Inflation Inequality Across Household Income Groups in Brazil: Persistence, Trend and Volatility

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Abstract

This article investigates inflation inequality across four income strata in Brazil (very low, low, middle, and high income) from July 2006 to April 2025, using the Headline IPCA as a benchmark. We test whether inflation dynamics and transmission mechanisms are structurally unequal and disproportionately affect lower-income households. The methodology combines a Univariate Unobserved Components model with Stochastic Volatility and Outlier Adjustment (UCSVO), to assess trend and volatility, with a Time-Varying Parameter (TVP) Phillips Curve, to evaluate persistence and macroeconomic sensitivity. Results indicate that trend inflation is consistently higher and more volatile among lower-income groups, that inflation outliers are more frequent and intense for these cohorts, and that persistence ranges from 0.28 to 0.40, being particularly unstable at the extremes of the income distribution. These findings reveal that a unified monetary intervention can inadvertently deepen socioeconomic divides by overlooking the highly inertial price dynamics of lower-income strata.
Keywords: IPCA; Income Groups; Stochastic Volatility; UCSVO; Phillips Curve.
JEL Classification: C32; D31; E31.

Resumo

Este artigo investiga a desigualdade inflacionária entre quatro estratos de renda no Brasil (renda muito baixa, baixa, média e alta) de julho de 2006 a abril de 2025, utilizando o IPCA agregado como referência. Testa-se a hipótese de que a dinâmica inflacionária e os mecanismos de transmissão são estruturalmente desiguais e afetam de forma desproporcional os domicílios de menor renda. A metodologia combina um modelo de Componentes Não Observados Univariado com Volatilidade Estocástica e Ajuste de Outliers (UCSVO), para analisar tendência e volatilidade, com uma Curva de Phillips com Parâmetros Variantes no Tempo (TVP), estimada pelo Filtro de Kalman, para avaliar persistência e sensibilidade macroeconômica. Os resultados indicam que a inflação de tendência é mais elevada e volátil nos grupos de menor renda, que os outliers são mais frequentes e intensos nesses estratos e que a persistência varia entre 0,28 e 0,40, sendo instável nos extremos da distribuição. Esses achados revelam que uma intervenção monetária unificada pode aprofundar as divisões socioeconômicas ao ignorar a dinâmica inercial dos preços nos estratos mais vulneráveis.
Palavras-chave: IPCA; Grupos de Renda; Volatilidade Estocástica; UCSVO; Curva de Phillips.

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1 Introduction

Since the 1994 Real Plan, Brazils macroeconomic stabilization has been anchored by an inflation-targeting regime that adopts the Extended National Consumer Price Index (IPCA) as its official target benchmark. Although the Headline IPCA reflects average household inflation, its aggregated nature masks significant heterogeneities across income groups, obscuring how price shocks affect a society marked by deep structural inequalities. Low-income households allocate a larger share of their budget to volatile and persistent essential items, such as food and energy, while higher-income groups maintain more diversified baskets with lower exposure to price disturbances. This divergence creates disparate inflationary experiences that further exacerbate socio-economic divides.

Therefore, understanding these asymmetries is a structural necessity for central banking, rather than a mere distributional exercise. If policymakers rely only on aggregated indices, they risk committing systematic policy errors by miscalculating the timing and magnitude of monetary interventions. A "one-size-fits-all" approach not only ignores how distinct income strata respond to shocks, but can inadvertently cause tightening or easing cycles to amplify the economic burdens of the most vulnerable while failing to anchor expectations among the wealthy. This paper matters precisely because it untangles these hidden operational frictions.

In light of these disparities, this article addresses the following question: to what extent do inflation dynamics and macroeconomic transmission mechanisms differ across income strata in Brazil? To address this issue, we investigate four strata (very low, low, middle, and high income) from July 2006 to April 2025, using the Headline IPCA as a benchmark. The central hypothesis is that inflation dynamics in Brazil are structurally unequal, with lower-income households facing a disproportionately more intense, volatile, and persistent inflationary process, while transmission mechanisms operate heterogeneously across groups. Methodologically, the study employs two econometric techniques: a Univariate Unobserved Components Model with Stochastic Volatility and Outlier Adjustment (UCSVO), to analyze trend and volatility dynamics, and a Time-Varying Parameter (TVP) Phillips Curve, to evaluate the influence of macroeconomic variables and inflation inertia. In addition to group-specific IPCA series, this second analysis incorporates inflation expectations, the Central Banks Economic Activity Index (IBC-Br) as a proxy for the output gap, and the real effective exchange rate.

Although previous studies have documented consumption discrepancies across income classes, literature often treats inflation dynamics as static or fails to simultaneously account for stochastic volatility, parameter variations, and recent global shocks in emerging economies. This study bridges this gap and contributes to the existing literature in three ways. First, it provides a comprehensive decomposition of inflation dynamics using a UCSVO model to capture stochastic volatility and outliers across income strata. Second, by employing a TVP Phillips Curve, it identifies time-varying asymmetries in macroeconomic transmission, particularly concerning inflation inertia and expectations. Finally, it offers updated empirical evidence on the regressive nature of inflation in a major emerging economy, covering recent global shocks up to 2025.

The empirical findings confirm a regressive bias in Brazilian inflation by income groups, highlighting the increased vulnerability of low-income households to both persistent and abrupt price shocks and revealing a structurally unequal inflation burden across income strata. Univariate estimates provide evidence of structural heterogeneity in price dynamics between income groups. Trend inflation is consistently higher and more volatile among very low- and low-income households, with high transitory and permanent volatility, especially between 2006 and 2016, reflecting persistent exposure to essential goods. In these groups, inflation uncertainty also exerts a stronger and more persistent effect compared to higher strata. Although transitory volatility declines after 2017, falling below the IPCA, it remains persistently elevated for these groups over time. In contrast, high-income households show increased transitory volatility from 2018 onward, reflecting greater sensitivity to volatile items, particularly following the COVID-19 pandemic shock. Inflation outliers occur more frequently and with greater magnitude in lower-income groups, decreasing in frequency and size as income rises.

In the multivariate investigation, the TVP Phillips Curve, estimated via the Kalman Filter, reveals substantial variation in inflation persistence across income groups compared to the Headline IPCA. Lagged inflation, our main variable of interest and proxy for inertia, is statistically significant for all strata except the high-income group during specific intervals. While IPCA persistence remains moderate and relatively stable, instability is more pronounced at inflation rates on the extremes of the income distribution (very low- and high-income groups). Regarding the control variables, the results show heterogeneous inflation dynamics and distinct macroeconomic transmission mechanisms across income strata, with the inflation expectations channel showing significance mainly for the high-income group.

In summary, these results demonstrate that inflation in Brazil is structurally unequal, characterized by inertia and abrupt shocks for the poor, and more forward-looking behavior among the wealthy. Such statistical discrepancies translate into profound economic asymmetries: while high-income households can effectively hedge against inflation through forward-looking expectations, lower-income strata remain trapped by inertia and delayed policy responses. Therefore, our findings bridge the literature on consumption discrepancies with the broader debate on macroeconomic transmission lags. Ultimately, this evidence highlights the challenges of using the Headline IPCA as the only metric for economic policy, rendering it necessary for policymakers to adopt income-disaggregated indicators to prevent monetary policy from inadvertently exacerbating socioeconomic divides.

The remainder of this article is organized as follows: Section 2 reviews the literature and Section 3 details the data and inflation characteristics. Section 4 describes the econometric methodologies. Section 5 discusses the empirical findings and Section 6 concludes.

2 Literature

2.1 Post-Keynesian Theory of Inflation and Distributive Conflict

The post-Keynesian tradition treats inflation as a fundamentally distributional phenomenon. In *A Treatise on Money*, Keynes (1930) viewed inflation as a contest over the functional distribution of income between wages and profits, in which firms reclaim purchasing power through price increases when nominal wages rise. This anticipated the core of the conflict approach: inflation arises when the claims of workers and firms over output are mutually inconsistent at a stable price level. Kalecki (1971) formalised this logic through mark-up pricing, in which the price level reflects the balance of power between capital and labour rather than a purely monetary phenomenon.

The formal conflicting claims model of Rowthorn (1977) established that inflation is driven by an aspiration gap between the real wage workers target and the one firms concede, accelerating whenever these claims are incompatible at prevailing levels of capacity utilisation. In Brazil, this framework found its most influential expression in the inertial inflation theory of Bresser-Pereira and Nakano (1984), who identified accelerators, maintainers (distributive conflict and indexation), and sanctioners (monetary accommodation), showing that generalised indexation produced a self-reproducing dynamic in which past inflation was fully transmitted to current prices. Lavoie (2022) consolidates these strands into a unified approach in which expectations are not independent of past inflation, introducing a backward-looking inertial component incompatible with mainstream New Keynesian models. This is directly relevant here: higher and more unstable persistence among lower-income groups is consistent with the prediction that households with weaker bargaining power and greater exposure to essential goods are less able to protect their real incomes.

Recent contributions reinforce this view. Hein (2024) argues that post-Keynesian models centring distributional conflict between wages, profits, and import prices interpret the post-2022 inflation and profit surge better than supply-chain or demand-pull narratives, a perspective especially relevant for Brazil, where food and energy weigh heavily in lower-income baskets. Within a Kaleckian framework,

Rolim (2024) links income inequality and inflation to unemployment and the foreign sector, while Rolim and Marins (2024) show that exchange-rate-transmitted foreign price shocks asymmetrically burden lower-income households, resonating with the pass-through heterogeneity documented here.

2.2 Inflation Inequality: International and Brazilian Evidence

Inflation does not affect all segments of the population uniformly due to the starkly different structures of their consumption baskets. While low-income households are disproportionately exposed to price increases in essential goods with inelastic demand, wealthier families benefit from highly diversified spending patterns. This diversification acts as a natural hedge, allowing for consumption reallocation and providing an inherent buffer against shocks in specific price components. Such disparity leads to inflation inequality, which has profound implications for economic policy and for the distributive analysis of price shocks.

Michael (1979) and Hagemann (1982) showed that price indices vary across households and that the real impact of inflation on population subgroups is determined in part by changes in prices and in part by income variations, in the case of the U.S. These early empirical efforts provided the first quantitative evidence of inflation's distributive effects, though they relied on highly aggregated consumption categories.

With the subsequent advancement of household expenditure surveys and higher-frequency data collection, later studies validated these findings across broader time horizons. For instance, Hobijn and Lagakos (2005), using U.S. data from 1984 to 2004, confirm significant inflation variation across demographic groups, showing that low-income households and the elderly faced higher inflation levels due to a larger expense share of essential, volatile goods like fuel and healthcare. However, this household-specific inflation shows low persistence over time, reflecting idiosyncratic shocks. Analyzing the shopping behavior of approximately 50,000 U.S. households between 2004 and 2013, Kaplan and Schulhofer-Wohl (2017) also found massive heterogeneity in inflation rates. Their findings reinforce the regressive nature of the phenomenon, demonstrating that lower-income families consistently experience higher average inflation, even when controlling for income, age, and location.

Binder (2019) used data from the Standardized World Income Inequality Database to document a significant structural shift in the relationship between inflation and inequality. Analyzing a balanced panel of 35 countries and an unbalanced panel of 146 nations, the study demonstrates that while the correlation between inequality and the inflation tax was positive prior to 1999, it turned near-zero or negative in subsequent decades. The author argues that although rising inequality can intensify political pressure for inflationary financing, particularly within democratic regimes, central bank independence serves as a critical institutional mechanism to resist such pressures.

Lee (2022) used retail data to compare Black and White households in the U.S. (20042020). The author finds that the former experienced slightly higher and significantly more volatile inflation. Over two-thirds of this variance stems from a consumption basket disproportionately composed of goods with unstable prices. Berisha et al. (2023) examined whether the impact of inflation on inequality differs across various levels of income inequality in U.S. states, revealing that significant differences may exist, while Berisha et al. (2024) showed that inflation triggers rapid shifts in income distribution. Focusing on the Covid-19 crisis from 2020 to 2023, Cavallo (2024) analyzed the restructuring of U.S. consumption baskets and found that the substitution of services with essential goods resulted in sharper inflation increases for low-income families, thus widening inflation inequality. This is consistent with Chalise (2026), who investigated U.S. consumption data from 2013 to 2023 and presented evidence that accumulated inflation was significantly higher for low-income families, especially due to rising food prices.

Jaravel (2021) consolidates decades of empirical findings on the distributive effects of inflation. Focusing on the U.S. and covering the period 1990–2020, the author identifies four main vectors: (i) the development of new price indices capable of capturing the inflation experience of heterogeneous

groups; (ii) evidence that inflation systematically declines as household income increases; (iii) the crucial role of the direction of technological innovation in exacerbating inflation inequality, while international trade has more homogeneous effects; and (iv) the implications of this pattern for the formulation and evaluation of public policies, especially monetary and fiscal, and for understanding structural macroeconomic trends such as labor market polarization and declining real interest rates.

Beyond the American context, a robust body of literature investigates inflation inequality across Europe and many other regions. Gürer and Weichenrieder (2020), using European data from 2010 to 2019, identify episodes of pro-rich inflation, where price increases affected goods and services predominantly consumed by high-income families, indicating that inflation inequality can take different directions depending on the nature of the price shock. In a broader European study, Neyer and Stempel (2022) emphasize that monetary policy that considers only average inflation risks ignoring distributive differences essential for social justice and effective economic stabilization, advocating for the explicit incorporation of inflation heterogeneity in policy decisions to mitigate asymmetric impacts on different population segments.

Country-specific evidence within the Euro Area further clarifies these dynamics. Basso et al. (2022) analyze the Spanish case from 2006 to 2021, finding that higher inflation rates disproportionately affect lower-income, larger households, as well as those headed by older, less-educated males. Similarly, Messner and Rumler (2024) investigate the Austrian case and found a considerable and persistent degree of heterogeneity among household inflation rates, with factors such as age and shopping behavior explaining some of these differences. While income plays a secondary role during normal times, the lowest income group faces higher inflation rates during periods of high inflation. Looking at daily consumption at the household level across the Euro Area from 2009 to 2018, Strasser et al. (2023) document significant idiosyncratic inflation differences, noting that while low-income households experienced higher inflation, the disparity compared to higher-income groups remained small and subject to time-variation. More recently, Kiss and Strasser (2024), using Eurosystem data from 2017 to 2023, demonstrate that recent inflation shocks more severely affected households in lower-income brackets. Additional evidence on inflation inequality within the European Union is provided by Akarsu and Gharehgozli (2024) and Simionescu (2025).

Looking at broader scales, Lokshin et al. (2025) analyze the global cost-of-living crisis from 2022 to 2024, finding that inflationary impacts were deeper and more prolonged for low-income groups given their limited budgetary flexibility. Finally, Ndou (2024) extended this discussion to the South African case.

To date, there is no empirical application of either Unobserved-Components Stochastic Volatility Outlier-adjusted (UCSVO) or Time-Varying Parameter (TVP-Kalman) state-space models to analyze inflation by income group in Brazil. Nevertheless, the existing literature offers foundational insights into inflation inequality and structural modeling. Silva and Fonseca Neto (2011) examined the 19942010 period and identified a "pro-poor" inflation regime, characterized by systematically higher inflation rates for low-income households, particularly in less developed regions. This greater exposure to inflationary shocks, even during periods of relative macroeconomic stability, is driven by the disproportionate weight of food and essential services in the consumption baskets of these families.

Souza and Ferreira (2022) investigated inflation heterogeneity in Brazil from 2010 to 2020, focusing on how monetary policy shocks asymmetrically affect different income strata. Their findings revealed a significant inflation differential driven by the composition of consumption baskets and varying degrees of nominal rigidity across groups. Specifically, the authors documented that negative price shocks are more persistent for lower-income brackets, suggesting that downward price movements last longer for the poor. M. L. C. Ferreira and Souza (2023) used quantile regressions to analyze inflation persistence across different income levels in Brazil from 2006 to 2021. They found evidence that the official IPCA index fails to capture significant inflationary heterogeneity across income strata. Moreover, negative shocks exhibit asymmetric persistence, creating more intense, long-lasting impacts for lower-income groups and highlighting the need for policymakers to look beyond aggregate

metrics to protect vulnerable households.

Regarding the application of unobserved components frameworks, Costa Filho (2023) employed a trend-cycle model with stochastic volatility, following Chan et al. (2018), to estimate Brazilian trend inflation from 2002Q1 to 2022Q4. The author documented a sustained downward trajectory starting in 2017largely attributed to institutional changesand demonstrated that this trend remained resilient against the inflationary surge triggered by the COVID-19 pandemic. Turning to the multivariate extension, Tangza (2019) applied the MUCSVO model to analyze Brazil's headline CPI inflation from January 2000 to June 2019, showing that Brazilian trend inflation has become progressively less susceptible to idiosyncratic shocks over time.

In the domain of the application of the time-varying Phillips curve for Brazil, D. Ferreira and Palma (2015) estimated a generalized Phillips curve from 2003 to 2013 within a state-space framework via the Kalman filter. Their results reject standard short- and long-term Phillips curve relationships for Brazil, while providing evidence of a decreasing trend in short- and medium-term exchange rate pass-through during the sample period. Similarly, Boaretto and Gomes da Silva (2018) applied a TVP state-space model to evaluate headline and services inflation from January 2004 to February 2016. Their findings underscore the relevance of the TVP framework due to observed instabilities across several estimated parameters. Crucially, while the coefficient for inflation inertia remained systematically smaller than that of inflation expectations across all specifications, the backward-looking inertial component proved to be far from negligible.

Therefore, despite these advances in the literature on inflation inequality, this article provides distinct methodological and empirical contributions to the discussion. First, using an econometric technique that filters transitory and permanent volatility while simultaneously controlling for extreme events (outliers), we identify whether trend and volatility regimes are structurally distinct across Brazilian income groups. Second, by applying a Time-Varying Parameter Phillips Curve, we demonstrate that intrinsic inflation persistence is not constant but fluctuates dynamically over time for each group. Third, we provide evidence that macroeconomic transmission mechanisms, such as the output gap, exchange rate pass-through, and expectations, affect income brackets with different intensities and time lags.

3 Data

To achieve our goal of investigating inflation inequality across income strata in Brazil from July 2006 to April 2025 using a univariate methodology (UCSVO) and a multivariate technique (TVP-Phillips Curve), we consider the following variables:

- IPCA: National Consumer Price Index (monthly %, seasonally adjusted). Source: Brazilian Institute of Geography and Statistics (IBGE).
- IPCA by Income Group: Consumer Price Index by income group (Very Low, Low, Middle, High) (monthly %, seasonally adjusted). Source: Institute for Applied Economic Research (IPEA).
- IPCA Expectations: One-month-ahead expectations (seasonally adjusted). Source: Central Bank of Brazil (BCB).
- IBC-Br: Central Bank's Economic Activity Index logarithm, HP-filtered, seasonally adjusted). Source: BCB.
- REER: Real Effective Exchange Rate (logarithm, first difference, seasonally adjusted; 2020=100). Source: Bank for International Settlements (BIS).

The output gap is obtained by applying the Hodrick-Prescott filter to the log-level of the IBC-Br at the monthly frequency, using the standard smoothing parameter $\lambda = 14{,}400$ for monthly data. The

resulting cyclical component is stationary, as confirmed by the unit root tests reported in Table 1, and serves as a proxy for domestic demand pressures in the TVP Phillips Curve estimation. Additionally, our decision to employ one-month-ahead inflation expectations, rather than the standard 12-month-ahead horizon, ensures strict methodological and frequency alignment with our monthly inertia component ($\alpha_{1,t}$). This high-frequency approach avoids time-aggregation bias and effectively isolates short-term price dynamics from long-term base effects.

Our primary variable of interest is the disaggregated IPCA by income group, originally developed by Lameiras et al. (2017), methodologically updated by Lameiras et al. (2020), and updated to its current structure in Lameiras (2025). This inflation rate series is published monthly by the IPEA, which defines six distinct socioeconomic tiers based on specific economic thresholds: Very Low, Low, Lower-Middle, Middle, Upper-Middle, and High. However, our econometric analysis focuses on four of these groups, as the Lower-Middle and Upper-Middle tiers exhibit strong convergence with the core Middle group.

Table 1 presents the descriptive statistics for both the aggregate IPCA and the disaggregated income-specific inflation series, alongside the other macroeconomic variables in our system. The monthly average inflation for the very low-income group is 0.492%, which exceeds the aggregate IPCA average of 0.460%. This segment also faces higher volatility, with a standard deviation of 0.360% compared to 0.294% for the general index. The low-income cohort displays a similar pattern. The maximum monthly rates further underline the vulnerability of lower-income groups, peaking at 1.813% versus 1.478% for the headline IPCA. In contrast, the middle- and high-income groups record historical monthly averages closer to or slightly below the aggregate baseline (0.452% for both), accompanied by lower or comparable volatility.

Regarding the remaining macroeconomic variables, the data reveal important patterns about monetary policy anchoring and economic cycles. Inflation expectations average 0.399% per month, structurally below the realized inflation across all income strata (which ranges from 0.452% to 0.492%). This wedge suggests a historical tendency of market expectations to underestimate effective inflationary pressures. The IBC-Br cyclical component, our proxy for the output gap, exhibits a mean near zero (0.000%) with a standard deviation of 0.021%, accurately capturing the cyclical variations of Brazilian economic activity throughout expansions and contractions. Finally, the first difference of the Real Effective Exchange Rate (REER) presents a neutral mean (-0.001%) but highly volatile fluctuations (ranging from -0.149% to 0.094%), reflecting the significant exposure of the domestic economy to external currency shocks. Taken together, these metrics provide a robust control framework for estimating the time-varying structural relationships within the Phillips Curve.

Table 1: Descriptive Statistics (% per month)

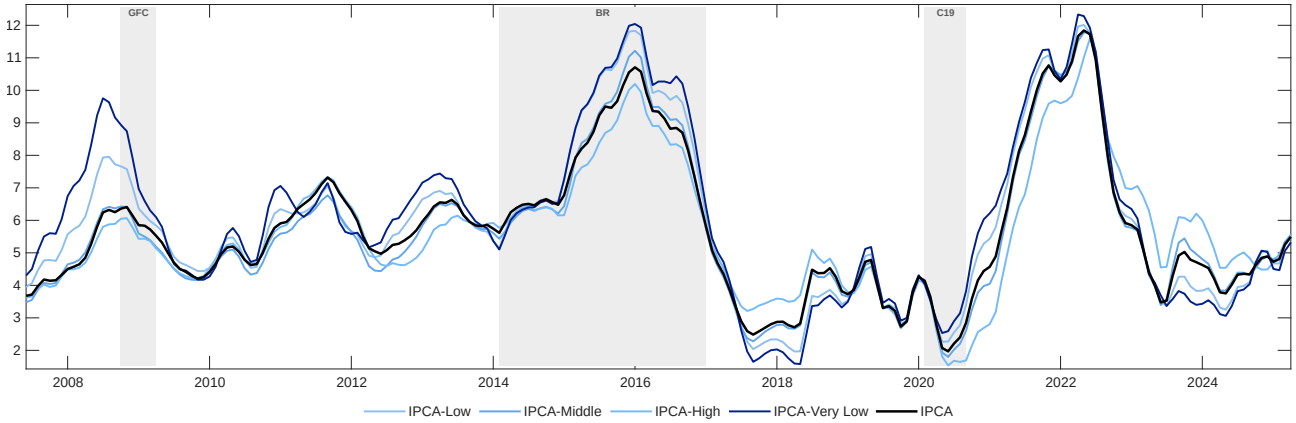
Variable / Stratum	Mean	Median	Max	Min	Std. Dev.
IPCA	0.460	0.421	1.478	-0.566	0.294
IPCA - Very Low	0.492	0.459	1.808	-0.218	0.360
IPCA - Low	0.476	0.450	1.813	-0.307	0.333
IPCA - Middle	0.452	0.410	1.586	-0.756	0.306
IPCA - High	0.452	0.423	1.277	-0.497	0.281
Inflation Expectations	0.399	0.399	1.074	-0.113	0.115
REER (Δe_t)	-0.001	0.001	0.094	-0.149	0.030
IBC-Br (y_t)	0.000	0.003	0.035	-0.138	0.021

Source: Prepared by the author based on IBGE and Lameiras (2025). Note: IPCA - Lower-Middle and IPCA - Upper-Middle are omitted from the econometric system due to high collinearity and statistical similarity with IPCA - Middle.

Figure 1 uncovers the underlying temporal patterns and helps evaluate the historical dynamics of inflation across income groups over time, by tracking the 12-month accumulated inflation across the analyzed strata. The shaded areas denote the recessions detected by the Brazilian Economic Cycle

Dating Committee (CODACE). The historical trajectories reveal distinct cyclical behaviors and structural vulnerabilities. The high-income group registered prominent peaks of 7.82% in April 2009 and 8.88% in September 2011, episodes heavily linked to demand-side shocks and exchange rate depreciation that disproportionately impacted durable goods and services. By contrast, the very low-income group faced much more severe inflationary spikes, reaching 9.84% in July 2008, 11.86% in December 2015, and peaking at 12.71% in April 2022. This heterogeneity highlights the distributive nature of inflation, which more severely affects lower-income strata, amplifying economic vulnerabilities through different supply and demand channels.

Figure 1: IPCA Inflation Dynamics Across Income Group (12-month cumulative %)



Source: IBGE and Lameiras (2025). Note: The curves present the heterogeneous inflationary trajectories for the headline IPCA and the specific income groups, ranging from very low income to high income.

4 Econometric Methodologies

4.1 Univariate Analysis: The UCSVO Model

The Unobserved-Components Stochastic Volatility Outlier-adjusted (UCSVO) model, developed by Stock and Watson (2007) and extended by Stock and Watson (2016), decomposes the inflation rate into permanent and transitory components, where innovations are explicitly adjusted for extreme events (outliers). This framework offers distinct advantages over traditional statistical filters. Unlike rigid methods such as the Hodrick-Prescott (HP) filter, which fail to capture structural breaks, the UCSVO model incorporates time-varying factor loadings and stochastic volatility. This flexible architecture allows the model to accommodate structural shifts in both the persistence and specific volatility of localized inflation series.

Another key strength of the UCSVO framework is its capacity to let the data endogenously determine whether an economic shock permanently shifts the inflation trend or merely represents a high-volatility transitory disturbance, while simultaneously controlling for extreme outliers that would otherwise distort variance estimations. This feature is particularly crucial for emerging economies like Brazil, where low-income consumer baskets are highly vulnerable to frequent food and energy supply shocks.

In this study, the model is estimated for the national headline IPCA ($R = 1$) and for four of the six income groups considered by IPEA ($R = 2, \ldots, 5$). This approach enables a granular investigation into the heterogeneous inflationary dynamics affecting different social groups. The UCSVO model is formalized by the following system of equations:

$$\pi_t^R = \tau_t^R + \varepsilon_t^R \tag{1}$$

$$\tau_t^R = \tau_{t-1}^R + \sigma_{\Delta\tau_t^R} \cdot \eta_{\tau,t}^R \tag{2}$$

$$\varepsilon_t^R = \sigma_{\varepsilon_t^R} \cdot s_t^R \cdot \eta_{\varepsilon,t}^R \tag{3}$$

$$\Delta \ln\left(\sigma_{\varepsilon_t^R}^2\right) = \gamma_\varepsilon^R \cdot v_{\varepsilon,t}^R \tag{4}$$

$$\Delta \ln\left(\sigma_{\Delta\tau_t^R}^2\right) = \gamma_{\Delta\tau}^R \cdot v_{\Delta\tau,t}^R \tag{5}$$

where π_t^R represents the observed inflation at time t for income group R, τ_t^R is the permanent (or trend) component, and ε_t^R is the transitory component. Equation (1) performs the structural decomposition of inflation. Equation (2) models the trend as a random walk with stochastic volatility $\sigma_{\Delta\tau_t^R}$, subject to the idiosyncratic shock $\eta_{\tau,t}^R$. From an economic standpoint, τ_t^R captures the long-run inflation anchor and structural price rigidities unique to each income cohort, reflecting permanent structural shifts such as policy changes or long-term agricultural regime shifts.

Equation (3) models the transitory component with an adjustment for extreme events through the scale factor s_t^R, which takes the value 1 with probability $(1-p)$ and uniformly distributed values in the interval $[2,10]$ with probability p, allowing for the identification of inflationary *outliers*. In practice, this formulation provides a crucial economic advantage for analyzing emerging markets like Brazil. It ensures that short-lived supply-side shocks, such as seasonal food shortages or energy tariff flags, are isolated as transitory outliers (ε_t^R) rather than being mathematically misabsorbed into the permanent core trend (τ_t^R). Equations (4) and (5) represent stochastic processes for the logarithmic evolution of the volatilities of the transitory component and the trend, respectively. The shocks $\eta_{\varepsilon,t}^R$, $\eta_{\tau,t}^R$, $v_{\varepsilon,t}^R$, and $v_{\Delta\tau,t}^R$ are independent and identically distributed idiosyncratic noises following a standard normal distribution $N(0,1)$. The joint variance-covariance matrix of these terms is assumed to be an identity matrix I_4, as specified in Stock and Watson (2016).

The UCSVO model contains only three primary parameters: γ_ε and $\gamma_{\Delta\tau}$, which are related to the innovations in the stochastic volatility process (Equations 4 and 5), and p, which represents the prior probability of outliers (Equation 3). A Bayesian approach is used in the UCSVO model estimations following the standard empirical literature (Stock & Watson, 2016). Priors are necessary for the stochastic volatility parameters γ_ε and $\gamma_{\Delta\tau}$, for the outlier probability p, and for the initial values τ_0, $\ln(\sigma_{\varepsilon,0})$, and $\ln(\sigma_{\Delta\tau,0})$. To ensure the framework is tightly motivated and standardized, the independent uniform priors for γ_ε and $\gamma_{\Delta\tau}$ are defined on the interval $[0,0.2]$, reflecting the smooth evolution of macroeconomic volatility.

The prior for the outlier probability p follows a $Beta(\alpha = 0.025, \beta = 0.975)$ distribution. Crucially, this specific hyperparameter setting serves as a conservative baseline prior, mathematically calibrated to represent an initial structural expectation of one extreme outlier every four years ($p = 2.5\%$). This conservative anchor prevents the algorithm from misidentifying standard transitory variance as extreme anomalies. However, because the Bayesian framework allows the posterior distribution to be endogenously driven by empirical data, the model remains fully flexible to capture a significantly higher real frequency of outliers. This structural adaptability is essential for emerging economies like Brazil, where actual price disruptions occur far more frequently than in developed markets. Finally, the priors for the initial values τ_0, $\ln(\sigma_{\varepsilon,0})$, and $\ln(\sigma_{\Delta\tau,0})$ are independent diffuse normal distributions with a mean of zero and a large variance, represented by $N(0,100)$, ensuring that initial conditions exert no distorting influence on the posterior estimates.

The model estimation is performed using Bayesian methods, specifically Markov Chain Monte Carlo (MCMC) techniques, which allows for robust inference about inflation decomposition and the identification of stochastic volatility over time for each income group. This structure provides valuable empirical evidence on the persistence, dispersion, and occurrence of atypical shocks in inflation between different socioeconomic groups in Brazil. To achieve this, a Gibbs sampling algorithm is implemented to sequentially draw the unobserved states and hyperparameters following the founda-

tional framework of Stock and Watson (2016). The MCMC protocol is executed with a total of 50,000 iterations, where the first 10,000 draws are discarded as a burn-in period to eliminate the influence of initial values. To mitigate serial autocorrelation among consecutive draws, a thinning interval of 10 is applied to the remaining iterations, yielding 4,000 independent posterior samples for statistical inference.

Despite these advantages, the univariate UCSVO framework evaluates each inflation series in isolation, omitting structural macroeconomic interactions such as supply-demand dynamics or exchange rate transmissions. To overcome this dimensional constraint, a natural statistical extension is the Multivariate (MUCSVO) model proposed by Stock and Watson (2016), which decomposes a panel of sectoral inflation rates into common and idiosyncratic permanent and transitory components. The multivariate setup incorporates time-varying factor loadings, isolating widespread trends from localized, sector-specific noise without requiring structural or causal assumptions. Nevertheless, the choice of the UCSVO model remains fully justified for this study, given that the inflation dataset released by IPEA does not provide the fully disaggregated sectoral series alongside their respective time-varying weights required by the MUCSVO. Consequently, the UCSVO serves as a highly efficient and robust alternative, successfully isolating core inflation trends and clarifying the specific socioeconomic dynamics under evaluation.

4.2 Multivariate Analysis: Time-Varying Parameter Phillips Curve

The univariate analysis outlined above captures the isolated trend, volatility, and specific outlier dynamics of income-specific inflation. Through the trend analysis, it is possible to investigate whether a given inflation rate persistently deviates above or below its specific trend or the headline inflation trend. However, this framework cannot capture intrinsic inflation persistence, the inertia originating from past inflation, and it lacks the macroeconomic interactions driving these processes. To bridge this gap, we implement a multivariate framework to evaluate how structural transmission mechanisms differ across socioeconomic strata. The hybrid specification draws on the New Keynesian Phillips Curve literature (Blanchard & Galí, 2007; Galí & Gertler, 1999; Galí et al., 2001), which shows that the coexistence of forward-looking and backward-looking price-setters generates both inertial and expectational dynamics. The time-varying parameters are estimated following Hall et al. (2009). An Augmented Hybrid New Keynesian Phillips Curve (NKPC) is specified as follows:

$$\pi_t^R = \alpha_{0,t} + \alpha_{1,t}\pi_{t-1}^R + \alpha_{2,t}E_t\pi_{t+1} + \alpha_{3,t}\Delta e_{t-4} + \alpha_{4,t}y_t + \varepsilon_t, \quad R = 1,\ldots,5, \tag{6}$$

where π_t^R represents the inflation rate for the headline IPCA ($R = 1$) and across the four specific income groups ($R = 2,\ldots,5$); $\alpha_{0,t}$ is the time-varying intercept; $\alpha_{1,t}$ captures inflation persistence (inertia); $\alpha_{2,t}$ measures the impact of inflation expectations; $\alpha_{3,t}$ is the coefficient related to the real effective exchange rate; $\alpha_{4,t}$ measures the impact of the output gap (y_t) on inflation; and ε_t is the error term.

From an economic and practical standpoint, allowing these parameters to fluctuate over time is essential for capturing structural shifts in the Brazilian economy, such as changes in monetary policy credibility, trade openness, and consumer behavior. For instance, the relative weight between inertia ($\alpha_{1,t}$) and expectations ($\alpha_{2,t}$) offers a direct metric of central bank anchoring across social classes. Lower-income strata, facing tighter budget constraints and limited financial literacy, are expected to exhibit a higher reliance on backward-looking indexation ($\alpha_{1,t}$). Conversely, wealthier households, with greater access to financial hedges, are likely more responsive to forward-looking policy signals ($\alpha_{2,t}$). Similarly, the output gap coefficient ($\alpha_{4,t}$) evaluates whether demand-driven monetary policy operates with the same intensity and lag across different segments of the population. Complementing these market dynamics, the four-month lag applied to the exchange rate (Δe_{t-4}) is structurally motivated by the empirical literature on emerging markets, reflecting the average time lag required for international supply-chain shocks and cost-push currency variations to effectively propagate into

domestic retail consumer prices.

A limitation of applying the standard Kalman filter directly to the Phillips curve is its assumption of regressor exogeneity, leaving the framework vulnerable to endogeneity bias. While using lagged variables (π^R_{t-1} and Δe_{t-4}) eliminates feedback from past shocks, contemporaneous regressors, specifically inflation expectations ($E_t\pi_{t+1}$) and the output gap (y_t), are determined simultaneously with current inflation. To overcome this constraint and avoid arbitrary or overly diffuse priors that could lead to unstable algorithmic paths, we follow Boaretto and Gomes da Silva (2018) and implement a two-stage estimation strategy that bridges frequentist robustness with adaptive state-space filtering (Elliott & Timmermann, 2008; Hamilton, 1994). In the first stage, a time-invariant version of Equation (6) is estimated via the Generalized Method of Moments (GMM) for each income group. This initial step addresses simultaneous endogeneity and residual autocorrelation through instrument orthogonality, verified via the Hansen J-test. The resulting GMM unbiased baseline parameters are then used to calibrate the initial state vectors and hyper-parameters. This initialization reduces the sensitivity of the Kalman filter to arbitrary prior choices, ensuring numerical stability and faster convergence toward the true parameter trajectory from the very first periods (Harvey, 1989; Kim & Nelson, 1999).

5 Empirical Findings

5.1 Preliminary Diagnostics: Unit Root and GMM Testing

Before presenting and discussing the empirical findings from our univariate and multivariate estimations, it is essential to establish the integration order of the time series under analysis. Evaluating the stationarity of these variables at level, or $I(0)$, is a crucial prerequisite to ensure the validity and robustness of the subsequent econometric modeling, preventing issues related to spurious regressions.

To achieve this, comprehensive unit root and stationarity tests were conducted, including the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Augmented Dickey-Fuller Generalized Least Squares (ADF-GLS), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. Additionally, the Zivot and Andrews (ZA) unit root test was implemented, which incorporates an endogenous structural break component to ensure that potential parameter shifts do not distort the stationarity inference (Zivot & Andrews, 1992). The complete results for all analyzed series are presented in Table 1. The tests systematically confirm that all analyzed time series are stationary at level, or $I(0)$, validating their suitability for subsequent econometric analysis.

The endogenously identified structural breaks in Table 2 align closely with major macroeconomic shifts in the Brazilian economy. For the IPCA income groups, the structural breaks are concentrated between August and September 2016, a period marked by a severe stagflationary environment characterized by high inflationary pressures and a deep economic recession. The 12-month accumulated IPCA inflation reached 8.97% in August, far exceeding the official 6.5% ceiling. These figures were driven by strong cost-push shocks, including the delayed pass-through effects of currency depreciation, the readjustment of previously regulated administered prices (such as energy and fuel), and climate-induced food supply disturbances. Regarding economic activity, the country's GDP experienced a sharp contraction, leading to an annual decline of 3.3% for 2016. In contrast, the breaks for the real exchange rate (Δe_t) and economic activity (y_t) are strictly clustered around the first half of 2020, capturing the unprecedented global and domestic supply-demand disruptions triggered by the onset of the COVID-19 pandemic.

Given the intrinsic flexibility of the econometric frameworks adopted in this study, explicit dummy variables for structural breaks were purposefully omitted from the core estimations. Both the UCSVO model and the TVP Phillips Curve inherently accommodate continuous shifts in long-run trends, conditional volatility, and parameter evolution over time. By modeling coefficients and variance processes as stochastic latent states, these methodologies endogenously absorb both abrupt macroeconomic shocks and smooth, gradual adjustments. Consequently, this approach circumvents the need

for ad hoc exogenous dummy placement.

Prior to estimation, the stationarity of all series entering the TVP Phillips Curve was assessed through a battery of unit root and stationarity tests. Table 2 reports results for the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), ADF-GLS, and KPSS tests, complemented by the Zivot-Andrews (ZA) test (Zivot & Andrews, 1992), which endogenously identifies a single structural break in the deterministic components. All series are stationary at level, $I(0)$. The ZA-identified breaks for the income-specific IPCA series cluster around 2016M08–2016M09, corresponding to the peak of Brazil's stagflationary episode, while the exchange rate and economic activity breaks are concentrated in early 2020, reflecting the onset of the COVID-19 pandemic.

Table 2: Unit Root Tests

Variables	**ADF**	**PP**	**ADF-GLS**	**KPSS**	**Zivot-Andrews (ZA)**	
	Stat.-t	Stat.-t	Stat.-t	Stat.-LM	Stat.-t	Break Date
IPCA	-8.29^{*}	-6.85^{*}	-8.32^{*}	0.09	-9.03^{*}	2016:09
IPCA-Very Low	-8.72^{*}	-4.73^{*}	-8.75^{*}	0.10	-9.46^{*}	2016:08
IPCA-Low	-8.65^{*}	-4.74^{*}	-8.75^{*}	0.08	-7.51^{*}	2016:08
IPCA-Middle	-8.42^{*}	-4.95^{*}	-8.44^{*}	0.08	-9.17^{*}	2016:08
IPCA-High	-8.70^{*}	-7.12^{*}	-8.76^{*}	0.10	-9.47^{*}	2016:09
Inf. Expectations	-3.39^{*}	-3.33^{*}	-8.64^{*}	0.19	-4.85^{*}	2017:03
Real Exch. Rate (Δe_t)	-11.58^{*}	-2.25^{*}	-11.53^{*}	0.17	-11.87^{*}	2020:06
Econ. Activity (y_t)	-6.05^{*}	-5.21^{*}	-5.06^{*}	0.03	-6.26^{*}	2020:03

Note: * indicates rejection of the null hypothesis at 5%. ADF, PP, ADF-GLS: H_0 = unit root; KPSS: H_0 = stationary; ZA: H_0 = unit root with one endogenous structural break (Zivot & Andrews, 1992). ZA critical value at 5%: -4.80.

Table 3 presents the baseline GMM estimations for the hybrid Phillips curves in the aggregate IPCA and the four income strata analyzed, with the Hansen J-test systematically confirming the validity of the instrument. Inflation persistence (π_{t-1}) is statistically significant in all specifications, ranging from 0.284 for the middle-income group to 0.397 for the headline IPCA. This variation provides the initial empirical evidence of structural disparities in macroeconomic inertia across different income levels. In contrast, IPCA inflation expectations ($E_t\pi_{t+1}$) are statistically significant in only 2 out of the 5 estimations, suggesting a potentially weaker anchoring mechanism for lower-income strata over the full sample. Furthermore, while the exchange rate pass-through coefficient (Δe_{t-4}) is highly significant in all income strata, the estimated output gap parameter (y_t) does not achieve statistical significance in any baseline specification.

To formalize this dynamic behavior, state-space modeling via Kalman filter estimations is utilized to generate Time-Varying Parameters (TVPs) for each income group's hybrid Phillips Curve. Operationally, the point estimates and standard errors extracted from an initial Generalized Method of Moments (GMM) approach, implemented under strict instrument endogeneity controls (Table 3), are used to calibrate the initial state vector, its variance bounds, and the robust prior distributions required to initialize the state-space equations.

Table 3: GMM Estimates by Income Strata

Dependent	Independent Variables (coefficients and SE)					J Stat
Variables	Intercept	π_{t-1}	$E_t\pi_{t+1}$	Δe_{t-4}	y_t	(p-value)
IPCA	-0.263	0.397*	1.354*	-1.644*	-0.123	6.227
	(0.207)	(0.091)	(0.581)	(0.613)	(1.353)	(0.514)
IPCA-Very Low	-0.150	0.382*	1.129	-2.044*	1.809	2.118
	(0.351)	(0.085)	(0.947)	(0.644)	(1.168)	(0.548)
IPCA-Low	-0.371	0.305*	1.749	-2.056*	1.829	2.114
	(0.369)	(0.098)	(1.013)	(0.699)	(1.330)	(0.549)
IPCA-Middle	-0.422	0.284*	1.862	-1.892*	1.735	2.014
	(0.457)	(0.139)	(1.281)	(0.717)	(1.315)	(0.570)
IPCA-High	0.083	0.378*	0.494*	-0.965*	1.127	1.896
	(0.072)	(0.076)	(0.193)	(0.414)	(0.801)	(0.863)

Note: * indicates statistical significance at 5%. H_0 (J Test): valid instruments. For the exchange rate: an increase denotes appreciation, and vice-versa. GMM equations estimated without imposing the long-run neutrality restriction.

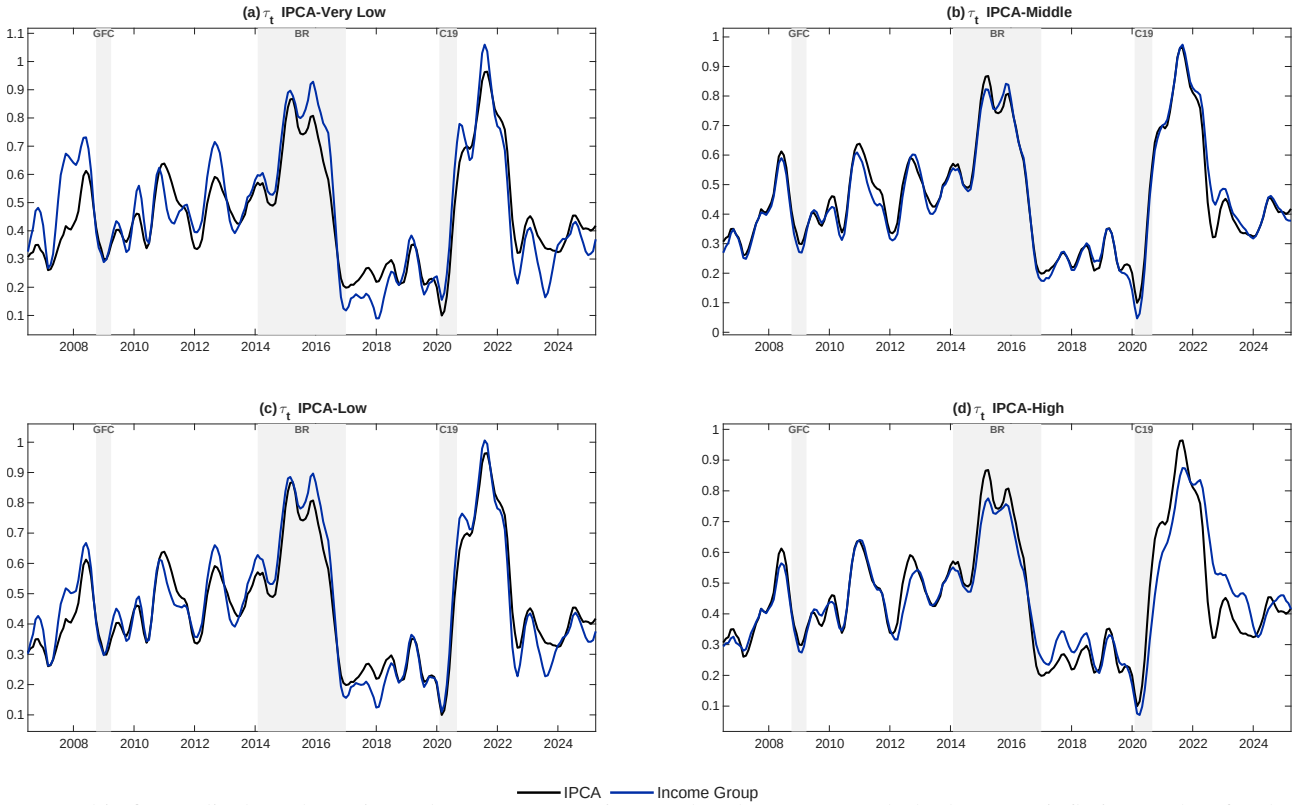
5.2 The UCSVO Estimation Results

First, we employ the univariate UCSVO model to analyze the evolution of trend inflation, permanent/transitory volatilities, and outliers across different Brazilian household income groups. Figure 2 plots the full-sample posterior means for trend inflation, comparing each income-specific rate against the headline IPCA. In terms of dynamics, all inflation trends in Figure 2 followed an upward trajectory from 2006 until late 2015. This period was characterized by the abandonment of the Macroeconomic Tripod (inflation targeting, fiscal surplus targets, and a floating exchange rate) in favor of the New Economic Matrix, which was marked by interventionist policies. The ensuing economic and political turbulence culminated in the Great Brazilian Recession. Following this crisis, the inflation trend steadily declined until the onset of the COVID-19 pandemic (Fishlow & Gomes da Silva, 2021).

Panels (2a) and (2c) indicate that, compared to the headline IPCA, the inflation trend is persistently higher for the very low and low income groups throughout the sample. Conversely, the trend inflation rates for the middle and high income groups (Panels 2b and 2d) follow a trajectory closer to the headline IPCA trend.

Several macroeconomic factors explain these divergent trends. Lower-income households are highly vulnerable to price increases in essential goods, such as food and utilities. In contrast, higher-income groups allocate a larger share of their budget to items with higher price elasticity that are less susceptible to global shocks. Wealthier households also possess greater financial flexibility to substitute consumption patterns, avoiding direct hits to their overall welfare, and have substantial access to financial instruments that provide real returns, neutralizing the eroding effect of inflation on their purchasing power. To formally validate whether these differences in trend inflation levels are statistically significant beyond descriptive inspection, we apply the non-parametric Friedman test for repeated measures (Friedman, 1937) to the UCSVO-estimated trend series ($\hat{\tau}_t$). Unlike conventional ANOVA or Kruskal-Wallis tests, which treat each monthly observation as an independent draw and thereby conflate cross-sectional inequality with within-group macroeconomic volatility, the Friedman test blocks the temporal dimension by comparing income groups period by period, effectively isolating the between-group signal from the aggregate shocks common to all strata. The results strongly reject the null hypothesis of equal rank distributions across the four main income groups ($\chi^2(3) = 17.02$, $p = 0.0007$), confirming that the observed heterogeneity in trend inflation is statistically robust..

Figure 2: UCSVO Posterior Means: Inflation Trend (τ_t) by Income Group



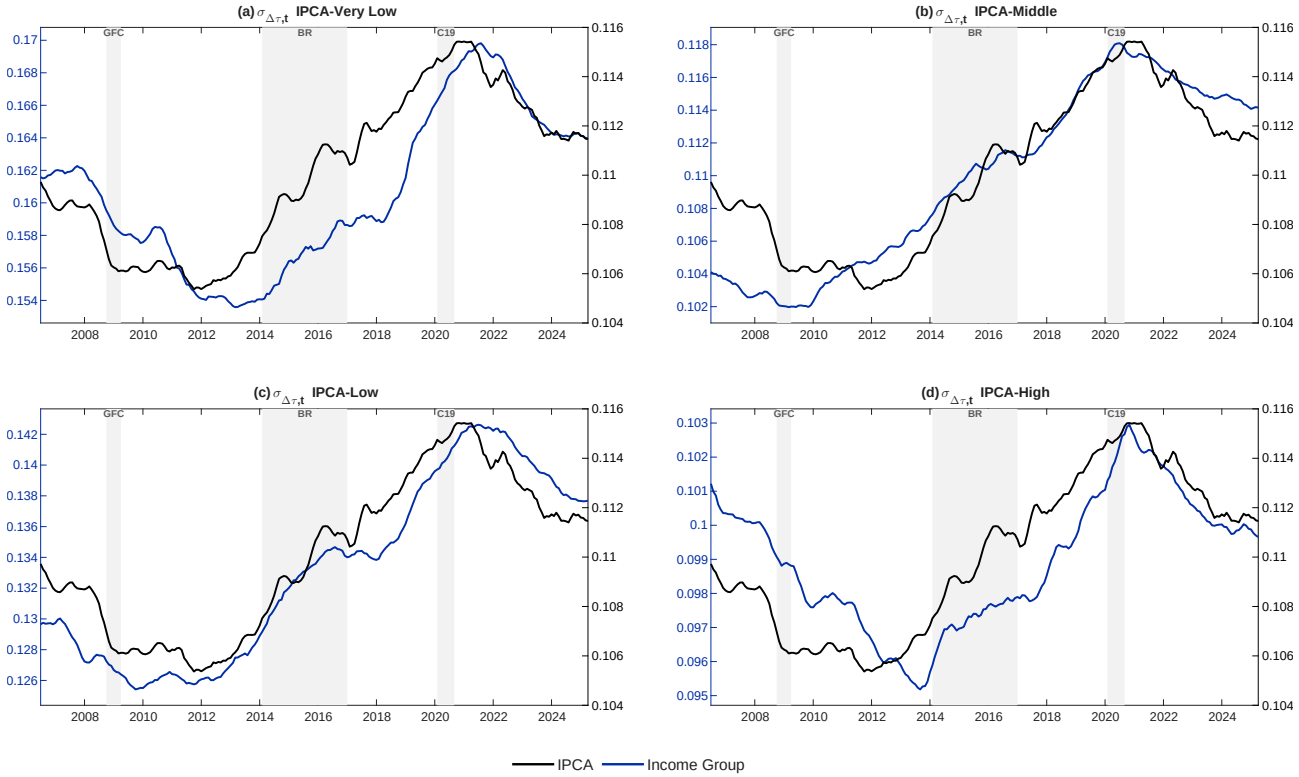
Note: This figure displays the estimated UCSVO posterior trends. The curves track the long-run inflation anchor for the headline IPCA ($R = 1$) and the four income cohorts ($R = 2$ to $R = 5$).

Figure 3 depicts the full-sample posterior means of the permanent volatility component, which plays a critical role in driving the long-run inflation trend. In the Brazilian context, all income groups share a broadly synchronized U-shaped trajectory, characterized by a steady decline from 2006 until mid-2011, a subsequent upward path leading into the COVID-19 pandemic, and a final downward correction thereafter.

However, a significant heterogeneity emerges when analyzing the magnitudes of these series. Although the headline IPCA permanent volatility reaches a maximum peak of 0.116, the very low-income group peaks at 0.170, followed closely by the low-income group at 0.142. Conversely, the middle and high-income groups register substantially lower maximum permanent volatilities of about 0.118 and 0.103, respectively. This hierarchy explains why the inflation trend of the middle-income group closely mirrors the national benchmark, as their variance magnitudes are nearly identical. More importantly, it reveals why the very low and low-income groups exhibit inflation trends that sit persistently and substantially above the headline IPCA, while the high-income group remains well below it.

From a welfare perspective, these percentage-based inflation differences represent the correct metric for assessing economic inequality, as they directly capture the erosion of purchasing power relative to each group's total budget constraint. Lower-income households are structurally exposed to much larger permanent inflationary shocks that fundamentally alter their price trajectory. Because these poorer segments live closer to subsistence levels and have a significantly higher marginal utility of income, a higher percentage inflation rate directly translates into a severe welfare loss, consuming a disproportionate share of their nominal budget. This asymmetric transmission mechanism demonstrates that inflation does not affect the population uniformly, placing a disproportionate and structural burden on the purchasing power of poorer families over the long run.

Figure 3: UCSVO Posterior Means - Permanent Volatility ($\sigma_{\Delta\tau,t}$) by Income Group

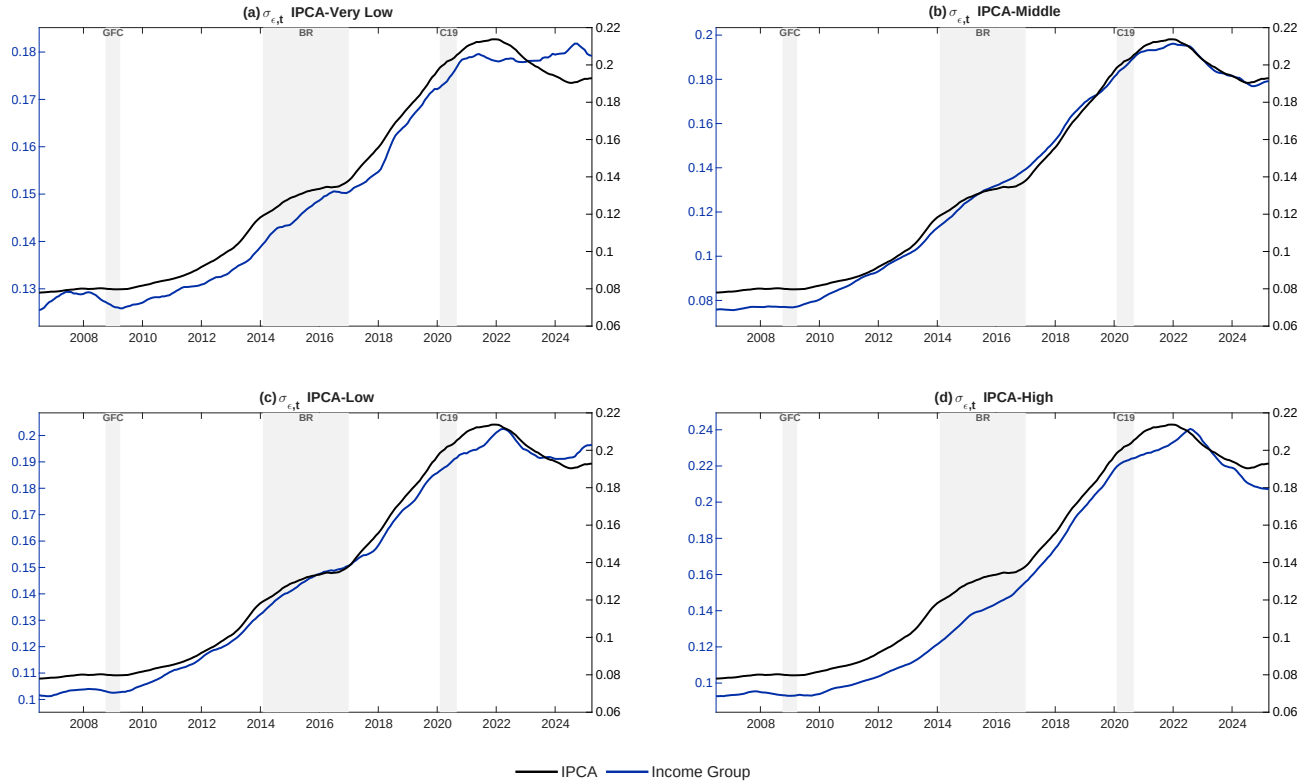


Note: This figure displays the estimated UCSVO posterior permanent volatilities ($\sigma_{\Delta\tau_t^R}$). The curves track the structural variance of the inflation trend for the headline IPCA and the four income cohorts.

Figure 4 depicts the transitory shock volatility dynamics across different Brazilian household income groups. All groups follow a broadly coherent trajectory, culminating in unprecedented volatility increases during the COVID-19 pandemic, where the headline IPCA peaked at approximately 0.22. Mirroring the permanent volatility pattern, the middle-income group aligns strictly with the headline benchmark throughout the sample. However, a contrast emerges at the opposing ends of the income distribution: the very low and low-income groups registered lower pandemic peaks of around 0.18 and 0.20, respectively, whereas the high-income group experienced the sharpest surge, peaking at almost 0.24.

Regarding the post-pandemic recovery phase, a key distinction lies in the speed of convergence toward pre-crisis volatility levels. For the high-income group, transitory volatility decreased rapidly after the initial pandemic shock. This behavior stems from their larger budgetary allocation to goods and services heavily exposed to global conditions, such as supply chain bottlenecks and international commodity shocks; as these global markets gradually adjusted, transitory volatility for this wealthier demographic collapsed. Conversely, the very low and low-income groups did not exhibit similar convergence. Their transitory volatilities remained elevated, indicating that poorer households continue to endure persistent, highly volatile short-term price disruptions. This reflects the sticky and localized nature of domestic inflationary pressures on essential goods, such as food and basic utilities. Ultimately, this asymmetric post-crisis stabilization highlights that even under transitory shocks, lower-income families face prolonged periods of price instability, fundamentally compounding their overall economic vulnerability (Figure 4).

Figure 4: UCSVO Posterior Means - Transitory Volatility ($\sigma_{\varepsilon,t}$) by Income Group



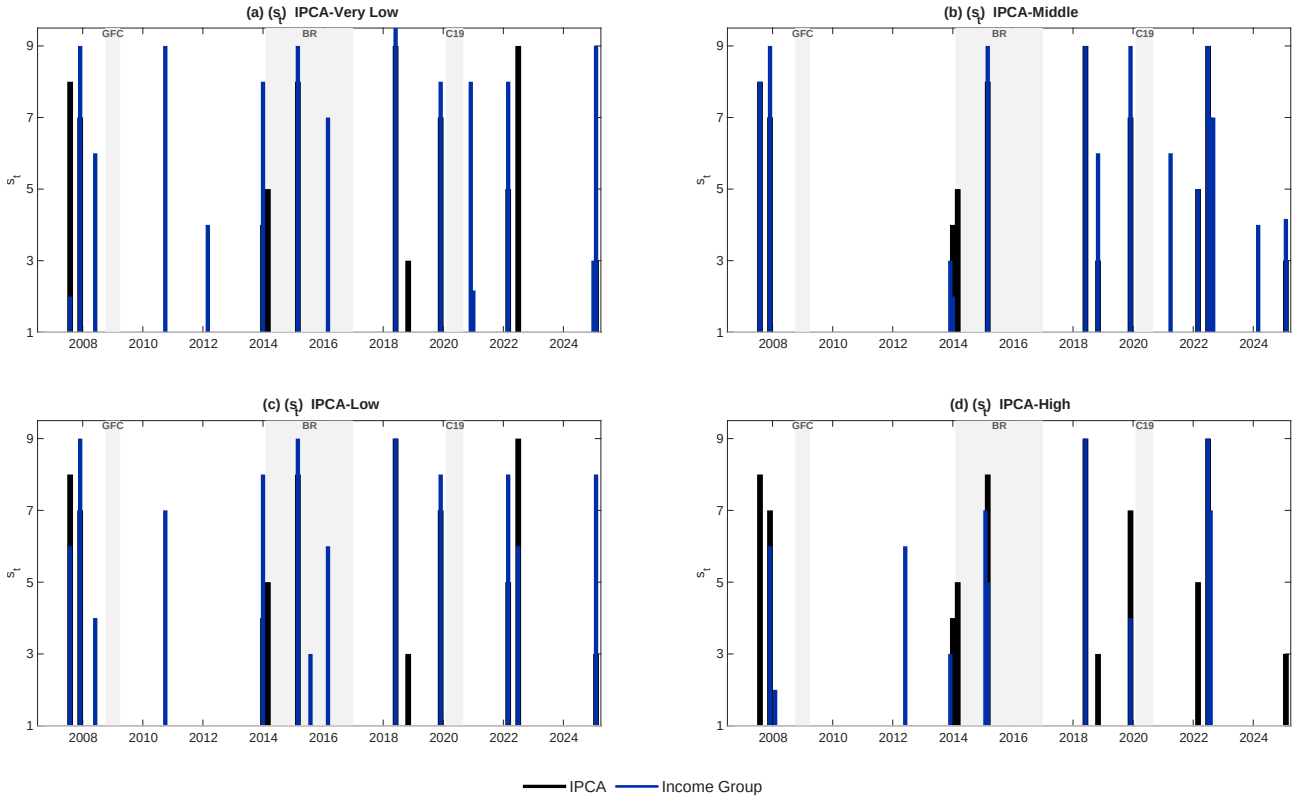
Note: This figure displays the estimated UCSVO posterior transitory volatilities ($\sigma_{\hat{\varepsilon}_t^R}$). The curves track the short-run variance of the inflation shocks for the headline IPCA and the four income cohorts.

Figure 5 reveals a considerable asymmetry in both frequency and intensity of the estimated outliers across income groups. The headline IPCA registers only 4 visible outliers throughout the entire sample, each mapped to major macroeconomic disruptions: the 2008 global financial crisis, the onset of the Great Brazilian Recession in 2014, the 2018 truck drivers' strike alongside administered price realignments, and the lingering supply chain disruptions of 2022.

However, a substantial discrepancy emerges when examining the detected outliers for each specific income level. The very low, low, and middle-income groups registered more than 10 outliers over the same period. In sharp contrast, the high-income group experienced far fewer anomalies, totaling approximately 6. This distribution confirms that lower-income households and the middle class are subjected to nearly double or triple the frequency of extreme price shocks compared to wealthier families.

The underlying structural and macroeconomic mechanisms driving these discrepancies in outlier frequency align with the consumption basket rigidities previously detailed in this study. Because less affluent households allocate a significantly higher portion of their income to non-discretionary items, they are systematically exposed to localized, high-magnitude supply disruptions that often wash out when aggregated into the national index. Ultimately, these findings corroborate the regressive nature of Brazilian inflation, proving that it penalizes vulnerable households not only through permanently higher trends but also through a higher concentration of unpredictable price anomalies.

Figure 5: UCSVO Posterior Means - Outliers (s_t) by Income Strata



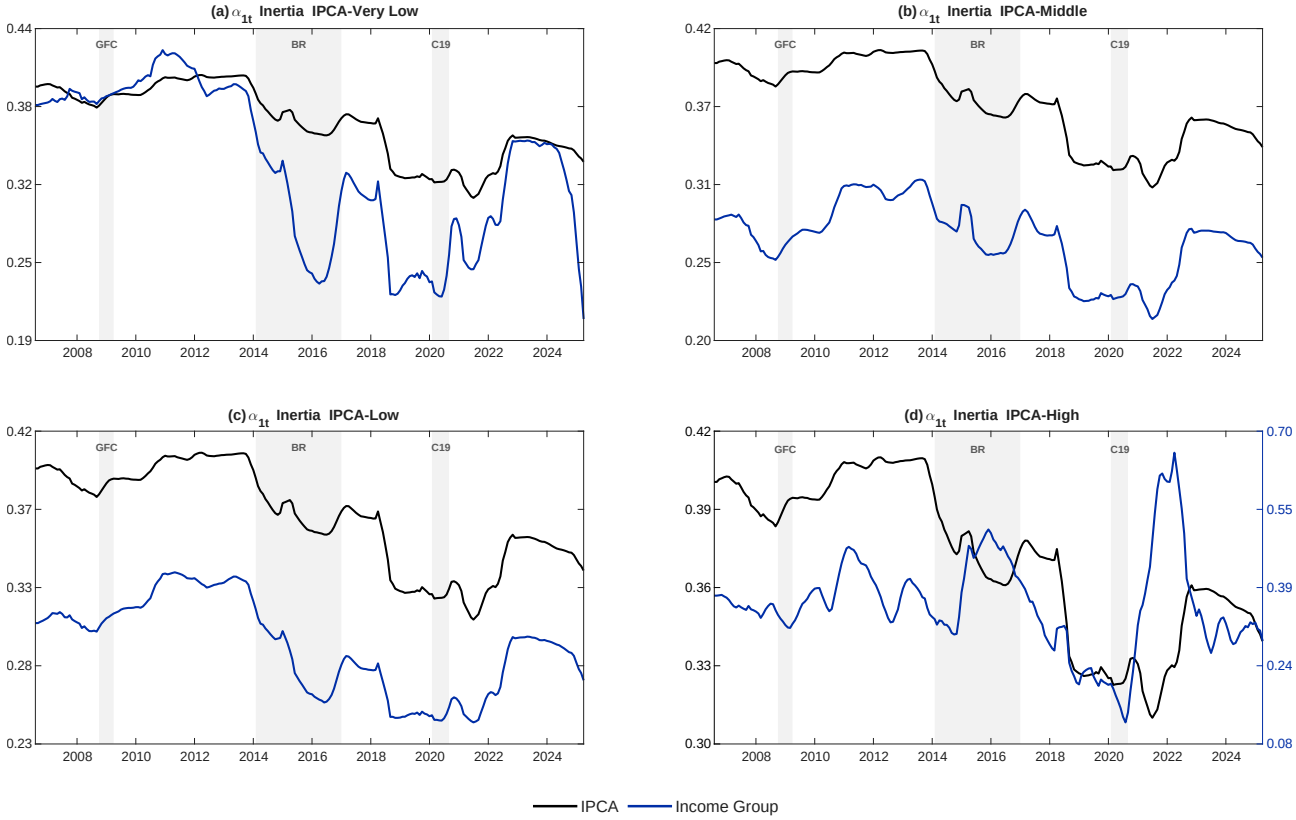
Note: This figure displays the estimated UCSVO posterior inflation outliers. The curves track the identified short-lived extreme supply-side shocks for the headline IPCA and the four income cohorts.

These findings are broadly consistent with the Brazilian literature on inflation inequality. Silva and Fonseca Neto (2011) documented a pro-poor inflation regime for the 1994-2010 period, showing that lower-income households faced systematically higher inflation rates due to the disproportionate weight of food and essential services in their consumption baskets. Souza and Ferreira (2022) extended this evidence to 2010-2020, finding that inflation differentials across income strata are driven by heterogeneous consumption basket composition and varying degrees of nominal rigidity, with negative price shocks being more persistent for lower-income brackets. M. L. C. Ferreira and Souza (2023) used quantile regressions and confirmed that the official IPCA fails to capture inflationary heterogeneity across income strata, reinforcing the need for disaggregated analysis. The present study advances this literature by providing, for the first time, a structural decomposition of trend, volatility, and outliers by income group using the UCSVO framework, which separates permanent from transitory shocks while explicitly controlling for extreme events.

5.3 The TVP Results: Time-Varying Parameter Phillips Curve

The Time-Varying Parameter Phillips Curve results are presented in Figure 6. The primary objective of estimating the TVP Phillips Curve is to isolate and analyze the continuous evolution of intrinsic inflation persistence, namely, the underlying macroeconomic inertia across different income strata. Regarding the headline IPCA, Panel 6a reveals that its inertia ($\pi_{1,t}$) fluctuates within a relatively bounded range between 0.31 and 0.41, remaining statistically significant throughout the sample.

Figure 6: Time-Varying Parameter Phillips Curve: Inertia (α_{1t}) by Income Strata.



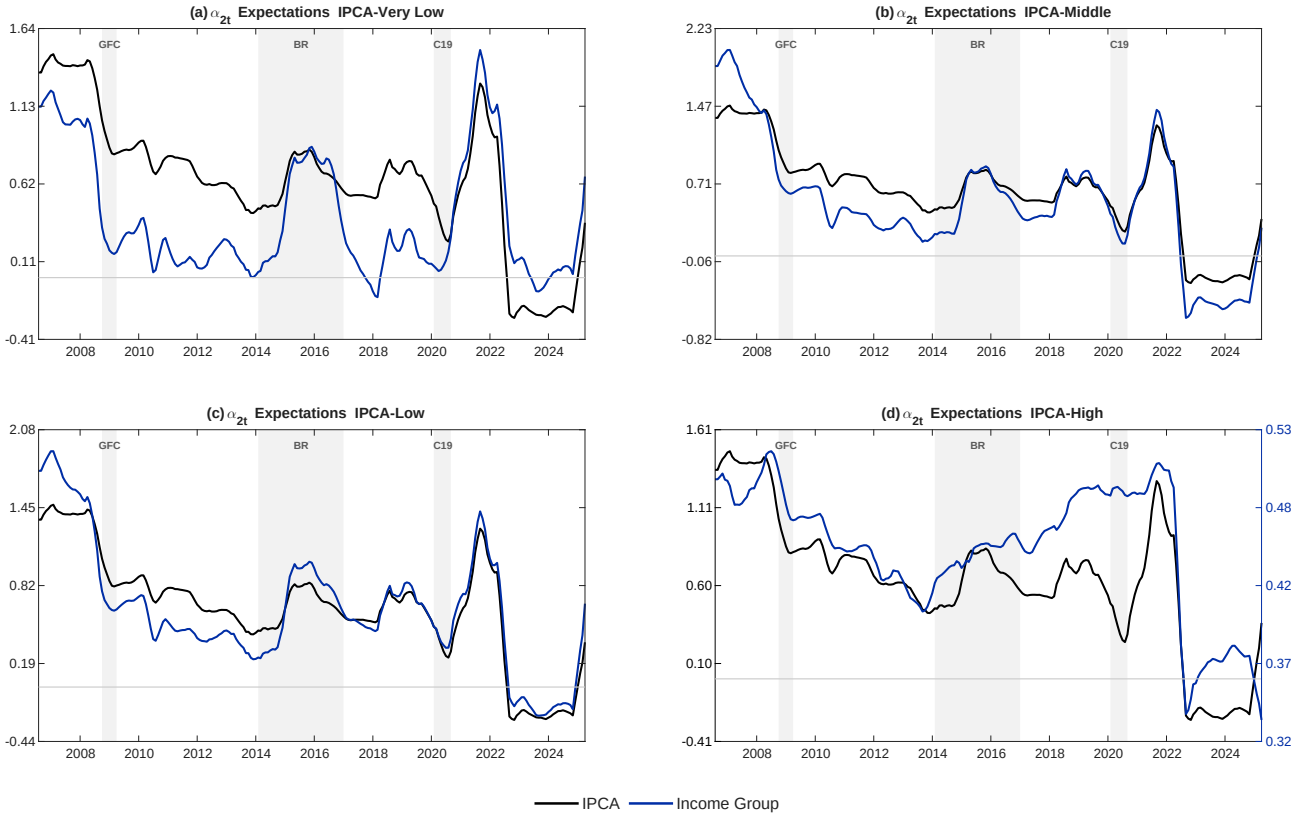
Note: This figure displays the estimated time-varying inflation inertia coefficients ($\alpha_{1,t}$) from the TVP-NKPC model. The curves track the historical evolution of backward-looking price-setting behavior for the headline IPCA and the four income cohorts.

A disaggregated cross-sectional analysis exposes critical asymmetries in intrinsic persistence that reflect distinct income-specific dynamics. Mirroring the previous unobserved components findings, the middle-income group (Panel 6b) closely tracks the trajectory of the headline IPCA, although its magnitude remains persistently lower across the entire sample period, ranging from 0.21 to 0.35. Similarly, the low-income group (Panel 6c), with coefficients oscillating between 0.24 and 0.34, exhibits a dynamic behavior that closely mimics the middle-income stratum.

In contrast, the extreme ends of the income distribution display divergent trajectories. For the very low-income group (Panel 6a), the intrinsic persistence begins tightly coupled with the headline IPCA. However, following the severe 20142015 macroeconomic crisis, this coefficient decouples and shifts downward, only beginning to re-converge toward the aggregate benchmark in the post-pandemic aftermath. Conversely, the high-income group (Panel 6d) exhibits the exact opposite behavior. Wealthier households display a persistence trajectory that remains heavily detached from the aggregate IPCA until the 2014-2015 recession. Between 2016 and the onset of the COVID-19 pandemic, the high-income inertia converged toward the headline index. Yet, triggered by the pandemic shock, the high-income persistence decreased strongly before executing a sharp post-crisis recovery to re-align once again with the headline IPCA dynamic. Notably, while the lower and middle strata maintain statistical significance throughout the sample, the high-income inertia is mostly non-significant, achieving statistical relevance only during specific volatile windows: 20092014, 20152018, and from 2021 onward.

Only the high income group, π_t^5, exhibits statistically significant expectations coefficients, ranging from 0.31 to 0.67, except for brief periods in 2012 and early 2013. Expectations in the other income groups, π_t^2 (very low), π_t^3 (low), and π_t^4 (middle), are not statistically significant. Notably, the high income group showed limited and period-specific significance in persistence coefficients, highlighting distinct dynamics between inflation inertia and expectations.

Figure 7: Time-Varying Parameter Phillips Curve: Expectations (α_{2t}) by Income Strata

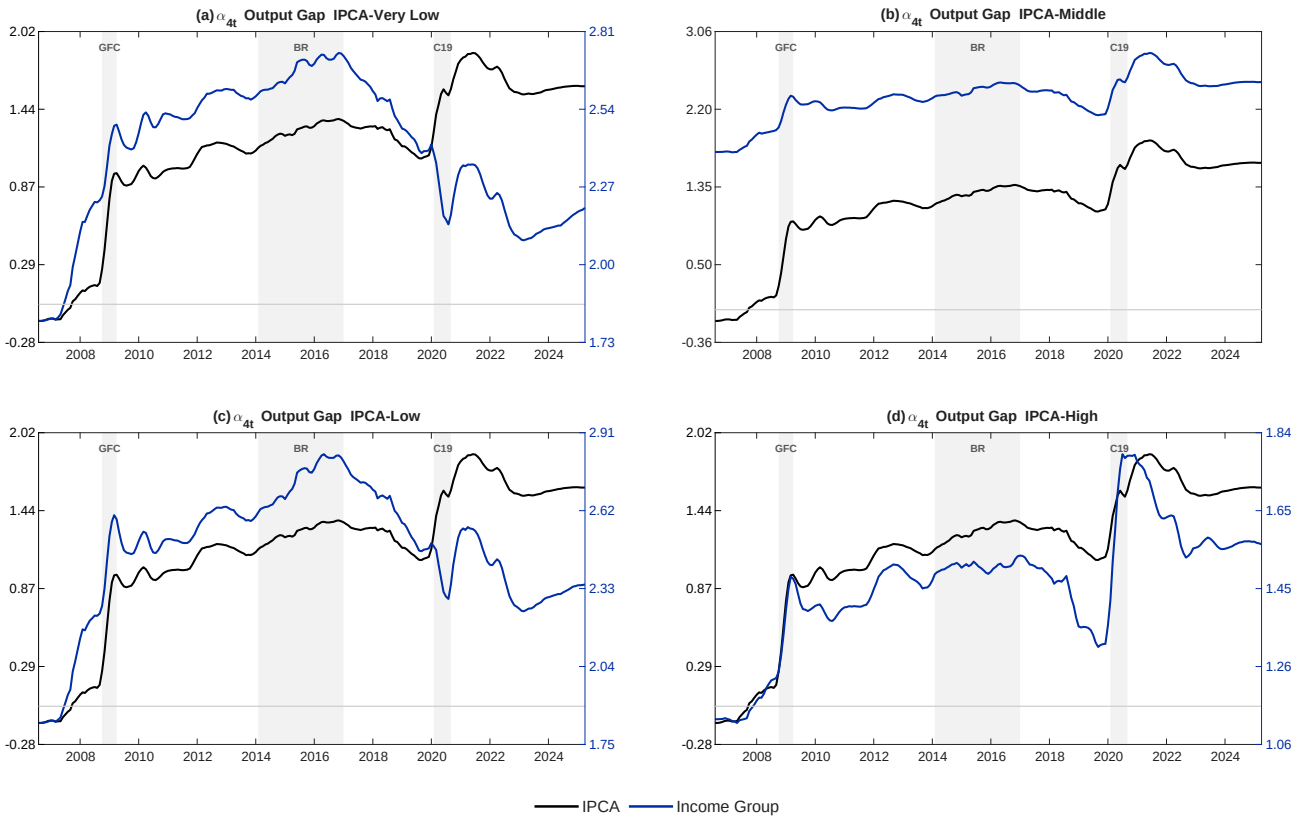


Note: Shaded areas denote recessions dated by CODACE/FGV, 2023.

The output gap coefficients for π_t^1 (IPCA) range from -0.1 to 1.9, becoming significant only from June 2020 onward. For π_t^2 (very low income), coefficients vary from 1.8 to 2.8 starting November 2008; for π_t^3 (low income), from 1.8 to 2.8 since January 2009; for π_t^4 (middle income), from 1.7 to 2.8 also from January 2009; and for π_t^5 (high income), from 1.1 to 2.0, with significance between January 2009 and September 2019 and again from December 2019 onward.

From an economic perspective, these findings suggest that higher-income households place greater emphasis on forward-looking inflation expectations rather than on past inflation persistence, which may reflect superior access to information, enhanced ability to anticipate economic conditions, and more responsive price-setting behavior. Conversely, lower-income groups appear to be more influenced by inflation inertia, indicating a stronger dependence on historical inflation in the formation of prices and wages within these segments.

Figure 8: Time-Varying Parameter Phillips Curve: Output Gap (α_{4t}) by Income Strata

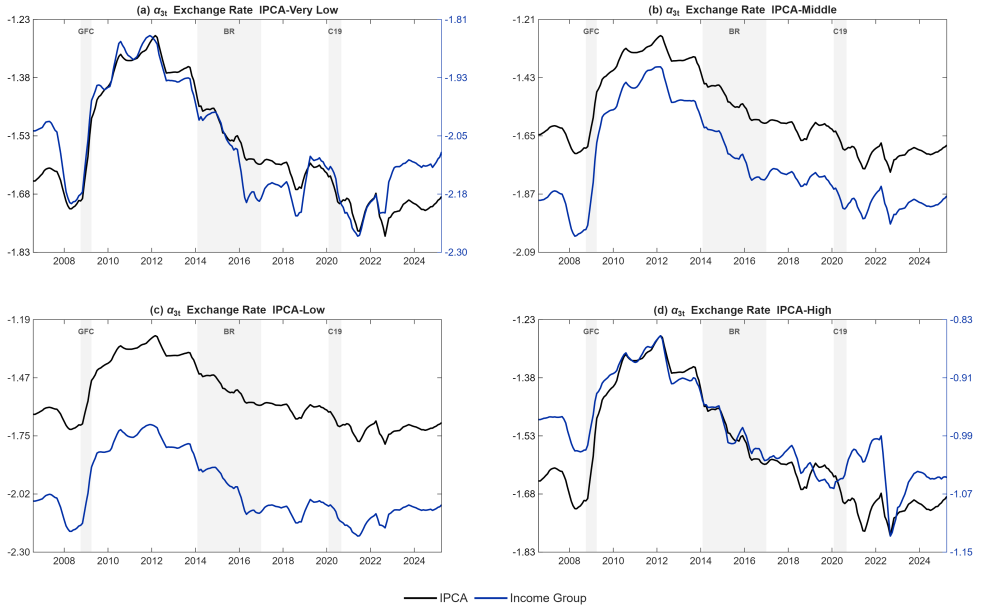


Note: Shaded areas denote recessions dated by CODACE/FGV, 2023.

These dynamics reflect well-known macroeconomic episodes: the 2008 global financial crisis increased volatility and affected demand and the output gap, especially for vulnerable groups; the 2015 and 2016 recession widened the negative output gap; and the 2020 COVID-19 pandemic induced simultaneous supply and demand shocks, followed by an uneven recovery and increased public spending through emergency measures that affected expectations, the output gap, and inflation persistence. Recent external shocks, including rising commodity prices and global supply-chain disruptions, amplified domestic inflation pressures heterogeneously: lower-income consumers experienced more persistent inflation through inertia and frequent adjustments of administered and food prices, while higher-income groups reacted primarily through expectations.

The exchange rate pass-through coefficient (α_{3t}) is presented across the four income panels, each comparing the income-specific estimate (blue) with the headline IPCA (black). In all strata the coefficient is negative and follows a common temporal trajectory, rising until around 2012 and declining thereafter, with marked reactions around the global financial crisis, the 2014–2016 Brazilian recession, and the COVID-19 shock. The panels differ, however, in the distance between each group and the aggregate index: at the extremes of the distribution, the very low-income (Panel a) and high-income (Panel d) groups track the headline IPCA closely, whereas the low-income (Panel c) and middle-income (Panel b) groups display a persistent gap, with their pass-through systematically more negative than the aggregate throughout the sample. This pattern is consistent with the post-Keynesian view of inflation as a distributive conflict mediated by external prices: Hein (2024) stresses that the conflict between wages, profits, and import prices is central to recent inflationary dynamics, while Rolim and Marins (2024) show that foreign price shocks transmitted through the exchange rate asymmetrically affect income and inflation inequality, with lower-income households bearing a disproportionate share of the adjustment burden. The pervasiveness of a significant pass-through across all groups confirms the structural exposure of the Brazilian economy to external cost-push pressures, transmitted through tradable goods, energy, and food priced in foreign currency.

Figure 9: Exchange Rate Pass-Through (α_{3t}) by Income Strata First Stage



Note: Shaded areas denote recessions dated by CODACE/FGV, 2023.

These dynamics mirror well-known macroeconomic episodes visible in the shaded windows of the figure. The 2008 global financial crisis triggered a sharp depreciation of the real and a surge in pass-through across all strata, as imported cost pressures spread through tradable goods and commodities. The 2014–2016 Brazilian recession, combined with the sovereign confidence crisis and currency depreciation of that period, sustained an elevated pass-through, particularly for the low- and middle-income groups, whose baskets are more exposed to administered and food prices. Finally, the 2020 COVID-19 pandemic produced simultaneous external and domestic shocks, with global supply-chain disruptions and rising commodity prices amplifying the exchange rate channel; while the headline IPCA and the income-specific coefficients moved largely in tandem, lower-income strata remained more persistently exposed to currency-driven cost shocks, reinforcing the asymmetric burden of external inflation across the income distribution.

6 Conclusion

This article investigated inflation inequality across four income strata in Brazil (very low, low, middle, and high income) from July 2006 to April 2025, using the headline IPCA as a benchmark. The central hypothesis, that inflation dynamics and transmission mechanisms are structurally unequal and disproportionately affect lower-income households, was tested through two complementary frameworks: a Univariate Unobserved Components model with Stochastic Volatility and Outlier Adjustment (UCSVO) and a Time-Varying Parameter (TVP) Phillips Curve estimated via the Kalman filter.

The empirical evidence confirms the hypothesis. The UCSVO results show that trend inflation is persistently higher for the very low- and low-income groups, while volatility and outliers are more frequent and intense for these cohorts, reflecting their greater exposure to disruptions in essential goods; the post-pandemic recovery was also asymmetric, with lower-income volatilities remaining elevated. The TVP Phillips Curve reveals inflation persistence ranging from 0.28 to 0.40, most unstable at the extremes of the distribution. Backward-looking inertia dominates price dynamics for lower- and middle-income households, while the expectations channel is significant only for the high-income group, and the output gap influenced lower-income strata as early as 2008, twelve years before its

effect on the aggregate IPCA.

These findings carry direct implications for monetary policy in unequal emerging economies. A framework guided solely by the headline IPCA is inherently reactive for the most vulnerable, since it ignores the lead-lag disparities across strata and the fact that expectations are anchored only by the high-income group, risking mistimed and socially regressive interventions. Incorporating income-disaggregated dynamics is therefore a technical requirement, not merely a distributional concern, and interest rate decisions should be complemented by targeted supply-side measures and social protection indexed to income-specific indices.

The study has limitations that open avenues for future research. The univariate approach evaluates each index in isolation; a natural extension is the Multivariate UCSVO (Stock & Watson, 2016), currently constrained by the absence of disaggregated sectoral series with time-varying weights in the IPEA database. Extending the TVP framework to model interactions across income groups could further reveal cross-group spillovers, and future work could incorporate welfare metrics to quantify the cumulative purchasing-power losses associated with the inflation inequality documented here.

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