9].

$$(1 + \varphi)n_2 = \log(1 - \alpha) - \mu_p - \Psi \quad [10]$$

According to the assumptions made, this value is independent of  $m$ , although it can be affected by changes in the preference parameter  $\Psi$ . The second-best output level, in turn, is determined by:

$$y_2 = \alpha m + (1 - \alpha)n_2 \quad [11]$$

While both the first-best output ( $y_1$ ) and the second-best output ( $y_2$ ) vary over time, the gap between them remains constant and is given by:

$$y_1 - y_2 = \frac{\mu^p (1 - \alpha)}{1 + \varphi} \equiv \Omega \quad [12]$$

## 1.3 The New-Keynesian Phillips Curve (NKPC)

It is assumed that price-setting decisions are staggered according to Calvo (1983). In this case, considering a steady state with zero inflation, the dynamics of inflation are represented by the following differential equation:

$$\pi = \beta E \pi(+1) + \lambda(mc + \mu^p) \quad [13]$$

In this context,  $mc + \mu^p$  represents the logarithmic deviation of the real marginal cost from its value in the steady state with zero inflation, while  $\lambda \equiv \phi^{-1}(1 - \phi)(1 - \beta\phi)$ , where  $f$  is the proportion of companies that keep their prices unchanged in each period.

By substituting equation [6] into equation [2] and using equations [10] and [11], the following equation is obtained:

$$mc + \mu^p = \left( \frac{1 + \varphi}{1 - \alpha} \right) (y - y_2) \quad [14]$$

By combining equations [13] and [14], we obtain the New-Keynesian Phillips Curve (NKPC):

$$\pi = \beta E \pi(+1) + \kappa(y - y_2) \quad [15]$$

Where  $\kappa \equiv \lambda(1 + \varphi)/(1 - \alpha)$ .

According to Blanchard and Galí (2007), inflation ( $\pi$ ) depends on expected inflation ( $\pi + 1$ ) and the output gap ( $y - y_2$ ), defined as the logarithmic distance between output and its natural level. Supply and preference shocks are indirectly reflected in equation [15], influencing the natural level of output,  $y_2$ , and consequently the output gap ( $y - y_2$ ).

Blanchard and Galí (2007) state that equation [15] keeps inflation stable and is equivalent to stabilizing the output gap ( $y - y_2$ ). As established in equation [12], we have that  $(y_1 - y_2) = \Omega$ . This implies that stabilizing the gap ( $y - y_2$ ) is simultaneously stabilizing the welfare-relevant logarithmic distance between output and its optimal level,  $(y - y_1)$ . When the two relationships are considered together, it follows that stabilizing inflation is the same as stabilizing the logarithmic distance associated with welfare relative to the optimal level. The constancy of  $\Omega$ , which represents the logarithmic difference between the first- and second-best output levels, is a crucial factor. As adverse supply shocks do not affect  $\Omega$ , there are no incentives for the monetary authority to adopt an inflationary policy other than the constant one.

#### 1.4 Introduction of Real Wage Rigidity

According to Gonçalves et al. (2020), the introduction of the idea of real wage rigidity aims to capture the effects of an opposite supply shock on the gap between the first best optimal level of output and the second-best optimal level of output, as well as to examine the possibility that the monetary authority was wish to depart from a constant inflation policy.

Thus, Blanchard and Galí (2007) assume that real wages ( $\omega$ ) respond slowly to labor market conditions because of some imperfection (not explicitly modeled) or friction in labor markets. Assuming a partial-adjustment model:

$$\omega = \gamma \omega(-1) + (1 - \gamma)MRS \quad [16]$$

In this context,  $\gamma$  can be understood as a measure of real wage rigidity. The slow adaptation of wages to labor market conditions stems from distortions, rather than from preference choices, ensuring that the efficient equilibrium is not impacted.

### 1.5 Flexible Price Equilibrium with Wage Rigidity (Second Best)

According to Blanchard and Galí (2007), both prices and wages are assumed to be flexible. In this scenario, the second-best level of employment is determined, since the first-best level remains unchanged relative to the previous case.

Thus, using equations [4], [16], and the technological assumptions applied in equation [2], from the point of view of rigid wages:

$$\begin{aligned} \omega &= \gamma \omega(-1) + (1 - \gamma)(y + \varphi n + \Psi) \\ &= \gamma \omega(-1) + (1 - \gamma)[\alpha(m - n) + (1 + \varphi)n + \Psi] \end{aligned} \quad [17]$$

From the point of view of firms, it follows that:

$$\begin{aligned} \omega &= mpn - \mu^p \\ &= (y - n) + \log(1 - \alpha) - \mu^p \\ &= \alpha(m - n) + \log(1 - \alpha) - \mu^p \end{aligned}$$

By combining the two expressions and rearranging the terms, it is possible to determine the second-best level of output  $y_2$  in relation to the first best level of output  $y_1$ , which remains constant and is defined by equations [7] and [8], in addition to the two exogenous driving forces.

$$[y_2 - y_1 + \Omega] = \Xi[y_2(-1) - y_1(-1) + \Omega] + \Xi(1 - \alpha)[\Delta m + (1 + \varphi)^{-1} \Delta \Psi] \quad [18]$$

Where  $\Xi \equiv \gamma\alpha/(\gamma\alpha + (1 - \gamma)(1 - \varphi)) \in [0, 1]$ .

Equation [18] highlights the consequences of incorporating rigidities in real wages. The distance between the first- and second-best levels of output is no longer fixed but varies according to changes in preferences and supply shocks.

As  $\Xi$  increases,  $\gamma$  also increases, indicating that the magnitude and persistence of the deviations between the second- and first-best levels of output widen as real rigidity increases. Consequently, an adverse supply shock (such as an unexpected reduction in  $m$ ) causes a sharper decrease in the second-best output compared to

the first-best output, thereby widening the gap in  $\gamma$ . This gap, however, gradually returns to the steady-state value  $\Omega$  as wages adjust over time. On the other hand, in the face of a preference shock that reduces the first-best level of output (such as an increase in  $\psi$ ), the second-best output suffers a less pronounced fall, since the assumed real rigidity limits the upward adjustment of wages, preventing them from fully accommodating the lower efficient level of employment and output.

### 1.6 The New Version of the NewKeynesian Phillips Curve

Blanchard and Galí (2007) point out that the staggered price equilibrium is derived under the assumption of staggered pricing determined by Calvo (1983). Thus, combining equations [1], [2], and [17], and rearranging the terms:

$$(mc + \mu^p) = \gamma(mc + \mu^p)(-1) + \chi_2 \tag{19}$$

In this context,  $\chi_2 \equiv (1 - \alpha)^{-1} [(1 - \gamma)(1 + \phi)(\psi - \psi_2) + \gamma\alpha(\Delta\psi - \Delta\psi_2)]$  represents a linear combination of the current value and the deviation relative to the second-best output. Thus, by combining equation [19] with equation [13]:

$$\pi = \beta E\pi(+1) + \frac{\lambda}{1 - \gamma T} \chi_2 \tag{20}$$

With  $T$  representing the lag operator, equation [20] shows the link between inflation and the implicit output gap. As in the basic NKPC model, there remains an ex ante relationship - albeit with slightly more sophisticated dynamics - between inflation, its expectations and the output gap (covering both its level and variation). In this way, the total stabilization of inflation remains compatible with the complete stabilization of the output gap, that is, the distance between output and its second-best level. In equation [20], a constant  $p$  results in a constant  $(y - y_2)$ .

Unlike the basic NKPC model, stabilizing the output gap  $(y - y_2)$  is no longer desirable, since, for welfare the relevant distance of output is not relative to its second-best level, but to its first-best level. Furthermore, unlike in the basic model, the difference between the first- and second-best levels of output does not remain fixed but is now influenced by shocks (Blanchard and Galí, 2007).

The impact of these changes leads to the combination of equations [20] and [18], making it possible to derive the relationship between inflation and the deviation of employment from its first-best level:

$$\pi = \beta E\pi(+1) + \frac{\lambda}{1 - \gamma T} \chi_1 - \frac{\lambda\gamma\alpha}{1 - \gamma T} [\Delta m + (1 + \phi)^{-1} \Delta\Psi] \tag{21}$$

$\chi_1 \equiv (1 - \alpha) - 1[(1 - \gamma)(1 + \varphi)(y - y_1 + \Omega) + \gamma\alpha(\Delta y - \Delta y_1)]$  represents a linear combination between the current output gap and the lagged one that is relevant to welfare. Inflation is determined by expected inflation, by a distributed lag of the distance of output from its first-best level, and by a distributed lag of both supply and preference shocks. In other words, there is no longer a precise relationship, regardless of its complexity, between inflation and the welfare-related output gap. Consequently, it is not possible to achieve simultaneous stabilization in the face of supply and preference shocks, which highlights a clear trade-off in monetary policy.

To identify the source of the trade-off, it is interesting to analyze the economy's price frontier. Consider  $v$  as the real price of the non-produced input. Thus, based on the Cobb-Douglas premise:

$$mc = (1 - \alpha)\omega + \alpha v + \text{constant}$$

Therefore, any shock that causes a rise in the real price of the non-produced input will inevitably result in a reduction in real wages or an increase in real marginal cost. The final impact, whether on production or inflation, will depend on the degree of monetary policy accommodation. This becomes clear when looking at the derivation of the inflation equation, now formulated as a function of  $Du$  and the distance of production from the first-best level. Thus:

$$\pi = \beta E\pi(+1) + \frac{\lambda}{1-ZT} \left[ (1-Z)(1+\varphi)(1-\alpha)^{-1}(y-y_1+\Omega) + Z\alpha\Delta v \right] \quad [22]$$

Where  $Z \equiv \frac{\gamma}{1-\alpha(1-\gamma)} \in [0,1]$  corresponds to a monotonic transformation of the rigidity index associated with real wages, represented by  $\gamma$ .

Faced with a shock that raises the real price of the non-produced input,  $v$ , stabilizing inflation requires a proportional reduction in the real wage. However, due to the rigidity of real wages, this can only be achieved through a reduction in output from its first-best level. If one chooses to stabilize the deviation of output from the first-best level, the result will be higher inflation.

## 2. LITERATURE REVIEW

Benigno and Eggertsson (2024) estimated the slanted-L Phillips Curve for Australia, Canada, Germany, France, the United Kingdom, Italy, Japan, and the United States from the first quarter of 2009 to the third quarter of 2023. They concluded that high unemployment rates and increased demand can reduce unemployment without creating strong inflationary pressures.

Benigno and Eggertsson (2023) proposed a nonlinear New Keynesian Phillips Curve for the United States in two distinct periods: 1960–2022 and 2008–2022. The rationale was to examine macroeconomic behavior in the face of the Volcker recession and the COVID-19 pandemic. Thus, it was determined that labor shortages pose a higher risk of inflation than previously expected.

Del Negro et al. (2020) tested four Phillips Curve hypotheses: incorrect measurement of inflation or economic slack; a flatter wage Phillips curve; a flatter price Phillips curve; and a flatter aggregate demand relationship. They used different empirical methods and sample periods. As a result, it was found that a flat aggregate supply curve better explains inflation responses to cost pressures.

McLeay and Tenreyro (2020) highlighted the difficulty in empirically presenting the Phillips Curve. To this end, several articles were presented with regional data from the United States and employing different methods to illustrate the challenges involved in estimating the Phillips Curve. The study argues that the Phillips Curve is valid, as a monetary policy aimed at minimizing welfare losses is consistent with the definition of the Phillips Curve.

Hazell et al. (2022) estimated the slope of the Phillips Curve for U.S. states in different periods. The results indicate that changes in monetary policy expectations help explain the stability of inflation in the early 1980s, while inflation expectations account for the stability of inflation in the mid-1990s.

Do and Spanos (2024) challenge the common empirical literature on the Phillips Curve, arguing that the empirical evidence from the most influential studies is not reliable. This is because the theoretical narratives and empirical evidence supporting the Phillips Curve are fragile. Thus, the Phillips Curve should not be considered an established empirical relationship, as the confidence placed in it to guide economic policy is questionable, given that the theoretical and statistical foundations that support it are inconsistent.

Ball and Mazumder (2021) investigated whether the traditional Phillips Curve is still valid for explaining underlying inflation in the Eurozone. The results indicate that the Phillips Curve continues to be a useful tool for understanding inflation dynamics in the Eurozone, as external shocks still influence inflation.

Tariq et al. (2022) investigated whether there is an “environmental” version of the Phillips Curve in South Asian countries between 1991 and 2019, relating unemployment and economic growth to environmental impacts. The results pointed

to a significant relationship between unemployment and the ecological footprint, suggesting that reducing unemployment tends to increase environmental pressure.

Lasarte-Navamuel et al. (2025) empirically analyzed Spain's regional Phillips curve, incorporating spatial dependence between regions. The results suggest the regional nature of the Phillips Curve, but its intensity varies according to the region and the period analyzed. There is clear evidence of spatial dependence—that is, neighboring regions influence each other in terms of inflation and unemployment—and ignoring these effects can lead to biased estimates and misleading conclusions.

Guirguis and Suen (2022) discussed methodological advances in estimating the Phillips curve, showing that the relationship between inflation and unemployment remains relevant but requires techniques that address problems of endogeneity, nonlinearity, and structural changes. The results indicate that when estimation problems are corrected, there is strong evidence of inflation sensitivity to the tightening of the U.S. labor market in the 1990s.

Malher et al. (2025) analyzed the dynamics of price and wage inflation in Brazil between 1999 and 2022, in four distinct phases. The results showed that cost inflation was predominant relative to excess demand that is, cost variables have greater weight than demand variables in explaining Brazilian inflation.

Alves and Ferreira (2023) investigated the relationship between the Phillips Curve and exchange rate pass-through, using a wavelet coherence approach to capture how this relationship changes over time and across different horizons. The results indicate that the Phillips Curve is not stable, as its intensity varies according to the period and the horizon of analysis. Exchange rate pass-through plays an important role in inflation dynamics, especially in periods of external shocks and currency devaluation.

Crump et al. (2024) evaluated the New Keynesian Phillips Curve during the COVID-19 pandemic in the United States, showing that the pandemic temporarily altered the trade-off between unemployment and inflation, as it caused a rapid and persistent increase in the natural rate of unemployment, reflecting structural changes in the labor market.

### **3. METHODOLOGIES**

The sample comprises the economies of Brazil and the United States from January 2010 to December 2023. The research data are divided into two parts: one drawing on Brazilian sources and another from U.S. sources. The rationale for choosing this period is that the research seeks to capture a variety of distinct economic

scenarios, such as the economic recovery from the 2008 subprime crisis, the 2015-2016 economic recession in Brazil, the normalization of the economy in the United States, and the shock of the COVID-19 pandemic.

The data used in the Brazilian series include: the unemployment rate, which refers to the unemployed population in the Metropolitan Regions analyzed by the Brazilian Institute of Geography and Statistics (IBGE) through the Monthly Employment Survey (PME) between 2010 and 2011. From the subsequent year onwards, the unemployment rate began to be calculated by the National Household Sample Survey (PNAD). The Brazilian inflation rate is represented by the Extended National Consumer Price Index (IPCA) and the expected inflation rate, both released by the Brazilian Institute of Geography and Statistics and the Brazilian Consumer Price Index System (IBGE/SNIPC). The Brazilian benchmark interest rate is the Special System for Settlement and Custody (SELIC), which serves as a reference for Brazilian public debt and is disclosed by the Central Bank of Brazil (BCB). Additionally, the average price of Brazilian commodities — including food products, agricultural raw materials, minerals, ores, metals, and fuels — and the commercial exchange rate (R\$/US\$), purchase average, were collected from the BCB database.

Since the analysis period spans from January 2010 to December 2023, to address the discontinuity in the Brazilian series, the time-series backcasting method suggested by Gonçalves et al. (2020) and employed by Vaz and Barreira (2021) is used.

The data for the U.S. series include the current inflation rate in the U.S. economy based on the Consumer Price Index (CPI) and its expected inflation rate, both available through the U.S. Bureau of Labor Statistics (BLS), as well as the unemployment rate. Meanwhile, the average price of U.S. commodities (agricultural, industrial supplies, and manufactured goods), the commercial exchange rate (US\$/€), and the U.S. benchmark interest rate were collected from the Federal Reserve System (Fed).

### 3.1 Empirical Model

Initially, the abbreviated form of the new NKPC model introduced by Mendonça et al. (2012) and adapted for this study is hypothesized as follows:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 E_t \pi_{t+1} + \beta_3 u_t + \beta_4 z_t + \beta_5 x_t + \varepsilon_t \quad [23]$$

Where  $\pi_t$  is the inflation rate at time  $t$ ;  $E_t \pi_{t+1}$  is the mathematical expectation of the inflation rate for the period  $t+1$ ;  $u_t$  represents the firm's marginal cost, proxied by the unemployment rate at time  $t$ ;  $z_t$  is a variable representing the supply shock; and  $\varepsilon_t$  is the error term, assumed to be independently and identically distributed.

Equation [23] is a reduced form of the structural model derived in Blanchard and Galí (2007) and is expressed as follows:

$$\pi_t = \frac{1}{1+\beta} \pi_{t-1} + \frac{\beta}{1+\beta} E_t \pi_{t+1} - \frac{\lambda(1-\alpha)(1-\gamma)\varphi}{\gamma(1+\beta)} u_t + \frac{\alpha\lambda}{1+\beta} z_t + \varepsilon_t \quad [24]$$

Where  $\beta \in (0,1)$  is the intertemporal discount factor,  $\alpha \in (0,1)$  indicates that the production function of the economy exhibits constant returns to scale, and  $\lambda \equiv \theta - 1(1 - \theta)(1 - \beta)\theta$ , where  $\theta$  is the fraction of firms that do not adjust their prices in each period,  $\lambda$  is the coefficient measuring wage rigidity, and  $\varphi$  indicates the slope of the labor supply curve.

Regarding the above equation, it is observed that current inflation depends on past inflation, expected inflation for the following period, the unemployment rate, and changes in the price of non-produced input (M). It can be noted that since  $\beta \in (0,1)$ , the stimationmethod imposes the following inequality restrictions on the variables  $\beta_1$  and  $\beta_2$ :

$$\beta_1, \beta_2 \in (0,1) \text{ and } \beta_1 + \beta_2 = 1 \quad [25]$$

The concept behind the restriction  $\beta_1 + \beta_2 = 1$  is that it is not possible to maintain a permanent unemployment rate below its steady-state level without indefinitely raising the inflation rate (Mazali and Divino, 2010).

### 3.2 Econometric Procedures

The estimations will be conducted through two econometric procedures. First, the Instrumental variables (IV) method will be used to address unobserved variables, which could lead to measurement errors in the parameter. Subsequently, the Generalized Method of Moments (GMM) will be used to estimate the NKPC, with the selection of the most appropriate instruments.

Thus, the two versions of the NKPC model will be estimated, along with unit root tests with structural breaks proposed by Saikkonen and Lütkepohl (2002) and Lanne et al. (2002, 2003) to analyze the stationarity of the series and the presence of structural breaks during the period, as well as smooth transitions across levels. The Pagan & Hall (1983) test will be applied to check for heteroskedasticity in the regression; the Cumby and Huizinga (1992) test will indicate the presence of residual autocorrelation. A underidentification test will evaluate whether the instruments applied to the IV method are appropriate, alongside the Sargan-Hansen and Stock

and Yogo (2005) tests to identify weak instruments; the partial  $R^2$  statistic will assess the correlation between the instruments.

#### 4. RESULTS AND DISCUSSIONS

To observe the behavior of the variables studied, an initial descriptive and analysis of the data was conducted, focusing on measures of central tendency for Brazil and the United States, as shown in Table 1.

**Table 1: Descriptive Statistics**

Variables	Brazil				
	Mean	Median	Standard Deviation	Min.	Max.
Inflation Rate	5,97	5,77	2,36	1,88	12,13
Expected Inflation Rate	5,03	4,81	1,32	1,61	8,66
Unemployment Rate	9,62	8,85	2,80	4,7	14,9
Commodity Prices	153,51	159,76	28,75	96,76	208,91
Interest Rate	9,49	10,25	3,58	2	14,25
Exchange Rate	3,44	3,28	1,31	1,56	5,65
Variables	United States				
	Mean	Median	Standard Deviation	Min.	Max.
Inflation Rate	2,6	2	2,01	-0,2	9,1
Expected Inflation Rate	3,38	3	1,11	2,33	6,8
Unemployment Rate	5,9	5,1	2,26	3,4	14,7
Commodity Prices	208,1	201,1	24,57	181,0	283,5
Interest Rate	1,00	0,3	1,45	0,06	5,50
Exchange Rate	0,84	0,85	0,07	0,69	1,01

Source: Elaborated by the Author (2024)

According to Table 1, the values for inflation rate, expected inflation rate, unemployment rate, interest rate, and exchange rate in Brazil are significantly higher than those observed in the United States. These data highlight the economic gap between Brazil and the United States, where the U.S. economy holds a leading position in the international market due to its stability, economic solidity, more advanced human capital, and sustained long-term economic growth, among other factors. While Brazil stands out as one of the largest economies globally, it remains a structurally unequal, unstable, and developing market.

This perception is not only based on the data in Table 1, but also supported by studies by Fiorelli (2023), Assis and Deos (2023), Gatla and Ulmer (2025), Menezes (2023), Santos et al. (2023), and Avila (2022) which corroborate the assertion of significant discrepancies between the economies of Brazil and the United States with regard to inflation, unemployment, interest rates, exchange rates, and commodity prices during the period in question.

To analyze the stationarity of the variables' time series, Table 2 presents the results of the unit root test with structural breaks, as proposed by Lanne et al. (2003). This method is based on estimating the deterministic component using generalized least squares (GLS) and removing this trend from the original series.

**Table 2: Unit Root Test with Structural Break for Brazil**

<b>Variables</b>	<b>Model<sup>a</sup></b>	<b>Lags<sup>b</sup></b>	<b>Type of Break</b>	<b>Break Date</b>	<b>Test Statistic<sup>c</sup></b>
Inflation Rate	C	2	<i>Impulse Dummy</i>	2018:06	-2,4152**
	C, T	2	<i>Rational Shift</i>	2018:06	-2,2609**
Expected Inflation Rate	C	2	<i>Impulse Dummy</i>	2022:07	-4,9428**
	C, T	2	<i>Rational Shift</i>	2022:07	-4,7762**
Unemployment Rate	C	2	<i>Impulse Dummy</i>	2012:02	- 1,3594**
	C, T	2	<i>Rational Shift</i>	2012:02	-1,4136**
Commodity Prices	C	2	<i>Impulse Dummy</i>	2020:04	-1,9172**
	C, T	2	<i>Rational Shift</i>	2020:04	-1,8175**
Interest Rate	C	2	<i>Impulse Dummy</i>	2017:03	-2,3203**
	C, T	2	<i>Rational Shift</i>	2017:03	-2,3801**
Exchange Rate	C	2	<i>Impulse Dummy</i>	2010:06	-0,9454**
	C, T	2	<i>Rational Shift</i>	2010:06	-1,4048**

a: Model C with constant and T with deterministic trend; b: number of lags selected according to the SC criterion; c: critical values with 1% significance. \* values at level; \*\* values in first difference. The critical values for the Saikkonen-Lütkepohl test are as follows (Lanne et al. 2002): (i) model with constant: -3.48 (1%); -2.88 (5%); and -2.58 (10%); (ii) model with constant and deterministic trend: -3.55 (1%); -3.03 (5%); and -2.76 (10%).

Source: Elaborated by the Author (2024)

According to Table 2, the results of the unit root test with a structural break indicate that the variables analyzed in the study are stationary in first differences, meaning that the variables are integrated of order one, I(1).

The structural breaks are associated with changes in the local and global economy during the analysis period. The inflation rate reflects the effects of the halt in the

freight transportation sector and adjustments in relative prices. Meanwhile, the expected inflation rate reflects consecutive increases in interest rates implemented by the BCB. Changes in the unemployment rate occurred as a result of rising formal employment levels, driven by strong performance in the economic activity of the services, construction, extractive industries, and commerce sectors. Commodity prices were influenced by record agricultural raw material prices due to the COVID-19 pandemic and the increasing food demand. The Brazilian interest rate reflected the resumption of growth in the Brazilian economy, with increases in GDP and economic productivity, followed by a subsequent decrease in inflation. The exchange rate was influenced by more favorable external financing conditions, resulting in net capital inflows due to interventions by the BCB through foreign currency purchases.

The unit root test with a structural break for the variables of the U.S. economy is presented in Table 3.

**Table 3: Unit Root Test with Structural Break for the United States**

<b>Variables</b>	<b>Model<sup>a</sup></b>	<b>Lags<sup>b</sup></b>	<b>Break Type</b>	<b>Break Date</b>	<b>Test Statistic<sup>c</sup></b>
Inflation Rate	C	2	<i>Impulse Dummy</i>	2023:01	-1,5768**
	C, T	2	<i>Rational Shift</i>	2023:01	-0,8748**
Expected Inflation Rate	C	2	<i>Impulse Dummy</i>	2013:05	-1,7821**
	C, T	2	<i>Rational Shift</i>	2013:05	-1,4929**
Unemployment Rate	C	2	<i>Impulse Dummy</i>	2020:04	-2,4341**
	C, T	2	<i>Rational Shift</i>	2020:04	-1,7262**
Commodity Prices	C	2	<i>Impulse Dummy</i>	2022: 07	-0,9709**
	C, T	2	<i>Rational Shift</i>	2022: 07	-0,7950**
Interest Rate	C	2	<i>Impulse Dummy</i>	2020:03	-0,0812**
	C, T	2	<i>Rational Shift</i>	2020:03	-0,7834**
Exchange Rate	C	2	<i>Impulse Dummy</i>	2015:11	-1,8577**
	C, T	2	<i>Rational Shift</i>	2011:11	-1,5431**

a: Model C with constant and T with deterministic trend; b: number of lags selected according to SC criterion; c: critical values at 1% significance. \*values at level; \*\*values at first difference. The critical values for the Saikkonen-Lütkepohl test are as follows (Lanne et al. 2002): (i) model with constant: -3.48 (1%); -2.88 (5%); -2.58 (10%); (ii) model with constant and deterministic trend: -3.55 (1%); -3.03 (5%); -2.76 (10%).

Source: Elaborated by the Author (2024)

Similarly to the Brazilian economy, the results of the unit root test with structural break shown in Table 3 indicate that the variables of the U.S. economy are stationary in first differences, meaning the variables are integrated of order one, I(1).

The structural breaks in the U.S. economy are linked to the behavior of economic agents and exogenous shocks that have occurred over recent decades. The inflation rate reflects the interest rate hikes by the FED aimed at curbing growth and spending to slow the largest inflation surge in four decades. Expected inflation stems from the Fed's accommodative monetary policy stance, reflected in reduction in the pace of purchases of mortgage-backed agency securities and long-term Treasuries. The unemployment rate derives from the worst economic performance of the United States since World War II, resulting from the effects of the COVID-19 pandemic, which devastated various service providers, leaving millions of Americans unemployed. Commodity prices rose due to the surge in agricultural input costs, influenced by the COVID-19 pandemic and the war in Ukraine. Similarly to unemployment, the interest rate dynamics were also shaped by the COVID-19 pandemic, as the Fed reduced interest rates to levels close to those of the 2008 financial crisis. The exchange rate reflects the U.S. debt-ceiling crisis, which sparked discussions about the government's future spending policies.

Regarding the analysis of the results from the empirical models obtained for the NKPC, Tables 4 and 5 present the estimation results of the Phillips Curve using time-series data for the period from January 2010 to December 2023. The inflation variable is measured by the IPCA rate of change for Brazil and the CPI for the United States.

At this stage, three sets of instrumental variables were analyzed to model the inflation rate, defined as follows:

C1 includes up to the first-order lags of inflation, expected inflation, the unemployment rate, and current observations of exogenous shocks relevant to each studied economy—Brazil (economic growth crisis, unemployment crisis, and the COVID-19 health crisis) and the United States (American financial system crisis, debt ceiling crisis, and the COVID-19 pandemic crisis).

C2 includes, in addition to the variables in C1, the interest rate and the exchange rate with the same lag orders.

C3 includes all variables from C2 along with the average commodity price indices.

After estimating the instrumental variables, the best-performing instruments in explaining the Phillips Curve will be selected and subsequently incorporated into the curve's estimation. These selections are outlined in the following tables.

**Table 4: Estimation for Brazil - Dependent Variable: IPCA**

<b>Variables</b>	<b>IV – C1 (1)</b>	<b>IV – C2 (2)</b>	<b>IV – C3 (3)</b>	<b>GMM – C3 (4)</b>
EXPINFLA <sub>BR</sub>	0,517 (0,023)	0,268 (0,017)	0,223 (0,026)	0,219 (0,027)
LAGINFLA <sub>BR</sub>	0,803 (0,000)	0,878 (0,000)	0,892 (0,000)	0,909 (0,000)
UNEMP <sub>BR</sub>	0,055 (0,256)	0,006 (0,800)	-0,001 (0,934)	-0,005 (0,824)
SHOCK <sub>BR</sub>	0,276 (0,360)	-0,033 (0,854)	-0,090 (0,627)	-0,031 (0,865)
Obs.	168	168	168	168
Pagan-Hall Test	$\chi^2 (4) = 2,721$ (0,605)	$\chi^2 (5) = 6,664$ (0,246)	$\chi^2 (6) = 8,058$ (0,233)	–
Cumby-Huizinga Test	$\chi^2 (1) = 2,329$ (0,126)	$\chi^2 (1) = 3,934$ (0,047)	$\chi^2 (1) = 4,059$ (0,043)	–
Underidentification Test:	$\chi^2 (1) = 7,508$ (0,006)	$\chi^2 (1) = 3,354$ (0,067)	$\chi^2 (3) = 15,410$ (0,001)	$\chi^2 (3) = 15,410$ (0,001)
Sargan-Hansen Test	$\chi^2 (1) = 0,576$ (0,447)	$\chi^2 (1) = 3,638$ (0,056)	$\chi^2 (2) = 4,361$ (0,113)	$\chi^2 (2) = 4,360$ (0,113)
Parcial R <sup>2</sup>	0,104	0,124	0,149	0,149
F test (1st stage)	12,56 (0,000)	11,40 (0,000)	7,77 (0,000)	7,77 (0,000)
Stock-Yogo Test	16,38 (does not reject at 10%)	19,93 does not reject at 10%)	13,91 does not reject at 5%)	13,91 (does not reject at 5%)
$\beta_1 + \beta_2 = 1$	F (2,121) = 7,048 (0,001)	F (2,120) = 8,512 (0,000)	F (3,119) = 6,99 (0,000)	$\chi^2 (4) = 9,08$ (0,000)

Source: Elaborated by the Author (2024). Standard errors in parentheses.

Following the guidelines adopted by Blanchard and Galí (2007), columns 1, 2, and 3 were estimated using the instrumental variable method based on the C1, C2, and C3 sets previously presented. Column 4 presents the Phillips Curve estimation using the best instrument set, employing the GMM-HAC method (Heteroskedasticity and Autocorrelation Consistent). The expected inflation rate (EXPINFLA<sub>BR</sub>) lagged inflation rate (LAGINFLA<sub>BR</sub>), unemployment rate (UNEMP<sub>BR</sub>), and exogenous economic shocks (SHOCK<sub>BR</sub>) were estimated in relation to Brazil’s official inflation. The shock variable is represented as a dummy, with a value of 1 during periods of economic crises and 0 otherwise.

The Pagan-Hall and Cumby-Huizinga tests for the Brazilian estimates indicate that the estimators remain consistent in the presence of autocorrelation and heteroskedasticity. The underidentification and Sargan-Hansen tests confirm that the order condition is met, while the Stock-Yogo and F-tests reject the hypothesis that the instruments used in the study are weak.

According to Table 4, the best instrument set is C3, as its results align with economic theory and best explain the trade-off between inflation and unemployment rates. Consequently, set C3 (Column 4) was applied in the estimation of the New-Keynesian Phillips Curve for Brazil. The results show that the estimated coefficients follow economic theory: a one-percentage-point increase in the expected inflation rate raises the inflation rate (IPCA) by 0.219 percentage points. Similarly, a one-percentage-point increase in the lagged inflation rate leads to a 0.909 percentage point increase in inflation. A one-percentage-point rise in the unemployment rate resulted in a 0.005-percentage-point decrease in inflation, while successive exogenous economic shocks led to a 0.031-percentage point reduction in inflation.

These findings indicate an inverse relationship between inflation and unemployment rates, a characteristic expected in the New-Keynesian Phillips Curve. Additionally, economic and health crises during the pandemic contributed to declines in inflation rates. This phenomenon can be attributed to the contraction of Brazil's economy during the initial crises, stemming from reduced economic activity and pandemic control measures, such as social isolation mandates, business closures, the suspension of academic activities, and decreased industrial production.

The estimations of the New Keynesian Phillips Curve for the United States are presented in Table 5. These results include the expected inflation rate ( $EXPINFLA_{US}$ ), lagged inflation rate ( $LAGINFLA_{US}$ ), unemployment rate ( $UNEMP_{US}$ ), and exogenous shocks ( $SHOCK_{US}$ ), with the latter being identified as a proxy for external economic disruptions in the U.S.

**Table 5: Estimation for the United States - Dependent Variable: CPI**

<b>Variables</b>	<b>IV – C1 (1)</b>	<b>IV – C2 (2)</b>	<b>IV – C3 (3)</b>	<b>GMM – C3 (4)</b>
EXPINFLA <sub>US</sub>	0,191 (0,602)	0,249 (0,471)	0,246 (0,339)	0,259 (0,304)
LAGINFLA <sub>US</sub>	0,868 (0,000)	0,862 (0,000)	0,863 (0,000)	0,860 (0,000)
UNEMP <sub>US</sub>	-0,062 (0,215)	-0,067 (0,133)	-0,067 (0,094)	-0,073 (0,048)
SHOCK <sub>US</sub>	-0,048 (0,853)	-0,0187 (0,938)	-0,020 (0,937)	0,010 (0,964)
Obs.	168	168	168	168
Pagan-Hall Test	$\chi^2 (4) = 6,862$ (0,104)	$\chi^2 (5) = 8,461$ (0,132)	$\chi^2 (6) = 8,649$ (0,194)	–
Cumby-Huizinga Test	$\chi^2 (1) = 7,024$ (0,008)	$\chi^2 (1) = 13,141$ (0,000)	$\chi^2 (1) = 7,171$ (0,007)	–
Underidentification Test	$\chi^2 (1) = 20,803$ (0,000)	$\chi^2 (2) = 23,283$ (0,000)	$\chi^2 (3) = 20,153$ (0,000)	$\chi^2 (3) = 20,153$ (0,001)
Sargan-Hansen Test	$\chi^2 (1) = 0,304$ (0,000)	$\chi^2 (1) = 0,301$ (0,583)	$\chi^2 (2) = 0,271$ (0,873)	$\chi^2 (2) = 0,271$ (0,873)
Partial R <sup>2</sup>	0,244	0,273	0,456	0,456
F test (1st stage)	24,67 (0,000)	14,90 (0,000)	27,88 (0,000)	27,88 (0,000)
Stock-Yogo Test	16,38 (does not reject at 10%)	19,93 (does not reject at 10%)	13,91 (does not reject at 5%)	13,91 (does not reject at 5%)
$\beta_1 + \beta_2 = 1$	F (2,120) = 12,13 (0,001)	F (2,119) = 14,67 (0,000)	F (3,119) = 6,99 (0,000)	$\chi^2 (4) = 5,65$ (0,000)

Source: Elaborated by the Author (2024). Standard errors in parentheses.

The Pagan-Hall and Cumby-Huizinga tests presented for the estimations in the United States indicate that the estimators are consistent in the presence of autocorrelation and heteroskedasticity. The underidentification and Sargan-Hansen tests confirm that the order condition is met, while the Stock-Yogo and F- tests reject the hypothesis that the instruments used in the study are weak.

According to Table 5, the best instrument in the GMM-HAC estimation was set C3, as its IV method results best explain the trade-off between the inflation rate and the unemployment rate. Thus, set C3 was applied in the estimation of the

New-Keynesian Phillips Curve for the United States. The results show that a one-percentage-point increase in the expected inflation rate raises the official inflation rate (CPI) by 0.259 percentage points. Likewise, a one -percentage-point increase in the lagged inflation rate increases the inflation rate by 0.860 percentage points. Additionally, a one-percentage-point increase in the unemployment rate leads to a reduction of 0.073 percentage points in the inflation rate. Meanwhile, uncertainties caused by crises resulted in a 0.010- percentage-point increase in the inflation rate.

These values indicate an inverse relationship between inflation and unemployment in the United States, a characteristic expected under the NewKeynesian Phillips Curve and economic theory. When evaluating exogenous shocks, it was observed that they led to an increase in the inflation rate. This reaction is explained by the Federal Reserve's response to the financial crisis and the public debt limit, later aggravated by the COVID-19 pandemic, which reduced U.S. production, affecting supply and demand. With fewer available goods and increased demand due to pandemic effects, prices tend to rise, leading to higher inflation.

## **5. FINAL CONSIDERATIONS**

The purpose of this study was to measure the New-Keynesian Phillips Curve for Brazil and the United States, considering the recent exogenous shocks affecting both economies. This research contributes to the theoretical and empirical discussion on the topic by presenting a current theoretical model combined with an empirical model that utilizes robust tools, integrating mathematical and statistical rigor with economic theory to generate more reliable results.

Based on the results presented, the model applied to Brazil behaves in accordance with economic theory. A one-percentage-point increase in inflation expectations leads to a 0.219 percentage point rise in the prevailing inflation rate. The same occurs in the relationship between lagged inflation and current inflation: a one-percentage-point increase in the lagged inflation rate raises inflation by 0.909 percentage points. Meanwhile, a one-percentage-point increase in the unemployment rate results in a 0.005-percentage-point decrease in inflation, a typical behavior of the Phillips Curve. The successive exogenous shocks in the Brazilian economy led to a 0.031-percentage-point decrease in inflation.

The results of the Brazilian economy confirm the hypothesis of adaptive/rational expectations, whereby agents anticipate higher inflation, materializing in effective price increases. There are indications that Brazilian inflation is highly inertial, that is, it is influenced by the past. This reflects the indexation of prices and wages. Although

the effect of unemployment has been very small, this shows that the Brazilian labor market has low inflationary discipline. A possible explanation for this behavior is the structural rigidity of the Brazilian labor market. Exogenous shocks reflect a reduction in inflation, and this behavior acted appears to have acted as a brake on domestic demand rather than on cost pressures.

In the U.S. economy, the results are similar those observed in Brazil. A onepercentage-point increase in expected inflation raises the official inflation rate by 0.259 percentage points. A one-percentage-point increase in past inflation raises inflation by 0.860 percentage points. An increase of one- percentage-point in the unemployment rate results in a 0.073-percentage point reduction in inflation, while exogenous shocks from crises led to a 0.010- percentage-point increase in U.S. inflation.

These results align with the Phillips Curve, as the inclusion of interest rates, exchange rates, and commodity prices in the empirical model contributed to the accuracy of the results and their analytical robustness. The impact of successive economic and health crises that recently affected the economies also positively influenced inflation rates in both countries.

These results are also consistent with the research by Pereira (2022), who estimated the Phillips Curve for Brazil and the United States using a Triangle Model, in which he noted out that inflationary inertia in the Brazilian economy varies from 0.688 to 0.723 with respect to the employment and unemployment gap, while in the U.S. economy, inflationary inertia reached just over 0.85 with respect to to the unemployment and employment gap.

Thus, the unemployment rates in Brazil and the United States have an inverse relationship with the prevailing inflation rate in their respective countries. This is a key premise for economic agents involved macroeconomic decision-making.

Future studies on this topic are suggested, incorporating different economies, additional control variables, and alternative methodologies that could either contrast with or support the findings of this research.

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