Inflationary and Deflationary Pressures: A Directional Decomposition of U.S. Inflation Dynamics

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21 July 2025

INFLATIONARY AND DEFLATIONARY PRESSURES: A DIRECTIONAL DECOMPOSITION OF U.S. INFLATION DYNAMICS

A PREPRINT

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September 8, 2025

ABSTRACT

This paper develops a pressure decomposition of inflation as the net outcome of two competing forces: inflationary pressure, defined by the frequency and magnitude of price increases, and deflationary pressure, determined by corresponding price decreases. Using 245 PCE sub-indices spanning 1959-2024, we construct an exact bottom-up inflation measure that transparently maps sectoral pricing decisions into macroeconomic aggregates. Our decomposition reveals fundamental asymmetries in inflation formation: inflationary pressure exhibits dramatic variation (2.35%-12.68%) while deflationary pressure remains remarkably stable (0.72%-5.18%), indicating inflation episodes are primarily driven by surges in upward pricing momentum rather than retreats of downward movements. Historical analysis shows distinct pressure regimes across major macroeconomic episodes: the Great Inflation featured extreme inflationary pressure volatility, the Great Moderation achieved balanced dynamics, the 2008-2009 crisis uniquely witnessed deflationary pressure dominance creating deflation risk, while COVID-19 saw dramatic inflationary pressure resurgence. We reassess the price puzzle using Bayesian local projections with alternative monetary policy shock identifications. Conventional narrative shocks generate sustained inflationary pressure increases with minimal deflationary response, while informationally robust shocks resolve the puzzle completely through both increased deflationary pressure and reduced inflationary pressure, with the deflationary channel providing the dominant contribution consistent with demand-channel transmission. Extensive robustness checks across specifications and estimation methods confirm these findings while revealing the diagnostic value of pressure decomposition for evaluating shock quality. Results demonstrate that the price puzzle reflects informational frictions rather than genuine economic phenomena, and suggest successful monetary policy operates through managing pressure balance with important implications for real-time policy diagnosis and central bank communication.

***K*eywords** Inflation decomposition · price puzzle · monetary policy transmission · pressure dynamics

JEL Classification: E31, E52, E58, C43

1 Introduction

The resurgence of inflation across advanced economies following the COVID-19 pandemic has reignited fundamental questions about the nature of price dynamics and monetary transmission mechanisms. In the United States, inflation reached levels not seen in four decades, challenging policymakers who had grown accustomed to the low and stable inflation environment of the Great Moderation. This episode underscores a persistent limitation in macroeconomic analysis: while aggregate inflation measures provide useful summary statistics, they obscure the rich heterogeneity in price-setting behavior that drives inflation dynamics and shapes policy transmission.

Traditional approaches to understanding inflation rely heavily on aggregate measures that treat price changes as uniform phenomena across sectors and time. However, mounting evidence from microeconomic studies reveals that inflation emerges from complex, heterogeneous price-setting decisions by firms operating under varying economic conditions, competitive pressures, and adjustment costs (Klenow and Kryvtsov, 2008; Nakamura and Steinsson, 2008)). This heterogeneity is not merely a technical detail—it has profound implications for how inflation responds to shocks, how monetary policy transmits through the economy, and how policymakers should interpret and respond to inflationary pressures.

The microeconomic foundations of price-setting behavior have been extensively documented, revealing substantial heterogeneity in both the frequency and magnitude of price adjustments across sectors. Golosov and Lucas Jr (2007) demonstrate that state-dependent pricing models with menu costs can generate realistic aggregate dynamics from heterogeneous firm-level decisions, while Midrigan (2011) shows that multiproduct firms exhibit complex pricing patterns driven by economies of scope in price adjustment and the interplay between regular and temporary pricing. Recent work by Ferrante et al. (2023) emphasizes how sectoral supply chain linkages create commonality in price movements that extends beyond traditional industry classifications. These microeconomic insights suggest that effective analysis of inflation dynamics requires frameworks that can capture the sectoral heterogeneity of price-setting while remaining tractable for macroeconomic analysis.

Building on this microeconomic evidence, several influential decomposition approaches have emerged to better understand aggregate inflation dynamics. Reis and Watson (2010) pioneer a factor-based decomposition that distinguishes between “pure inflation”—equiproportional price changes across all goods—and relative price movements that capture sectoral deviations. Their framework elegantly demonstrates that once relative price components are filtered out, the Phillips correlation between inflation and output largely vanishes, challenging conventional interpretations of aggregate inflation measures. More recently, Shapiro (2024) introduces a structural approach that attributes inflation to supply or demand forces using sign restrictions on price and quantity residuals, revealing intuitive patterns where demand-driven inflation responds to monetary policy while supply-driven inflation follows energy price dynamics. Extensions of these approaches to international contexts (Gonçalves and Koester, 2022) and alternative decomposition schemes (Stock and Watson, 2016; Kamber and Wong, 2020) underscore growing recognition that disaggregating inflation into interpretable components is essential for both empirical analysis and policy guidance. However, existing approaches either rely on statistical abstractions that may obscure sectoral heterogeneity (Reis and Watson, 2010) or require structural assumptions about supply and demand identification that may not hold universally (Shapiro, 2024).

The disconnect between aggregate measures and underlying sectoral foundations becomes particularly problematic during periods of economic turbulence, when traditional relationships break down and policymakers struggle to distinguish between transitory and persistent inflation dynamics. Recent experience demonstrates that inflation can surge rapidly through some sectors while remaining subdued in others, creating challenges for both forecasting and policy response that aggregate measures alone cannot adequately address. These challenges are compounded by persistent puzzles in monetary transmission, particularly the price puzzle identified by Sims (1986) where inflation often rises following contractionary monetary policy, suggesting fundamental gaps in how we understand the interaction between policy actions and price-setting behavior.

This paper introduces a pressure decomposition that provides a diagnostic framework for understanding inflation as the net outcome of two competing forces: **inflationary pressure**, capturing the frequency and magnitude of price increases across sectors, and **deflationary pressure**, capturing corresponding price decreases. Rather than treating inflation as a statistical summary, our framework views it as an emergent outcome of observable price-setting behaviors, providing a transparent mapping from microeconomic decisions to macroeconomic aggregates while preserving the rich heterogeneity often lost in conventional measures.

Our approach differs fundamentally from existing decomposition methods by grounding the analysis in observed pricing decisions. Sectors dynamically contribute to different pressure components based on their pricing decisions in each period, avoiding the limitations of fixed classifications like “core” versus “volatile” components. This sectoral foundation enables the framework to capture asymmetric dynamics—such as monetary shocks that may intensify upward pricing pressure without affecting downward price rigidities—that conventional approaches often miss.

This paper makes three contributions to the literature on inflation dynamics and monetary transmission. First, methodologically, we develop a methodologically transparent framework that maps granular price data from 245 PCE sub-indices into aggregate inflation dynamics while preserving sectoral heterogeneity. The decomposition is exact by construction and provides intuitive economic interpretation of pressure dynamics across different macroeconomic regimes. Second, empirically, we document fundamental asymmetries in inflation formation using over six decades of U.S. data: inflation episodes are primarily driven by surges in upward pricing pressures rather than retreats of deflationary forces, with deflationary pressure remaining remarkably stable across most historical periods. We also document state-dependent persistence patterns where dominant pressure components exhibit greater inertia, suggesting endogenous adjustment behavior across macroeconomic regimes. Third, for monetary policy, we reexamine the persistent price puzzle in monetary economics by showing that informationally robust policy shocks eliminate puzzling responses at both aggregate and component levels, operating primarily through increased deflationary pressure consistent with demand channel transmission.

Beyond these core contributions, our framework provides practical tools for monetary policy implementation. The diagnostic capabilities of pressure decomposition prove valuable for evaluating the quality of monetary policy shock identification—a crucial concern in empirical monetary economics (Stock and Watson, 2018). While we do not estimate structural causal relationships, our approach offers a transparent lens into inflation dynamics. Similar to diagnostic approaches in Stock and Watson (2018) or Shapiro (2024), our method prioritizes empirical clarity over structural identification, enhancing the interpretability of inflation responses to monetary policy innovations. Extensive robustness checks across alternative specifications and estimation methods demonstrate that properly identified shocks produce stable results across our pressure components, while misspecified shocks exhibit sensitivity that can be detected through component-level analysis. This methodological contribution addresses ongoing debates about optimal approaches to monetary policy identification and provides practitioners with additional tools for assessing empirical results.

Applied to U.S. inflation dynamics from 1959 to 2024, our decomposition reveals distinct historical regimes with dramatically different pressure configurations. The Great Inflation era featured extreme inflationary pressure volatility, the Great Moderation achieved balanced dynamics through stabilized inflationary pressure, the 2008-2009 crisis uniquely witnessed deflationary pressure dominance creating deflation risk, while the COVID-19 period saw dramatic inflationary pressure resurgence reminiscent of the 1970s. Our reexamination of the price puzzle using Bayesian local projections, validated through extensive robustness checks across multiple estimation methods and specifications, demonstrates that informationally robust shocks resolve puzzling responses completely, producing strong demand-channel effects through increased deflationary pressure while leaving inflationary pressure unaffected. These findings establish pressure decomposition as both a diagnostic tool for monetary policy identification and a practical framework for enhancing central bank communication and policy effectiveness.

The remainder of this paper proceeds as follows. Section 2 introduces and formalizes the inflation pressure decomposition and demonstrates its implementation using disaggregated PCE data. Section 3 applies the decomposition to historical inflation dynamics, revealing how pressure configurations have evolved across major macroeconomic episodes. Section 4 revisits the price puzzle through the lens of pressure dynamics, showing how different identification strategies affect inflationary and deflationary pressures separately. Section 5 concludes by discussing implications for monetary policy and directions for future research.

2 The Decomposition Framework

This section develops our pressure decomposition methodology that reframes inflation as the net outcome of competing price adjustment forces. We begin by establishing the theoretical foundation for our approach, then present the mathematical framework, and finally demonstrate its empirical implementation using disaggregated PCE data.

2.1 Theoretical Foundation

2.1.1 Motivation: Beyond Aggregate Measures

Traditional inflation measurement treats price changes as a uniform phenomenon, obscuring the heterogeneous nature of price-setting decisions across sectors and time. Consider the standard aggregate price index:

$$P_t = \sum_{i=1}^{N} w_{i,t} P_{i,t} \tag{1}$$

where $P_{i,t}$ represents the price of good i at time t and $w_{i,t}$ denotes the corresponding expenditure weight. The inflation rate is then computed as:

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \sum_{i=1}^{N} w_{i,t} \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \tag{2}$$

While this approach provides a summary measure of average price changes, it conflates two fundamentally different economic phenomena: the propensity of firms to raise prices and their propensity to lower them. Economic theory suggests these behaviors may respond differently to shocks and exhibit distinct persistence properties.

2.1.2 Price-Setting Foundations

Our decomposition builds on three key insights from the price-setting literature:

- **Asymmetric Price Adjustment**: Following Peltzman (2000) and Klenow and Kryvtsov (2008), price increases and decreases may exhibit different frequencies, magnitudes, and persistence due to:
  - Menu costs that create thresholds for adjustment
  - Loss aversion in consumer psychology
  - Competitive dynamics that make price cuts more strategic than increases
  - Supply chain constraints that affect upward versus downward flexibility
- **State-Dependent Pricing**: As demonstrated by Golosov and Lucas Jr (2007), the frequency and size of price adjustments depend on economic conditions. Our framework captures this by allowing sectors to dynamically contribute to different pressure components based on their adjustment decisions.
- **Sectoral Heterogeneity**: Different sectors may respond to shocks with varying timing and intensity (Baqaee and Farhi, 2022). Rather than imposing fixed sectoral classifications, our approach lets the data reveal which sectors contribute to inflationary versus deflationary pressures in each period.

2.2 Mathematical Framework

2.2.1 Index Construction

We begin by constructing a tractable approximation to the official PCEPI that facilitates our decomposition. Let $f_{i,t} = \frac{P_{i,t}}{P_{i,t-1}}$ denote the gross price change for subindex i in period t. We define our aggregate price index recursively as:

$$I_t = I_{t-1} \cdot G_t \tag{3}$$

where the aggregator function is:

$$G_t = \prod_{i=1}^{245} (f_{i,t})^{w_{i,t}} \tag{4}$$

and weights are given by:

$$w_{i,t} = \frac{P_{i,t} \cdot Q_{i,t}}{\sum_{j=1}^{245} P_{j,t} \cdot Q_{j,t}} \tag{5}$$

Here, $P_{i,t} \cdot Q_{i,t}$ represents the expenditure on subindex i at time t. This geometric aggregation provides an excellent approximation to the official PCEPI (correlation > 0.99) while yielding a functional form amenable to our decomposition.

2.2.2 Pressure Decomposition

At each point in time, we partition the set of all price indices into three mutually exclusive and collectively exhaustive sets:

$$\mathcal{UP}_t = i \in 1, ..., 245 : f_{i,t} > 1 \quad \text{(Price increases)} \tag{6}$$
$$\mathcal{DOWN}_t = i \in 1, ..., 245 : f_{i,t} < 1 \quad \text{(Price decreases)} \tag{7}$$
$$\mathcal{SAME}_t = i \in 1, ..., 245 : f_{i,t} = 1 \quad \text{(Unchanged prices)} \tag{8}$$

This partition allows us to rewrite the aggregator as:

$$G_t = \left[\prod_{i \in UP_t} (f_{i,t})^{w_{i,t}}\right] \cdot \left[\prod_{i \in DOWN_t} (f_{i,t})^{w_{i,t}}\right] \cdot \left[\prod_{i \in SAME_t} (1)^{w_{i,t}}\right] \tag{9}$$

Since the third term equals unity, we obtain:

$$G_t = \left[\prod_{i \in UP_t} (f_{i,t})^{\frac{w_{i,t}}{w_{up,t}}}\right]^{w_{up,t}} \cdot \left[\prod_{i \in DOWN_t} (f_{i,t})^{\frac{w_{i,t}}{w_{down,t}}}\right]^{w_{down,t}} \tag{10}$$

where $w_{up,t} = \sum_{i \in UP_t} w_{i,t}$ and $w_{down,t} = \sum_{i \in DOWN_t} w_{i,t}$ represent the expenditure shares of goods with price increases and decreases, respectively.

2.2.3 Component Definition

We define the weighted geometric averages:

$$f_{up,t} = \prod_{i \in UP_t} (f_{i,t})^{\frac{w_{i,t}}{w_{up,t}}} \quad \text{(Average price increase factor)} \tag{11}$$
$$f_{down,t} = \prod_{i \in DOWN_t} (f_{i,t})^{\frac{w_{i,t}}{w_{down,t}}} \quad \text{(Average price decrease factor)} \tag{12}$$

This yields the compact representation:

$$G_t = (f_{up,t})^{w_{up,t}} \cdot (f_{down,t})^{w_{down,t}} \tag{13}$$

Taking logarithms:

$$\ln(G_t) = w_{up,t} \ln(f_{up,t}) + w_{down,t} \ln(f_{down,t}) \tag{14}$$

2.2.4 Annual Inflation Decomposition

For annual inflation rates, we compute:

$$\pi_t^{12} = \ln\left(\frac{I_t}{I_{t-12}}\right) \times 100 = \sum_{s=0}^{11} \ln(G_{t-s}) \times 100 \tag{15}$$

Substituting our decomposition:

$$\pi_t^{12} = \sum_{s=0}^{11} [w_{up,t-s} \ln(f_{up,t-s}) + w_{down,t-s} \ln(f_{down,t-s})] \times 100 \tag{16}$$

Using the identity $\sum_{s=0}^{11} a_s b_s = 12\bar{a}\bar{b} + 12\text{Cov}(a, b)$ where $\bar{a}$ and $\bar{b}$ are 12-month averages:

$$\pi_t^{12} = 12\bar{w}_{up,t}\overline{\ln(f_{up,t})} + 12\text{Cov}(w_{up,t}, \ln(f_{up,t})) + 12\bar{w}_{down,t}\overline{\ln(f_{down,t})} + 12\text{Cov}(w_{down,t}, \ln(f_{down,t})) \tag{17}$$

Thus,

$$\pi_t^{12} = \underbrace{12\bar{w}_{up,t}\overline{\ln(f_{up,t})} + 12\text{Cov}(w_{up,t}, \ln(f_{up,t}))}_{\text{Inflationary Pressure}} - \underbrace{(-12\bar{w}_{down,t}\overline{\ln(f_{down,t})} - 12\text{Cov}(w_{down,t}, \ln(f_{down,t})))}_{\text{Deflationary Pressure}} \tag{18}$$

2.2.5 Final Decomposition

Our final decomposition takes the form:

$$\pi_t^{12} = \text{InflationaryPressure}_t - \text{DeflationaryPressure}_t \tag{19}$$

where:

- **Inflationary Pressure** captures both the average intensity of price increases (first term) and the covariance between the share and magnitude of increases (second term).
- **Deflationary Pressure** is defined as the negative of the sum of the corresponding terms for price decreases, ensuring that increases in downward price adjustments contribute positively to deflationary pressure.

2.3 Key Properties of the Decomposition

2.3.1 Exactness

Our decomposition is exact by construction: summing the pressure components exactly recovers the aggregate inflation rate with zero approximation error (see Appendix B for verification).

2.3.2 Exclusivity and Exhaustivity

The framework satisfies three crucial properties:

- **Exclusivity**: The sets UP_t, $DOWN_t$, and $SAME_t$ are mutually exclusive, ensuring no double-counting of price signals.
- **Exhaustivity**: Every price change contributes to exactly one pressure component, capturing all inflation dynamics without loss.
- **Dynamic Sectoral Contribution**: Sectors can migrate between pressure components over time, avoiding the limitations of fixed classifications like “core” vs. “food” inflation.

2.3.3 Economic Interpretation

The decomposition provides intuitive economic interpretation:

- **Rising inflationary pressure** indicates either more sectors raising prices, larger average increases, or both
- **Rising deflationary pressure** indicates either more sectors cutting prices, larger average decreases, or both
- **Net inflation** emerges from the balance between these competing forces

2.4 Data and Implementation

2.4.1 PCE Sub-Index Data

We employ the Personal Consumption Expenditures Price Index (PCEPI) rather than the Consumer Price Index as our benchmark, following standard practice in monetary policy research (Aruoba and Drechsel, 2024; Shapiro, 2024; Reis and Watson, 2010). The PCEPI’s Fisher-ideal aggregation formula and broader coverage make it more appropriate for our decomposition framework.

We employ the most disaggregated level of PCE price data available from the Bureau of Economic Analysis, yielding 245 sub-indices that span the entire consumption basket. This level of disaggregation captures heterogeneity across:

- Goods vs. services
- Durable vs. non-durable goods
- Market-determined vs. regulated prices
- Domestically produced vs. imported items

The sub-indices are listed in Appendix A along with their corresponding BEA codes.

2.4.2 Sample Period and Frequency

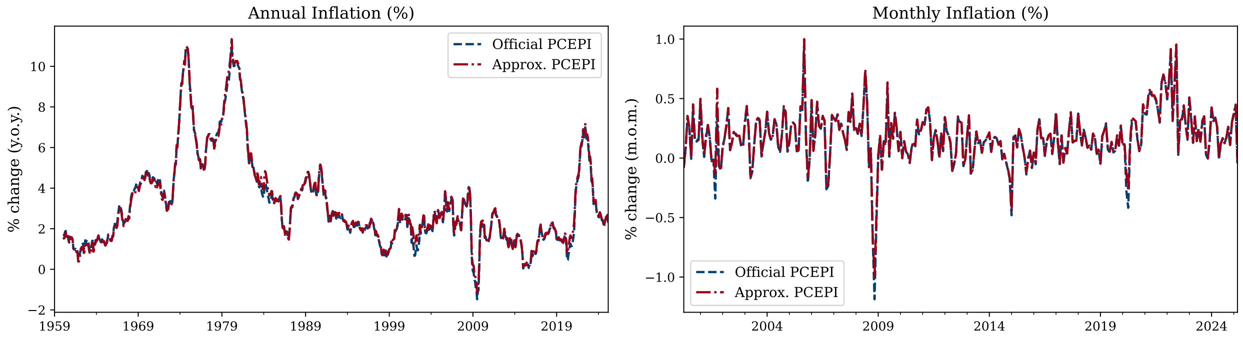
Our analysis covers December 1959 to December 2024, providing 781 monthly observations that span multiple macroeconomic regimes. This long sample allows us to study pressure dynamics across:

- The Great Inflation and oil shock episodes (1970s-1980s)
- The Volcker disinflation (1980s)
- The Great Moderation (1990s-2000s)
- The Financial Crisis and its aftermath (2008-2015)
- The COVID-19 inflation surge (2020-2024)

2.4.3 Approximation Quality

Figure 1 demonstrates that our approximation closely tracks the official PCEPI across both annual and monthly frequencies. The correlation between our constructed series and the official measure exceeds 0.99, with mean absolute deviations below 0.1 percentage points for annual inflation rates.

Figure 1: A Quite Accurate Approximation of Inflation



Note: The inflation rates are calculated as logarithmic growth.

2.4.4 Covariance Terms

In monthly data, the covariance terms in our decomposition remain small due to the limited window for correlation to develop between shares and magnitudes. However, these terms can become economically significant during periods of rapid structural change or when using higher-frequency data.

2.5 Connection to Existing Literature

Our approach complements and extends several strands of research:

- **Relative to Reis and Watson (2010)**: While they decompose inflation into "pure" and relative price components using factor models, we focus on the sectoral drivers of price adjustment decisions.
- **Relative to Shapiro (2024)**: Where Shapiro identifies supply vs. demand origins using quantity restrictions, we capture the decision-making process of price-setters directly through their revealed choices.
- **Relative to Granular Data Studies**: Our framework aggregates sectoral pricing dynamics while preserving the rich heterogeneity often lost in aggregate measures, building on the granular macroeconomics literature

(Gabaix, 2011; Acemoglu et al., 2012) and disaggregated price studies (Nakamura and Steinsson, 2013) that emphasize how sectoral dynamics shape aggregate outcomes. This provides a bridge between sectoral and macro perspectives.

The framework thus offers a novel lens through which to study inflation dynamics, one that is grounded in observable behavior while remaining tractable for macroeconomic analysis.

3 Historical Dynamics of Inflation

Our decomposition of U.S. inflation into inflationary and deflationary pressures reveals striking patterns across more than six decades of price dynamics, from December 1959 to December 2024. This section examines how these pressure components have evolved through major macroeconomic episodes, documenting empirical patterns in the sectoral foundations of inflation formation. Following the approach of Blanchard and Simon (2001), who documented the "Great Moderation" in output volatility, we analyze whether similar patterns emerge in inflation pressure dynamics and explore what these patterns reveal about the changing nature of price-setting behavior in the U.S. economy.

Figure 2 presents the complete time series decomposition, illustrating the evolution of both pressure components alongside net inflation across the entire sample period. The comprehensive historical perspective reveals distinct episodes where pressure dynamics shifted dramatically, providing a visual foundation for the detailed analysis that follows.

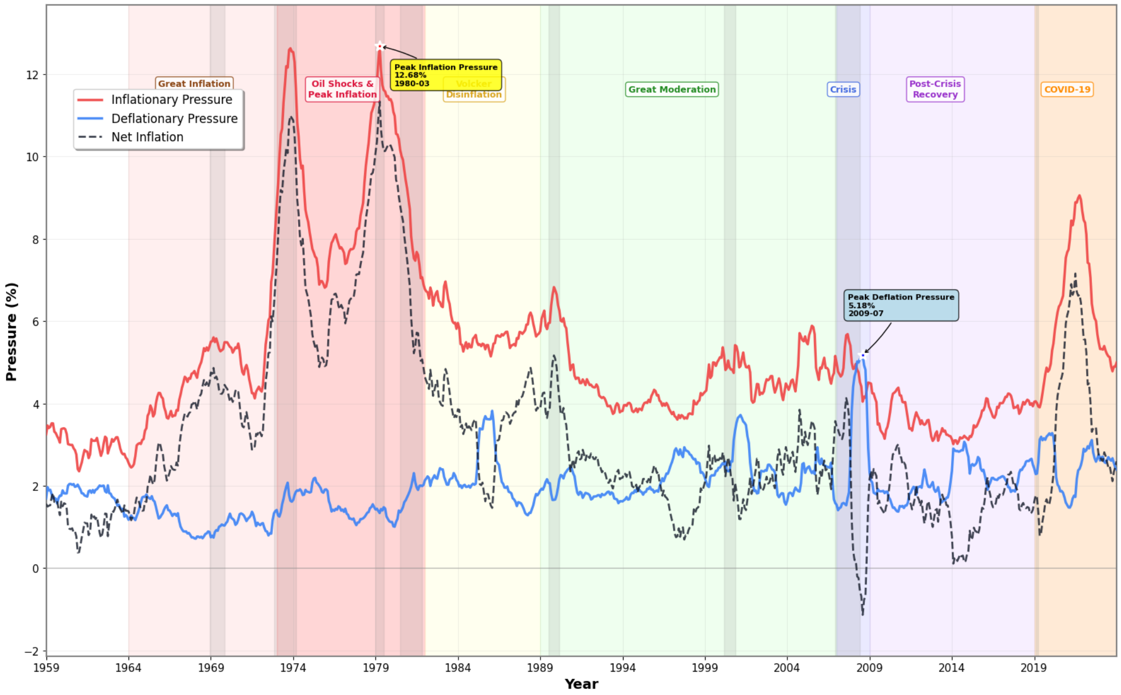


Figure 2: Complete Pressure Decomposition Time Series (1959-2024)

3.1 The Fundamental Asymmetry in Inflation Formation

The most striking feature of our decomposition is the fundamental asymmetry between inflationary and deflationary pressures documented in Table 1. Based on our analysis of 781 monthly observations spanning 1959-2024, inflationary pressure exhibits dramatic variation—ranging from a minimum of 2.35% during the early period to peaks exceeding 12.68% during the oil shock episodes-while deflationary pressure remains remarkably stable, fluctuating primarily between 0.72% and 5.18% across the entire sample period.

This asymmetry suggests that inflation episodes are primarily driven by forces that push prices upward rather than by a retreat of downward price movements. The average inflationary pressure over the full sample is 5.25% with a standard deviation of 2.08%, while deflationary pressure averages just 1.98% with a standard deviation of 0.68%. This fundamental insight-that inflation formation is asymmetric-provides quantitative support for the widely held intuition that "inflation tends to emerge from forces pushing prices upward, rather than from a disappearance of price decreases".

As illustrated in Figure 5, our phase diagram reveals that most observations cluster well above the 45-degree line representing zero net inflation, with inflationary pressure consistently dominating deflationary pressure across decades. Only during the most severe economic disruptions—such as the 2008-2009 financial crisis—do we observe episodes where deflationary pressure temporarily approached or exceeded inflationary pressure, creating the conditions for deflation risk.

Table 1: Summary Statistics by Major Historical Periods

			Inflationary Pressure				Deflationary Pressure				Net Inflation	
Period	Years	Obs	Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std
Early Period	1960-64	60	3.00	0.28	2.35	3.52	1.79	0.21	1.18	2.05	1.22	0.34
Great Infl. Buildup	1965-73	108	4.63	1.11	2.44	8.81	1.16	0.28	0.72	1.79	3.47	1.25
Oil Shocks & Peak	1974-82	108	9.29	1.81	6.77	12.68	1.59	0.33	1.01	2.31	7.70	1.93
Volcker Disinflation	1983-89	84	5.83	0.47	5.14	6.96	2.20	0.63	1.29	3.82	3.63	0.88
Great Moderation	1990-07	216	4.60	0.72	3.61	6.82	2.20	0.47	1.54	3.72	2.40	0.82
Financial Crisis	2008-09	24	4.80	0.46	4.04	5.68	3.28	1.55	1.41	5.18	1.52	1.84
Post-Crisis Rec.	2010-19	120	3.67	0.39	3.01	4.48	2.11	0.41	1.37	3.07	1.56	0.65
COVID-19 Era	2020-24	60	6.22	1.57	3.91	9.05	2.52	0.53	1.47	3.28	3.70	1.89

Notes: This table presents summary statistics for inflationary pressure, deflationary pressure, and net inflation across major historical periods. All values are in percentage points. Inflationary pressure captures the frequency and magnitude of price increases, while deflationary pressure captures the frequency and magnitude of price decreases. Net inflation is the difference between the two pressure components. Sample period: December 1959 to December 2024 (781 monthly observations).

3.2 The Great Inflation Era: Pressure Surge Dynamics (1970-1982)

The period from 1970 to 1982, encompassing the oil shock episodes, provides the most dramatic illustration of our framework's insights, as shown in the first panel of Figure 4. During this era, inflationary pressure averaged 9.29% compared to just 1.59% for deflationary pressure, representing a net inflation rate of 7.70%—the highest sustained inflation in our sample. However, the volatility of inflationary pressure (standard deviation of 1.81%) was more than five times that of deflationary pressure (0.33%), indicating that the rising inflation of this period reflected increasingly aggressive upward price adjustments rather than weakening deflationary forces

The peak inflationary pressure of 12.68% occurred during this period, coinciding with the second oil crisis. This pattern supports Hamilton's (1983) seminal work demonstrating that oil price shocks were key drivers of 1970s inflation. However, our decomposition reveals an important additional insight: oil shocks worked primarily through the inflationary pressure channel rather than by reducing deflationary pressures, suggesting that these supply shocks created broad-based upward pricing momentum rather than simply eliminating downward price flexibility.

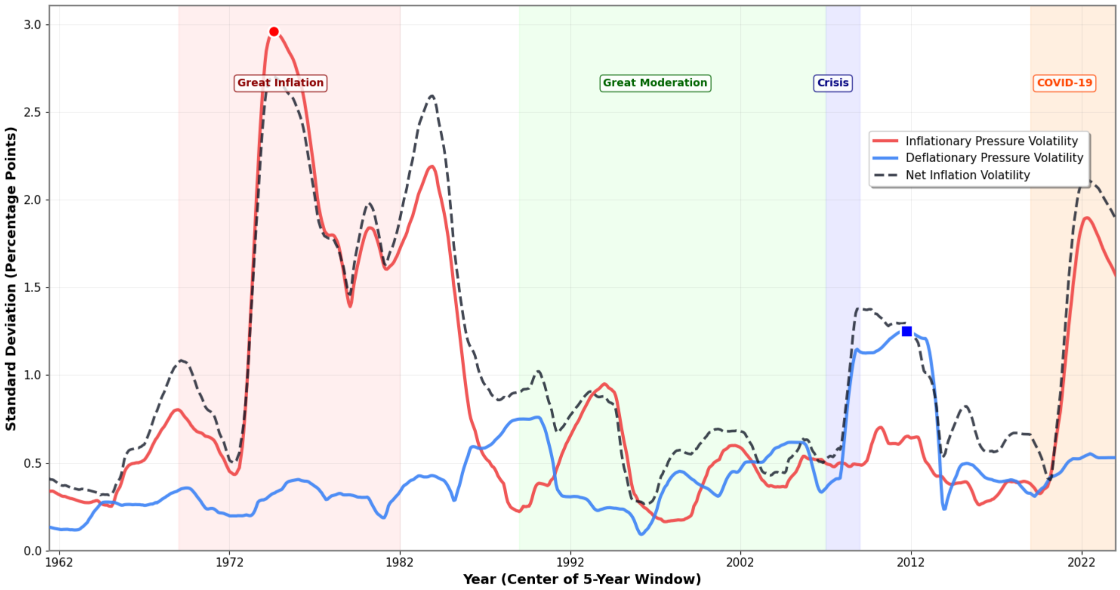


Figure 3: Evolution of Inflation Pressure Volatility
(5-Year Rolling Standard Deviations)

Our correlation analysis in Table 3 shows that during both the Great Inflation Buildup (1965-1973) and Oil Shocks & Peak periods (1974-1982), the correlation between pressure components was negative (-0.42 and -0.29 respectively), indicating offsetting dynamics where periods of high inflationary pressure coincided with relatively stable or declining deflationary pressure. The asymmetry ratios during these periods-4.00 and 5.85 respectively-represent the most extreme imbalances in our entire sample.

3.3 The Volcker Disinflation: Dual Channel Policy Transmission (1983-1989)

The Volcker disinflation provides a particularly illuminating case study of how monetary policy affects pressure dynamics, as illustrated in the second panel of Figure 4. During 1983-1989, inflationary pressure fell sharply to an average of 5.83%, representing a decline of nearly 37% from the oil shock period. However, deflationary pressure simultaneously increased to 2.20%—its highest sustained level in the sample prior to the 2008 financial crisis.

The volatility patterns during this period reveal important insights that extend Ball's (1994) work on credible disinflation. As shown in Table 2, inflationary pressure volatility declined dramatically to 0.47% —among the lowest levels in decades—while deflationary pressure volatility increased to 0.63%. This suggests that credibility gained during the Volcker era worked asymmetrically: it stabilized upward pricing pressures while allowing market forces to operate more freely in reducing prices where justified by economic fundamentals.

The correlation between pressure components during this period was -0.25 (Table 3), indicating continued offsetting dynamics as the economy adjusted to the new monetary regime. The asymmetry ratio fell to 2.65, still elevated but substantially lower than during the high-inflation period. This pattern is consistent with Ball's observation that rapid disinflations may entail lower output costs than traditional Phillips curve models suggest, but our decomposition reveals that this occurs through a rebalancing rather than a simple suppression of price dynamics.

3.4 The Great Moderation: Balanced Pressure Dynamics (1990-2007)

The Great Moderation period offers compelling evidence of how improved monetary policy frameworks can stabilize inflation dynamics. During 1990-2007, inflationary pressure averaged 4.60%—remarkably close to its level during the earlier buildup period (1965-1973: 4.63%)—but with significantly lower volatility (standard deviation of 0.72% versus 1.11%). Deflationary pressure stabilized at 2.20%, creating average net inflation of 2.40%-very close to the informal inflation target that emerged during this period.

Our pressure-based findings provide strong support for Bernanke's (2004) "Great Moderation" hypothesis while offering new insights into its mechanisms. The key insight from our analysis aligns with Taylor's (1999) emphasis on systematic

Table 2: Evolution of Inflation Pressure Volatility: A Blanchard-Simon Analysis

	Inflationary Pressure		Deflationary Pressure		Net Inflation		Volatility Ratios	
Period	Mean	Volatility	Mean	Volatility	Mean	Volatility	Infl/Defl	Relative CV
Early Period	3.00	0.28	1.79	0.21	1.22	0.34	1.31	0.78
Great Infl. Buildup	4.63	1.11	1.16	0.28	3.47	1.25	3.92	0.98
Oil Shocks Peak	9.29	1.81	1.59	0.33	7.70	1.93	5.50	0.94
Volcker Disinflation	5.83	0.47	2.20	0.63	3.63	0.88	0.74	0.28
Great Moderation	4.60	0.72	2.20	0.47	2.40	0.82	1.53	0.73
Financial Crisis	4.80	0.46	3.28	1.55	1.52	1.84	0.30	0.20
Post-Crisis Rec.	3.67	0.39	2.11	0.41	1.56	0.65	0.96	0.55
COVID-19 Era	6.22	1.57	2.52	0.53	3.70	1.89	2.97	1.20
Memo items:								
1970s-1980s Average	6.96	1.46	1.37	0.31	5.58	1.59	4.77	0.94
Great Moderation	4.60	0.72	2.20	0.47	2.40	0.82	1.53	0.73
Volatility Reduction	-34%	-51%	61%	54%	-57%	-48%	-68%	-22%

Notes: This table analyzes the evolution of volatility in inflation pressure components following Blanchard and Simon (2001). Volatility is measured as the standard deviation within each period. Volatility ratios compare inflationary to deflationary pressure volatility. Relative CV is the coefficient of variation of inflationary pressure divided by that of deflationary pressure. The memo items compare the high-inflation decades (1970s-1980s) with the Great Moderation period. Negative percentages in the volatility reduction row indicate increases in volatility.

monetary policy during this period. The Taylor rule's success appears to have worked through expectations anchoring that stabilized both components of our decomposition.

Applying Blanchard and Simon's (2001) analytical framework to our pressure data, we find that the volatility reduction during the Great Moderation was substantial but not uniform across components. As shown in our memo items in Table 2, inflationary pressure volatility fell by 51% relative to the 1970s- 1980s average (from 1.46% to 0.72%), while deflationary pressure volatility increased by 54% (from 0.31% to 0.47%). This pattern echoes Blanchard and Simon's findings for output volatility but reveals an important asymmetry: the stabilization of aggregate inflation reflected a rebalancing of pressure dynamics rather than across-the-board volatility reduction.

The correlation between pressure components during the Great Moderation was 0.09 (Table 3), indicating largely independent movement—a stark contrast to the negative correlations observed during crisis periods. The asymmetry ratio of 2.09 suggests more balanced dynamics than during previous decades, though inflationary pressure still dominated.

3.5 The Financial Crisis: Deflationary Pressure Surge (2008-2009)

The 2008-2009 financial crisis provides the clearest example in our sample of deflation risk materializing through the pressure channel framework, as dramatically illustrated in the third panel of Figure 4. During these 24 months, deflationary pressure surged to an average of 3.28%—the highest sustained level in the entire sample—while inflationary pressure remained relatively stable at 4.80%.

Our findings offer new perspectives on the deflationary concerns that dominated policy discussions during this period. Krugman (2009) warned of a "liquidity trap" with persistent deflation, while Bernanke (2002) had earlier outlined the Fed's strategy for preventing deflation. Our pressure decomposition reveals that deflation risk during the crisis materialized primarily through surging deflationary pressure rather than collapsing inflationary pressure, suggesting that the crisis created conditions for widespread downward price adjustments rather than simply eliminating upward pricing momentum.

The crisis period exhibits extreme volatility in deflationary pressure (standard deviation of 1.55%), reflecting the rapid and widespread nature of price adjustments during the economic collapse. At its peak in early 2009, deflationary pressure reached 5.18%—the highest single observation in our sample—temporarily exceeding inflationary pressure and producing the most negative net inflation (-1.13%) in our data.

The correlation analysis in Table 3 shows the strongest negative correlation in our sample (-0.54) during this period, indicating severe offsetting dynamics. The asymmetry ratio fell to 1.46 -the lowest in our sample-confirming this as the only period when "Deflationary" forces dominated the pressure dynamics. This unique configuration validates our framework's ability to identify and characterize deflation risk episodes.

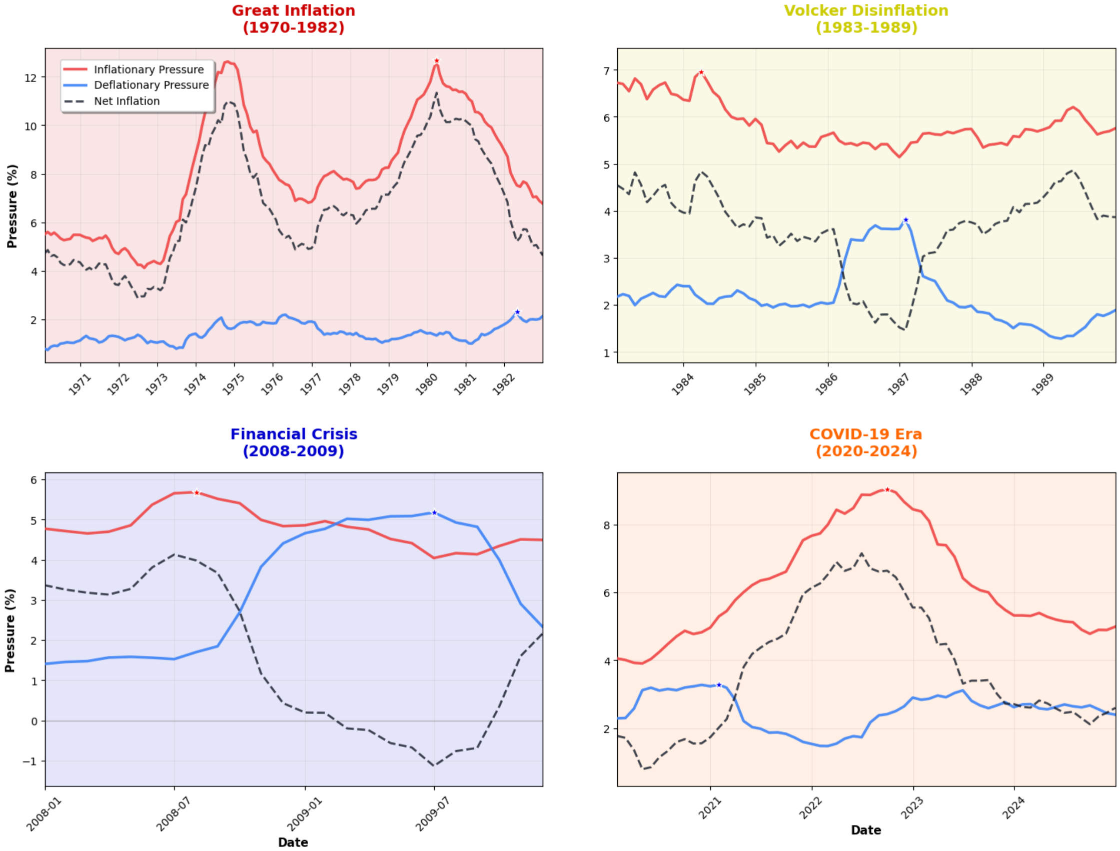


Figure 4: Pressure Dynamics During Key Historical Episodes

Table 3: Cross-Period Correlations and Asymmetry in Pressure Dynamics

Period	Correlation (Infl, Defl)	Asymmetry Ratio*	Persistence (Infl)	Persistence (Defl)	Dominant Component
Early Period	0.09	1.68	0.88	0.93	Mixed (Infl)
Great Infl. Buildup	-0.42	4.00	0.99	0.96	Inflationary
Oil Shocks Peak	-0.29	5.85	0.99	0.96	Inflationary
Volcker Disinflation	-0.25	2.65	0.95	0.97	Mixed (Defl)
Great Moderation	0.09	2.09	0.97	0.96	Inflationary
Financial Crisis	-0.54	1.46	0.90	0.96	Deflationary
Post-Crisis Rec.	-0.34	1.74	0.95	0.96	Balanced
COVID-19 Era	-0.50	2.47	0.99	0.95	Inflationary
Full Sample	-0.17	2.64	1.00	0.98	Inflationary

Notes: *Asymmetry Ratio = (Mean Inflationary Pressure)/(Mean Deflationary Pressure). Persistence measured as first-order autocorrelation coefficient. Dominant component determined by which pressure contributes more to net inflation variance. Correlation shows contemporaneous relationship between pressure components. Negative correlations suggest offsetting dynamics, while positive correlations indicate co-movement.

3.6 Post-Crisis Recovery and the "Lowflation" Period (2010-2019)

The post-crisis decade reveals another distinctive pressure configuration that provides new insights into one of the most puzzling macroeconomic phenomena of recent decades. Inflationary pressure fell to its lowest sustained level in the modern era, averaging just 3.67% with minimal volatility (0.39%). Meanwhile, deflationary pressure stabilized at 2.11%, similar to Great Moderation levels. This produced average net inflation of only 1.56%-well below the Federal Reserve's 2% target.

Our pressure decomposition offers a pressure perspective on the "lowflation" puzzle that has occupied researchers including Yellen (2017), who observed that inflation remained below target for an extended period despite sustained monetary accommodation. The puzzle becomes clearer through our framework: the problem was not excessive deflationary pressure but rather insufficient inflationary pressure. Despite unprecedented monetary accommodation, firms appeared reluctant to raise prices aggressively, possibly reflecting persistent effects of the crisis on expectations, competitive dynamics, or structural changes in the economy.

This finding complements but refines the analysis by Del Negro et al. (2015), who used DSGE models to argue that the slow recovery explained low inflation through traditional Phillips curve channels. Our decomposition suggests that while weak aggregate demand may have contributed to low inflation, the mechanism worked primarily by constraining inflationary pressure rather than by strengthening deflationary pressure.

The stability of both pressure components during this period—with coefficients of variation below 0.20 for both measures—suggests that the low inflation environment became entrenched in pricing behavior across sectors. The correlation between components was -0.34 (Table 3), indicating continued offsetting dynamics, while the asymmetry ratio of 1.74 represented relatively balanced conditions.

3.7 The COVID-19 Inflation Surge: Return of Pressure Dynamics (2020-2024)

The COVID-19 era represents one of the most dramatic shifts in pressure dynamics since the 1970s, offering insights into contemporary inflation mechanisms that complement recent analyses of pandemic-era price dynamics. As shown in the fourth panel of Figure 4, inflationary pressure surged to an average of 6.22%—a 70% increase relative to the pre-pandemic decade—while deflationary pressure increased more modestly to 2.52%. The resulting average net inflation of 3.70% marked the highest sustained inflation in over three decades.

Our pressure decomposition provides new perspectives on the debate over the causes of COVID-19 inflation. Blanchard and Pisani-Ferry (2022) argued that the inflation surge reflected both supply and demand factors, while others emphasized supply chain disruptions (Benigno et al., 2022) or fiscal stimulus (Summers, 2021). Our framework suggests that regardless of the initial causes, the inflation surge manifested primarily through an intensification of inflationary pressure rather than a collapse of deflationary forces.

The volatility patterns during the COVID era echo those of earlier inflationary episodes and provide support for historical parallels. Inflationary pressure volatility increased dramatically to 1.57%—reaching levels not seen since the 1970s-1980s—while deflationary pressure volatility remained relatively contained at 0.53%. This pattern is remarkably similar to what we observed during the Great Inflation, supporting arguments by economists like Summers (2021) who drew parallels between the 1970s and the current period.

However, our decomposition also reveals important differences from the 1970s experience. The peak inflationary pressure of 9.05% reached in 2021-2022, while high, remained well below the 12.68% peak of the early 1980s. More importantly, deflationary pressure did not collapse entirely during the COVID surge, maintaining levels above 1.5% throughout the period. This suggests that competitive forces and price sensitivity remained more operative during the COVID inflation than during the 1970s, potentially explaining why inflation expectations remained better anchored as noted by Borio et al. (2023).

The correlation analysis shows a strong negative correlation of -0.50 during the COVID period (Table 3), indicating significant offsetting dynamics. The asymmetry ratio of 2.47, while elevated, remained below the extreme levels observed during the 1970s-1980s, consistent with the view that market mechanisms remained more functional during the recent episode.

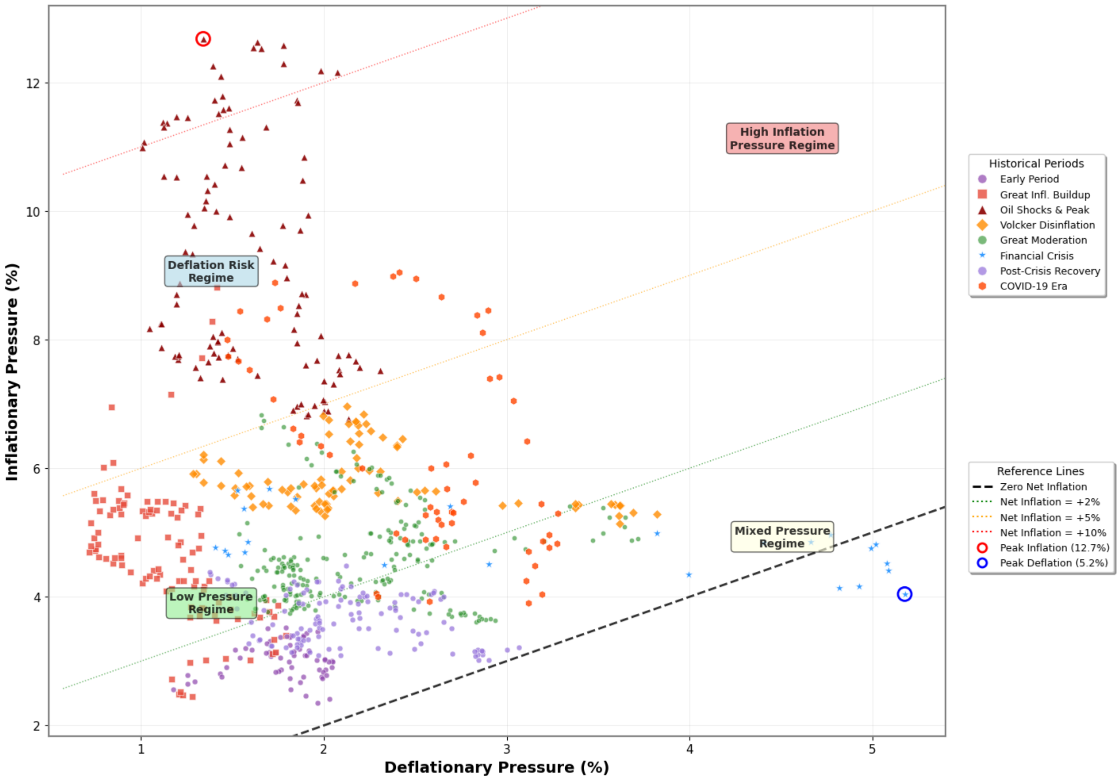


Figure 5: Inflation Pressure Phase Diagram (1959-2024)

3.8 Cross-Period Comparisons and Structural Insights

Our pressure decomposition reveals several important structural features of inflation dynamics that complement and extend existing analytical frameworks. The persistence analysis in Table 3 reveals an intriguing state-dependent pattern: inflationary pressure exhibits higher persistence than deflationary pressure during periods of elevated inflation (Great Inflation Buildup: 0.99 vs 0.96, Oil Shocks: 0.99 vs 0.96, COVID-19: 0.99 vs 0.95), while deflationary pressure shows higher persistence during periods of disinflation or economic distress (Volcker Disinflation: 0.97 vs 0.95, Financial Crisis: 0.96 vs 0.90, Post-Crisis Recovery: 0.96 vs 0.95). This state-dependent persistence pattern suggests that the dominant pressure component tends to be more persistent - when inflationary forces dominate the economy, they exhibit greater inertia, while during disinflationary episodes, downward price adjustments become more persistent. This finding is consistent with state-dependent pricing models where firms' adjustment behavior depends on the macroeconomic environment (Golosov and Lucas Jr, 2007).This differential persistence varies with the economic regime, providing micro-founded support for state-dependent models of price adjustment where persistence itself responds to macroeconomic conditions.

The asymmetric behavior of pressure components is quantified in Table 3, which shows that the asymmetry ratio ranges from 1.46 during the financial crisis to 5.85 during the oil shock period. Across the full sample, inflationary pressure averages 2.64 times the level of deflationary pressure, confirming the fundamental asymmetry in price-setting behavior. Moreover, the correlation between pressure components varies dramatically across periods, from strongly negative during crisis periods (Financial Crisis: -0.54, COVID-19: -0.50) to near-zero during stable times (Great Moderation: 0.09), suggesting that the relationship between upward and downward pricing pressures is highly state-dependent.

The episodes where deflationary pressure does surge—notably during the Volcker disinflation, the 2008-2009 crisis, and to a lesser extent during the early 1960s—appear to coincide with periods of significant economic disruption or policy regime change. This pattern is consistent with state-dependent pricing models, as in Golosov and Lucas Jr (2007), that predict more frequent price adjustments during periods of high uncertainty or large shocks. [1] Our aggregate evidence

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[1] While Golosov and Lucas Jr (2007) do not explicitly model uncertainty, one could argue that large shocks or volatile environments—which often coincide with heightened uncertainty—lead firms to adjust prices more frequently in state-dependent frameworks.

suggests that while downward price adjustments are generally constrained, sufficiently severe shocks can overcome these constraints and generate substantial deflationary pressure.

The volatility evolution shown in Figure 3 and analyzed systematically in Table 2 provides new insights into the sources of inflation predictability. Our findings complement Cogley and Sargent's 2005 work on time-varying inflation persistence by showing that changes in aggregate inflation dynamics reflect shifting balances between pressure components rather than simple changes in overall inflation variability. The Great Moderation's success appears to have stemmed from stabilizing inflationary pressure while allowing controlled flexibility in deflationary pressure, while the current policy challenge involves managing the resurgence of volatile inflationary pressure dynamics.

The phase diagram in Figure 5 reveals distinct clustering patterns by historical period, with clear evolution from one regime to another. The Financial Crisis stands out as the unique period where observations cluster near or below the 45-degree line, confirming it as the only episode of true deflation risk in our sample. The COVID-19 period shows renewed dispersion above the diagonal but with less extreme positioning than the 1970s-1980s episodes.

These patterns provide new evidence for the debate over the sources of inflation persistence. Our finding that inflationary pressure exhibits much greater persistence than deflationary pressure across all periods (with full sample autocorrelations of 1.00 versus 0.98) supports models that emphasize intrinsic inflation persistence as in Christiano et al. (2005) over purely forward-looking models. However, the fact that both components can shift rapidly during crisis periods suggests that persistence is state-dependent rather than structural.

The decomposition thus provides both historical perspective and contemporary relevance for understanding how inflation materializes through the complex interaction of sectoral pricing decisions. As policymakers grapple with the challenges of maintaining price stability in an evolving economic environment, this pressure-based framework offers a valuable lens for monitoring and interpreting the sectoral foundations of inflation dynamics. The asymmetric nature of pressure evolution, the state-dependent correlations between components, and the regime-dependent persistence patterns all point toward a richer understanding of inflation formation that goes beyond traditional aggregate measures to capture the underlying microeconomic foundations of price-setting behavior.

4 The Price Puzzle Revisited

The price puzzle—where inflation rises following contractionary monetary policy—has been a persistent challenge in empirical macroeconomics since Sims (1986). This section leverages our decomposition framework to provide new insights into this puzzle by examining how monetary policy shocks affect inflationary and deflationary pressures separately. Our approach offers a pressure-based interpretation of the puzzle and tests whether recent advances in shock identification have truly resolved it.

4.1 Monetary Policy Shocks and Identification

We employ two prominent monetary policy shock series that represent different approaches to addressing identification challenges in the literature.

4.1.1 Romer and Romer (2004) Shock

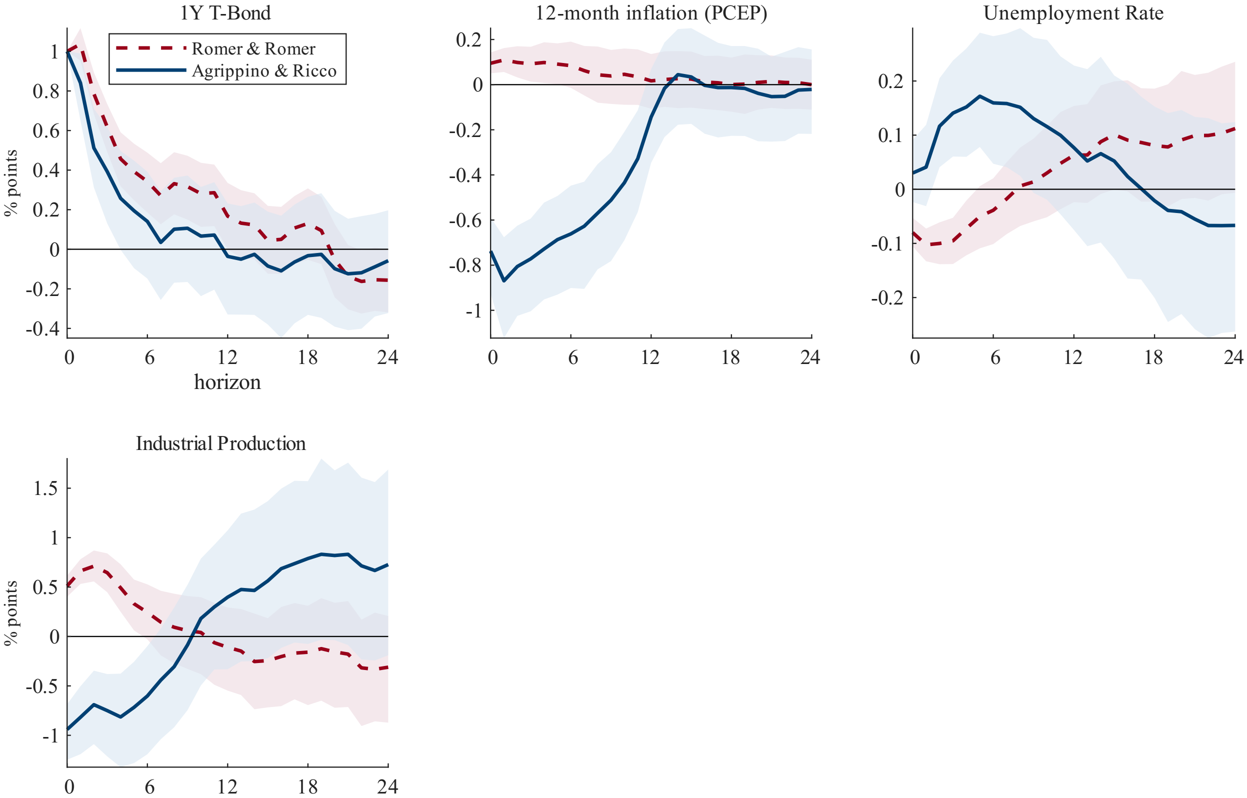
The Romer and Romer (2004) narrative approach constructs shocks by regressing the Federal Reserve's intended federal funds rate changes on Greenbook forecasts, interpreting residuals as policy innovations orthogonal to the Fed's information set. This approach addresses the "Fed information effect" problem identified by Romer and Romer (2000), where the central bank's superior information could contaminate shock identification.

Despite widespread use, studies employing this shock series often find persistent price puzzles, particularly in more recent samples (Ramey, 2016; Barakchian and Crowe, 2013). The puzzle's persistence has led to several explanations, including imperfect measurement of the Fed's information set and the presence of cost channels in monetary transmission (Barth and Ramey, 2002; Christiano et al., 2005).

4.1.2 Miranda-Agrippino and Ricco (2021) Shock

Miranda-Agrippino and Ricco (2021) develop an informationally robust shock that combines high-frequency identification with narrative approaches while explicitly modeling information frictions. Their methodology addresses both the Fed information effect and delayed information absorption by private agents, producing shocks that eliminate traditional monetary policy puzzles across different specifications. This shock series represents the current frontier in monetary policy identification and provides a benchmark for evaluating whether puzzling responses reflect genuine economic mechanisms or identification problems.

Figure 6: Baseline - Bayesian Local Projections IRFs



Note: The figure reports impulse responses estimated using Bayesian Local Projections using the identification scheme of Romer and Romer (2004) and Miranda-Agrippino and Ricco (2021) shocks separately. Inflation rates are measured as the logarithmic growth of the corresponding price index. All responses are normalized such that the identified shock raises the one-year Treasury rate by one percentage point on impact. The BLP model is estimated using data from 1979M1 to 2014M12, with prior information based on the pre-sample period 1973M1 to 1979M12.

4.2 Empirical Framework

4.2.1 Bayesian Local Projections

We estimate impulse response functions using the Bayesian Local Projections (BLP) methodology of Ferreira et al. (2025). This approach combines the robustness of local projections with the efficiency of Bayesian VARs, making it particularly suitable for analyzing monetary transmission through our pressure components.

The BLP framework estimates the sequence:

$$y_{t+h} = \alpha_h + \beta_h \epsilon_t^{MP} + \sum_{j=1}^{p} \Gamma_{h,j} X_{t-j} + u_{t+h} \tag{20}$$

where y_{t+h} represents either aggregate inflation or our pressure components, ϵ_t^{MP} is the monetary policy shock, and X_t contains control variables. We follow Ferreira et al. (2025) in using a pre-sample period (1973M1-1979M12) to construct informative priors, with the main estimation covering 1979M1-2014M12.

4.2.2 Variable Set and Normalization

Our baseline specification includes industrial production, unemployment rate, PCE inflation, commodity prices, excess bond premium (Gilchrist and Zakrajšek, 2012), and the one-year Treasury rate as the policy variable. All shocks are normalized to generate a one percentage point increase in the one-year rate on impact. This specification closely follows the literature while substituting PCE inflation for CPI inflation to maintain consistency with our decomposition framework.

4.3 Baseline Results

Figure 6 presents impulse responses to both shock series for standard macroeconomic variables. Consistent with the literature, the Romer-Romer shock generates a price puzzle lasting approximately six months, while the Miranda-Agrippino-Ricco shock produces the expected decline in inflation. The unemployment and industrial production responses align with conventional views of monetary transmission under the informationally robust shock, while showing counterintuitive patterns under the narrative shock. These baseline results confirm that substituting PCE for CPI inflation does not materially affect the main findings, validating our choice to use the PCE-based decomposition for the subsequent analysis.

4.4 Pressure Dynamics and the Price Puzzle

4.4.1 Decomposition Results

Figure 7 presents our main results examining how monetary policy shocks affect inflation through the pressure channel decomposition. The findings reveal stark differences between the two shock series and shed light on the nature of the price puzzle.

Romer-Romer Shock Response: The narrative shock produces a sustained increase in inflationary pressure, rising by over 0.1 percentage points on impact and remaining elevated for more than a year. In contrast, deflationary pressure shows only a brief and modest increase lasting a few months before becoming statistically insignificant. This pattern indicates that the price puzzle under this identification stems primarily from intensified upward pricing momentum rather than weakened downward price adjustments.

Miranda-Agrippino-Ricco Shock Response: The informationally robust shock generates markedly different dynamics. Deflationary pressure increases by 0.4 percentage points on impact, peaking at 0.5 percentage points after two months, and remaining elevated for approximately one year. Meanwhile, inflationary pressure declines by 0.3 percentage points initially and gradually returns to baseline. This dual-channel configuration—with deflationary pressure contributing the larger and more persistent disinflationary effect—is consistent with standard monetary transmission mechanisms where contractionary policy reduces aggregate demand, encouraging both price cuts and restraining price increases.

4.4.2 Interpretation Through Transmission Channels

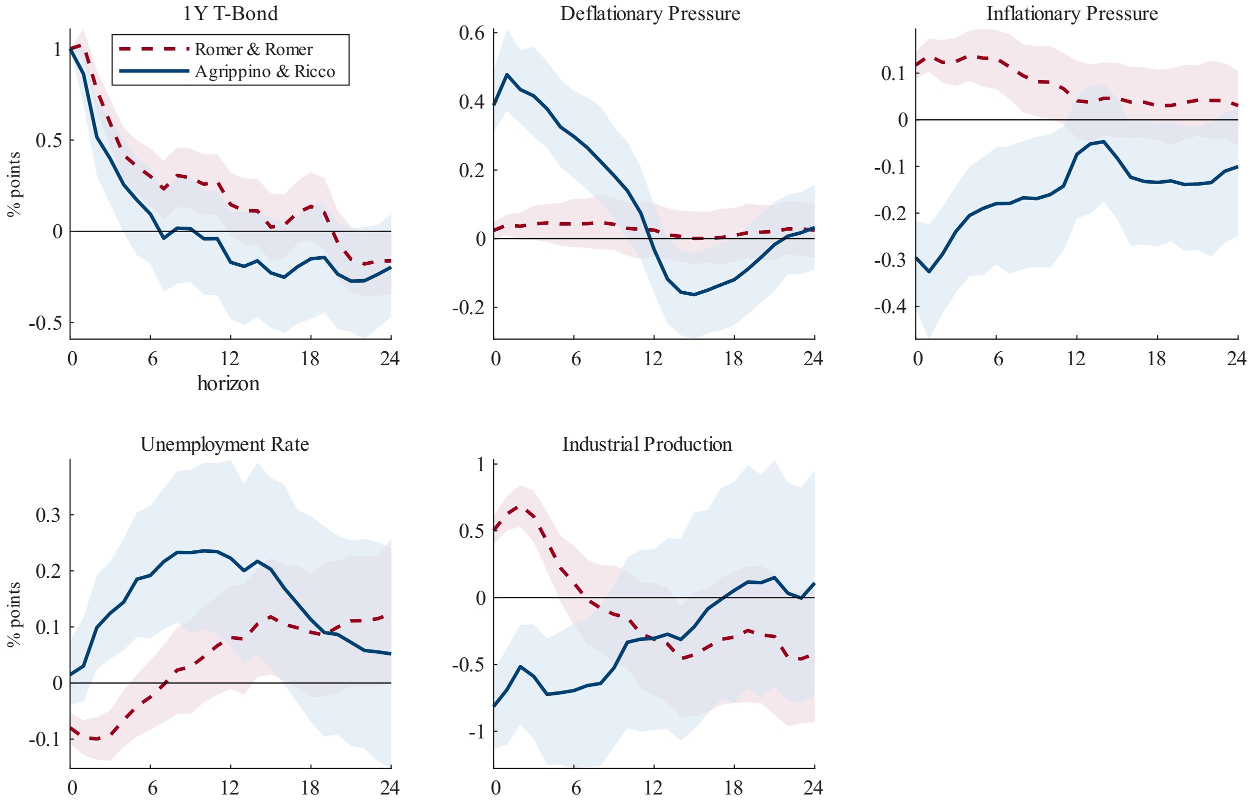
Our framework enables a novel interpretation of these patterns through the lens of monetary transmission channels. The sustained increase in inflationary pressure under the Romer-Romer shock is consistent with cost channel effects, where monetary tightening raises firms' financing costs and leads to higher prices (Barth and Ramey, 2002; Ravenna and Walsh, 2006). However, the absence of a corresponding decrease in deflationary pressure suggests this interpretation faces empirical challenges. The Miranda-Agrippino-Ricco shock results align closely with demand channel transmission, where contractionary policy reduces aggregate demand and leads firms to cut prices. The strong and persistent increase in deflationary pressure, combined with stable inflationary pressure, supports this conventional view of monetary transmission.

4.5 Resolution of the Price Puzzle

Our decomposition provides clear evidence that the Miranda-Agrippino-Ricco shock resolves the price puzzle not just at the aggregate level but also at the component level. The pronounced and theoretically consistent responses in both pressure components suggest that this identification successfully captures genuine monetary transmission mechanisms.

In contrast, the Romer-Romer shock generates what we term a "partial price puzzle"—one that operates primarily through the inflationary pressure channel without corresponding movements in deflationary pressure. While this pattern might initially suggest cost channel effects, the theoretical literature emphasizes that such effects should be primarily short-lived (Barth and Ramey, 2002), and empirical support for cost channels strong enough to generate sustained price puzzles remains limited.

Figure 7: Main Result: Bayesian Local Projections



Note: The figure reports impulse responses estimated using Bayesian Local Projections using the identification scheme of Romer and Romer (2004) and Miranda-Agrippino and Ricco (2021) shocks separately. Inflation rates are measured as the logarithmic growth of the corresponding price index. All responses are normalized such that the identified shock raises the one-year Treasury rate by one percentage point on impact. The BLP model is estimated using data from 1979M1 to 2014M12, with prior information based on the pre-sample period 1973M1 to 1979M12.

4.6 Robustness Checks

To establish the credibility of our main findings, we conduct several robustness exercises that examine the sensitivity of our results to alternative specifications and methodological choices. These tests are particularly important given the ongoing debate about optimal approaches to monetary policy shock identification (Ramey, 2016) and the sensitivity of impulse response estimates to specification choices (Christiano et al., 2005).

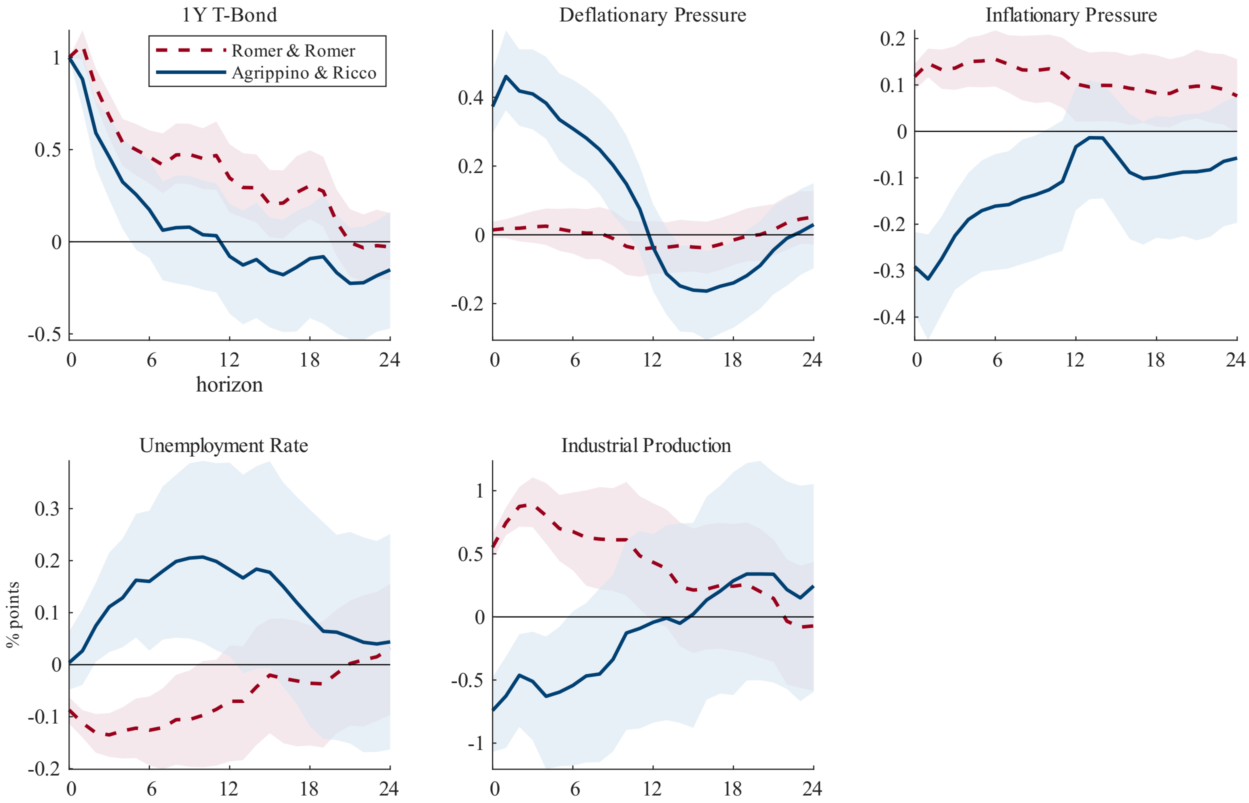
4.6.1 Alternative Control Variable Specifications

Our first robustness check examines sensitivity to the inclusion of financial market indicators that have become prominent in monetary transmission research. Figure 8 presents results excluding the excess bond premium of Gilchrist and Zakrajšek (2012) from our baseline BLP estimation. This exercise is motivated by concerns that financial market variables may themselves respond endogenously to monetary policy, potentially contaminating our identification (Miranda-Agrippino and Ricco, 2021).

The results reveal important differences in the responses to the two shock series. For the Romer-Romer shock, removing the excess bond premium strengthens our main findings: the deflationary pressure response becomes statistically insignificant, while the inflationary pressure response remains significantly positive for over two years—compared to only one year in our baseline. This enhanced sensitivity reinforces our interpretation that the Romer-Romer shock suffers from specification issues rather than capturing genuine cost-channel effects.

In contrast, both pressure components' responses to the Miranda-Agrippino-Ricco shock remain virtually unchanged, demonstrating the robustness of informationally-robust identification. The persistence of strong deflationary pressure responses (peaking at 0.4 percentage points) and stable inflationary pressure declines aligns with theoretical predictions of demand-channel transmission (Christiano et al., 2005). This differential sensitivity across shock series supports recent arguments by Miranda-Agrippino and Ricco (2021) that proper identification of monetary policy shocks should be robust to reasonable specification choices.

Figure 8: Robustness 1: Bayesian Local Projections excluding Excess Bond Premium



Note: The figure reports impulse responses estimated using Bayesian Local Projections using the identification scheme of Romer and Romer (2004) and Miranda-Agrippino and Ricco (2021) shocks separately. Inflation rates are measured as the logarithmic growth of the corresponding price index. All responses are normalized such that the identified shock raises the one-year Treasury rate by one percentage point on impact. The BLP model is estimated using data from 1979M1 to 2014M12, with prior information based on the pre-sample period 1973M1 to 1979M12.

4.6.2 Cross-Method Validation

Our second robustness exercise compares BLP estimates with traditional Bayesian VAR and local projection methods, following the methodological comparison framework of Ramey (2016). Figure 9 presents impulse responses estimated using all three approaches with identical lag structures (12 lags) and variable sets.

For the Miranda-Agrippino-Ricco shock (Panel 9a), all three methods produce qualitatively consistent results, though with notable dynamic differences. The BVAR implies more persistent inflationary pressure declines lasting over two years, while the BLP suggests convergence to zero within one year. Critically, the sign and economic interpretation remain consistent across methods: contractionary policy increases deflationary pressure while reducing inflationary pressure, consistent with standard demand-channel transmission.

The cross-method comparison proves particularly revealing for the Romer-Romer shock (Panel 9b). While all three approaches show similar inflationary pressure responses, deflationary pressure responses vary considerably in magnitude and persistence. Local projections produce the largest deflationary response, followed by BVAR and BLP. However, the confidence intervals for local projections are substantially wider, highlighting the efficiency gains from Bayesian regularization noted by Ferreira et al. (2025).

This pattern of sensitivity is consistent with Stock and Watson (2018), who demonstrate that misspecified policy shocks tend to produce unstable results across different estimation methods. The remarkable stability of the Miranda-Agrippino-Ricco results across methodologies, combined with the instability of Romer-Romer responses, provides strong evidence supporting our main interpretation of the price puzzle resolution.

4.6.3 Implications for Monetary Policy Shock Identification

Our robustness exercises contribute to the broader literature on monetary policy identification by demonstrating that pressure decomposition provides a useful diagnostic tool for evaluating shock quality. The framework's ability to reveal different transmission channels offers a more nuanced assessment than aggregate inflation responses alone.

Following Ramey (2016), we interpret the sensitivity of Romer-Romer shock results across specifications as evidence of potential misidentification, while the robustness of Miranda-Agrippino-Ricco results supports their informationally-robust approach. This finding has important implications for empirical monetary economics, suggesting that future research should evaluate shock series not only based on aggregate responses but also on their component-level stability and theoretical consistency.

The cross-method stability analysis extends recent work by Plagborg-Møller and Montiel Olea (2021) on the efficiency of different impulse response estimators. Our results demonstrate that while local projections offer transparency, the efficiency gains from Bayesian methods become particularly valuable when analyzing more granular decompositions that may be noisier than aggregate series.

4.7 Implications for Monetary Policy

Our findings offer several important insights for monetary policy conduct and central bank communication. The component-level analysis reveals that successful monetary transmission operates through demand channels, generating both increased deflationary pressure and reduced inflationary pressure, with the deflationary channel providing the larger and more persistent contribution to the disinflationary effect. This insight has practical implications for how central banks should interpret and respond to inflation dynamics.

- **Real-Time Monitoring and Diagnosis:** Our decomposition framework provides central banks with a tool for real-time diagnosis of inflation sources and transmission effectiveness. During periods when aggregate inflation appears unresponsive to policy actions, pressure component analysis can reveal whether the issue stems from insufficient demand-channel transmission (weak deflationary pressure response) or offsetting supply-side forces (elevated inflationary pressure). This diagnostic capability could prove particularly valuable during episodes like the post-2008 "lowflation" period, where our analysis suggests the problem was insufficient inflationary pressure rather than excessive deflationary forces.

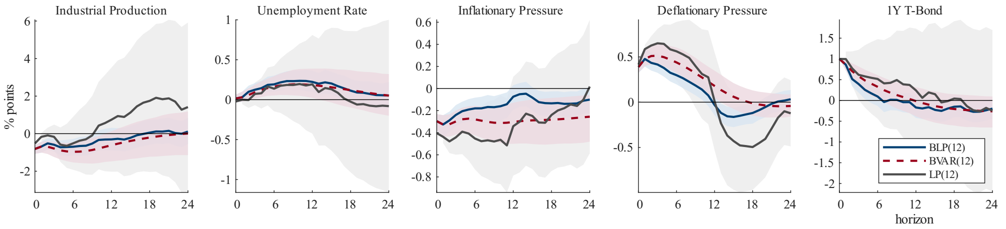
- **Forward Guidance and Communication:** The asymmetric nature of pressure dynamics—with inflationary pressure exhibiting much greater volatility than deflationary pressure—suggests that forward guidance might be most effective when it anchors expectations about upward pricing momentum rather than focusing solely on aggregate inflation targets. Central banks might enhance their communication by explaining how policy actions are expected to influence the balance between pressure components, potentially improving the transmission of monetary policy through expectations channels (Bernanke, 2004).

- **Policy Framework Design:** Our historical analysis suggests that successful monetary policy frameworks achieve inflation stability by maintaining balanced pressure dynamics rather than suppressing overall price movements. The Great Moderation's achievement appears to reflect stabilization of inflationary pressure while preserving sufficient flexibility in deflationary pressure to allow for relative price adjustments. Moreover, the state-dependent persistence patterns we document suggest that central banks should adjust their reaction functions based on which pressure component dominates, as persistence characteristics change with the macroeconomic regime.

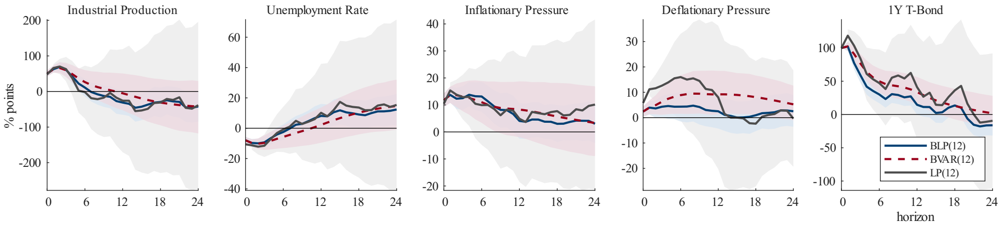
- **Crisis Response and Deflation Risk Assessment:** The 2008-2009 financial crisis represents the unique episode in our sample where deflationary pressure dominated, creating deflation risk. Our framework provides early warning indicators for such episodes by monitoring the balance between pressure components. When deflationary pressure persistently exceeds inflationary pressure, as during the crisis, it signals the need for aggressive monetary accommodation to prevent deflationary spirals.

Figure 9: Robustness: BVAR, LP and BLP with Miranda-Agrippino and Ricco (2021) and Romer and Romer (2004) shocks

(a) Shock: Miranda-Agrippino and Ricco (2021)



(b) Shock: Romer and Romer (2004)



Note: The figure reports impulse responses estimated using Bayesian Local Projections, Bayesian VAR and Local Projections using the identification scheme of Romer and Romer (2004) and Miranda-Agrippino and Ricco (2021) shocks separately. Inflation rates are measured as the logarithmic growth of the corresponding price index. All responses are normalized such that the identified shock raises the one-year Treasury rate by one percentage point on impact. All models are estimated using data from 1979M1 to 2014M12. For the BLP, prior information based on the pre-sample period 1973M1 to 1979M12.

5 Conclusions

This paper introduces a pressure decomposition of inflation, reframing price dynamics as the net outcome of competing forces: inflationary pressure, capturing the frequency and magnitude of price increases, and deflationary pressure, capturing corresponding decreases. Applied to more than six decades of U.S. data using 245 PCE sub-indices, our framework reveals fundamental asymmetries in inflation formation and provides new insights into both historical inflation dynamics and the persistent price puzzle in monetary economics.

Our key empirical findings establish that inflation episodes are primarily driven by surges in inflationary pressure rather than retreats of deflationary forces, with deflationary pressure remaining remarkably stable across most historical periods. This fundamental asymmetry—with inflationary pressure ranging from 2.35% to 12.68% while deflationary pressure varies only between 0.72% and 5.18%—provides quantitative support for the intuition that inflation emerges from forces pushing prices upward rather than from weakened downward price adjustments. Additionally, we document state-dependent persistence patterns where the dominant pressure component in each regime exhibits greater inertia.

Historical analysis reveals distinct pressure regimes corresponding to major macroeconomic episodes: the Great Inflation featured extreme inflationary pressure volatility, the Great Moderation achieved balanced dynamics through stabilized inflationary pressure, the 2008-2009 crisis uniquely witnessed deflationary pressure dominance creating deflation risk, while the COVID-19 era saw dramatic inflationary pressure resurgence reminiscent of the 1970s. These patterns offer new perspectives on the evolution of price-setting behavior and monetary policy effectiveness across different economic environments.

Our reexamination of the price puzzle demonstrates that informationally robust monetary policy shocks resolve puzzling responses completely at both aggregate and component levels, operating through both increased deflationary pressure and reduced inflationary pressure, with the deflationary channel providing the dominant contribution consistent with demand channel transmission. Conventional narrative shocks generate partial puzzles through sustained inflationary pressure increases that lack theoretical foundation, suggesting that apparent price puzzles reflect identification problems rather than genuine economic phenomena.

The robustness exercises confirm that our main results are stable across alternative specifications and estimation methods when using properly identified shocks, while highlighting the sensitivity of misspecified shock series. This finding contributes to the monetary policy identification literature by demonstrating that pressure decomposition provides a valuable diagnostic tool for evaluating shock quality beyond aggregate responses.

For monetary policy practice, our framework offers several insights. Successful policy operates through managing the balance between pressure components rather than simply suppressing aggregate measures, suggesting that central banks should monitor pressure dynamics for both real-time diagnosis and forward guidance communication. The asymmetric nature of pressure evolution indicates that policy frameworks should focus on anchoring expectations about upward pricing momentum while preserving flexibility for relative price adjustments.

The price-setting foundations of our decomposition, combined with its exact mathematical properties and rich empirical applications, establish it as a promising framework for future research on inflation dynamics. Natural extensions include applications to other countries, higher-frequency data, and integration with structural models to better understand the microeconomic foundations of monetary transmission. The state-dependent nature of persistence in our pressure components suggests that future research should explore time-varying parameter models and regime-switching frameworks to better capture these dynamics. The framework's ability to transparently map disaggregated sectoral price dynamics into macroeconomic aggregates—while preserving sectoral heterogeneity across sectors—offers valuable opportunities for bridging micro-founded intuition and aggregate inflation analysis.

Our findings ultimately support the view that understanding inflation requires frameworks that capture the heterogeneous, sectoral foundations of price-setting decisions. By revealing how inflation emerges from the complex interaction of sectoral pricing choices, our decomposition provides both historical insights and practical tools for navigating the challenges of maintaining price stability in an evolving economic environment.

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Appendix A Personal Consumption Expenditure Price Indices

Index	**Code**
New domestic autos	DNDCRG
New foreign autos	DNFCRG
New domestic light trucks	IA001081
New foreign light trucks	IA001083
Net transactions in used autos	DNETRG
Used auto margin	DMARRG
(Less) Employee reimbursement	DREERG
Net transactions in used trucks	DUTNRG
Used truck margin	DUTMRG
Tires	DTATRG
Accessories and parts	DPAARG
Furniture	DFNRRG
Clocks, lamps, lighting fixtures, and other household decorative items	DCLFRG
Carpets and other floor coverings	DFLRRG
Window coverings	DWCTRG
Major household appliances	DMHARG
Small electric household appliances	DSEARG
Dishes and flatware	DCHNRG
Nonelectric cookware and tableware	DNECRG
Tools, hardware, and supplies	DHDWRG
Outdoor equipment and supplies	DLWNRG
Televisions	DTVSRG
Other video equipment	DOVARG
Audio equipment	DAUDRG
Audio discs, tapes, vinyl, and permanent digital downloads	DRTDRG
Video discs, tapes, and permanent digital downloads	DOVERG
Photographic equipment	DCAMRG
Personal computers/tablets and peripheral equipment	DCPPRG
Computer software and accessories	DCPSRG
Calculators, typewriters, and other information processing equipment	DOIPRG
Sporting equipment, supplies, guns, and ammunition	DSPGRG
Motorcycles	DMCYRG
Bicycles and accessories	DBCYRG
Pleasure boats	DBOARG
Pleasure aircraft	DAIRRG
Other recreational vehicles	DREVRG
Recreational books	DRBKRG
Musical instruments	DMSCRG
Jewelry	DJLYRG
Watches	DWTCRG
Therapeutic medical equipment	DTMERG
Corrective eyeglasses and contact lenses	DEYERG
Educational books	DEBKRG
Luggage and similar personal items	DLUGRG
Telephone and related communication equipment	DTCERG
Cereals	DGRARG
Bakery products	DBAKRG
Beef and veal	DBEERG
Pork	DPORRG
Other meats	DMEARG
Poultry	DPOURG
Fish and seafood	DFISRG
Fresh milk	DMILRG

table continues

Table A1 – table continues

Index	**Code**
Processed dairy products	DDAIRG
Eggs	DGGSRG
Fats and oils	DFATRG
Fruit (fresh)	DFRURG
Vegetables (fresh)	DVEGRG
Processed fruits and vegetables	DPFVRG
Sugar and sweets	DSWERG
Food products, not elsewhere classified	DOFDRG
Coffee, tea, and other beverage materials	DCTMRG
Mineral waters, soft drinks, and vegetable juices	DJNBRG
Spirits	DLIQRG
Wine	DWINRG
Beer	DMLTRG
Food produced and consumed on farms	DFFDRG
Women’s and girls’ clothing	DWGCRG
Men’s and boys’ clothing	DMBCRG
Children’s and infants’ clothing	DCICRG
Clothing materials	DCSMRG
Standard clothing issued to military personnel	DMICRG
Shoes and other footwear	DSHURG
Gasoline and other motor fuel	DGASRG
Lubricants and fluids	DLUBRG
Fuel oil	DOILRG
Other fuels	DLPFRG
Prescription drugs	DRXDRG
Nonprescription drugs	DNRDRG
Other medical products	DOMPRG
Games, toys, and hobbies	DDOLRG
Pets and related products	DPRPRG
Flowers, seeds, and potted plants	DFLORG
Film and photographic supplies	DFLMRG
Household cleaning products	DCLERG
Household paper products	DPAPRG
Household linens	DLINRG
Sewing items	DSEWRG
Miscellaneous household products	DMHPRG
Hair, dental, shaving, and miscellaneous personal care products except electrical products	DOPHRG
Cosmetic / perfumes / bath / nail preparations and implements	DCOSRG
Electric appliances for personal care	DEAPRG
Tobacco	DTOBRG
Newspapers and periodicals	DMAGRG
Stationery and miscellaneous printed materials	DSTYRG
Government employees’ expenditures abroad	DARTRG
Private employees’ expenditures abroad	DARSRG
(Less) Personal remittances in kind to nonresidents	DREMRG
Tenant-occupied mobile homes	DTMHRG
Tenant-occupied stationary homes	DTSPRG
Tenant landlord durables	DTLDRG
Tenant-occupied, including landlord durables	IA000630
Owner-occupied mobile homes	DOMHRG
Owner-occupied stationary homes	DOSTRG
Rental value of farm dwellings	DFARRG
Group housing	DGRHRG
Water supply and sewage maintenance	DWSMRG
Garbage and trash collection	DREFRG
	table continues

Table A1 – table continues

Index	Code
Electricity	DELCRG
Natural gas	DGHERG
Physician services	DPHYRG
Dental services	DDENRG
Home health care	DHHCRG
Medical laboratories	DMLBRG
Specialty outpatient care facilities and health and allied services	DOMSRG
All other professional medical services	DOMORG
Nonprofit hospitals' services to households	DNPHRG
Proprietary hospitals	DFPHRG
Government hospitals	DGVHRG
Nonprofit nursing homes' services to households	DNPNRG
Proprietary and government nursing homes	DFPNRG
Motor vehicle maintenance and repair	DVMRRG
Auto leasing	DALERG
Truck leasing	DTLERG
Motor vehicle rental	DMVRRG
Parking fees and tolls	DPFTRG
Railway transportation	DIRRRG
Intercity buses	DIBURG
Taxicabs and ride sharing services	DTAXRG
Intracity mass transit	DIMTRG
Other road transportation service	DORTRG
Air transportation	DAITRG
Water transportation	DWATRG
Membership clubs and participant sports centers	DMDFRG
Amusement parks, campgrounds, and related recreational services	DORSRG
Motion picture theaters	DMOVRG
Live entertainment, excluding sports	DLIGRG
Spectator sports	DSPERG
Museums and libraries	DMUSRG
Cable, satellite, and other live television services	DCTVRG
Photo processing	DFDVRG
Photo studios	DPICRG
Repair and rental of audio-visual, photographic, and information processing equipment	DAPIRG
Video streaming and rental	IA000233
Audio streaming and radio services (including satellite radio)	IA000232
Casino gambling	DCASRG
Lotteries	DLOTRG
Pari-mutuel net receipts	DPARRG
Veterinary and other services for pets	DVETRG
Package tours	DHOLRG
Maintenance and repair of recreational vehicles and sports equipment	DRRERG
Elementary and secondary school lunches	DESLRG
Higher education school lunches	DHSLRG
Meals at limited service eating places	DMLSRG
Meals at other eating places	DMOERG
Meals at drinking places	DMDPRG
Alcohol in purchased meals	DAPMRG
Food supplied to civilians	DCFDRG
Food supplied to military	DMFDRG
Hotels and motels	DHOTRG
Housing at schools	DSCHRG
Commercial banks	DIMCRG
Other depository institutions and regulated investment companies	DIMNRG

table continues

Table A1 – table continues

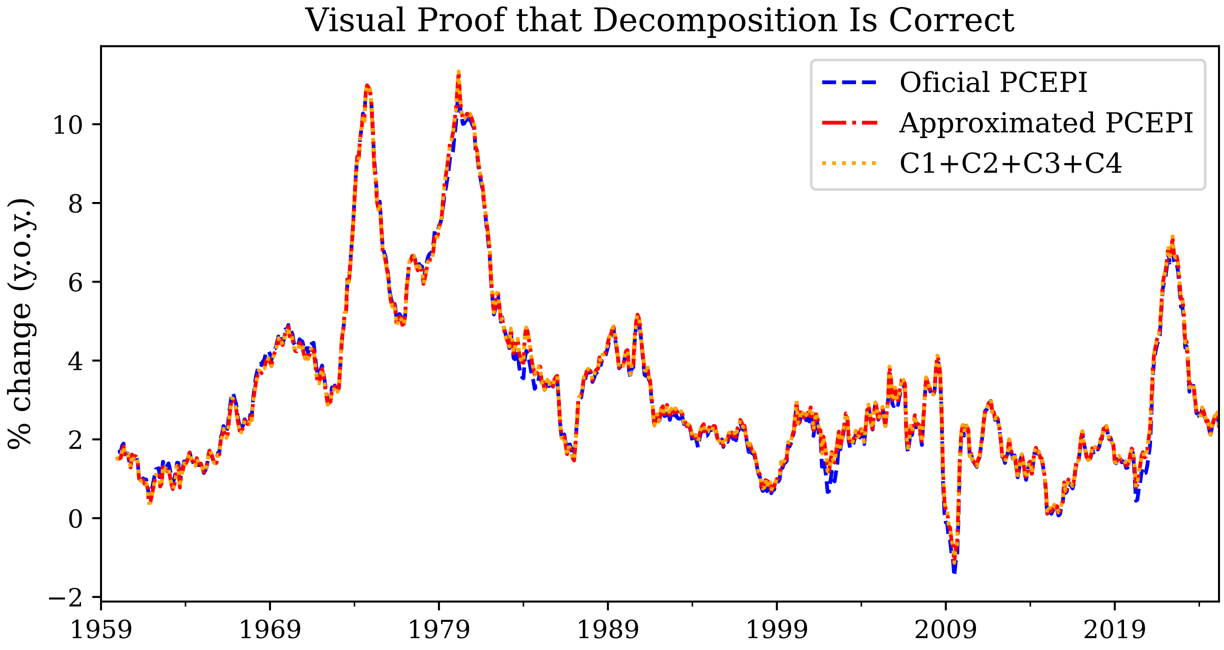
Index	Code
Pension funds	DPENRG
Financial service charges and fees	DFEERG
Exchange-listed equities	DDCERG
Other direct commissions	DDCORG
Over-the-counter equity securities	DICVRG
Other imputed commissions	DICORG
Mutual fund sales charges	DMUTRG
Portfolio management and investment advice services	DPMIRG
Trust, fiduciary, and custody activities	DTRURG
Life insurance	DLIFRG
Household insurance premiums and premium supplements	DFIPRG
(Less) Household insurance normal losses	DFIBRG
Medical care and hospitalization	DMINRG
Income loss	DIINRG
Workers' compensation	DPWCRG
Net motor vehicle and other transportation insurance	DTINRG
Land-line telephone services, local charges	DLOCRG
Land-line telephone services, long-distance charges	DLDTRG
Cellular telephone services	DCELRG
First-class postal service (by U.S. Postal Service)	DPSTRG
Other delivery services (by non-U.S. postal facilities)	DODSRG
Internet access	DINTRG
Proprietary and public higher education	DGEDRG
Nonprofit private higher education services to households	DPEDRG
Elementary and secondary schools	DESCRG
Day care and nursery schools	DNSCRG
Commercial and vocational schools	DVEDRG
Legal services	DGALRG
Tax preparation and other related services	DTAPRG
Employment agency services	DGENRG
Other personal business services	DTHERG
Labor organization dues	DUNSRG
Professional association dues	DAXSRG
Funeral and burial services	DFUNRG
Hairdressing salons and personal grooming establishments	DBBBRG
Miscellaneous personal care services	DMPCRG
Laundry and drycleaning services	DDRYRG
Clothing repair, rental, and alterations	DLGRRG
Repair and hire of footwear	DSCLRG
Child care	DCHCRG
Homes for the elderly	DELDRG
Residential mental health and substance abuse	DMENRG
Individual and family services	DFAMRG
Vocational rehabilitation services	DVOCRG
Community food and housing / emergency / other relief services	DCFORG
Other social assistance, not elsewere classified	DSIARG
Social advocacy and civic and social organizations	DSADRG
Religious organizations' services to households	DRELRG
Foundations and grantmaking and giving services to households	DGIVRG
Domestic services	DDMSRG
Moving, storage, and freight services	DMSERG
Repair of furniture, furnishings, and floor coverings	DFRERG
Repair of household appliances	DERERG
Other household services	DMHSRG
Passenger fares for foreign travel	DAFTRG

table continues

Table A1 – table continues

Index	Code
U.S. travel outside the United States	DUSTRG
U.S. student expenditures	DUSSRG
(Less) Foreign travel in the United States	DFTURG
(Less) Medical expenditures of foreigners	DMEFRG
(Less) Expenditures of foreign students in the United States	DEFSRG
Outpatient services, gross output	DOUGRG
Nonprofit hospitals, gross output	DHSORG
Nonprofit nursing homes, gross output	DNXORG
Recreation services, gross output	DRCGRG
Education services, gross output	DEDGRG
Social services, gross output	DSSGRG
Religious organizations, gross output	DREORG
Foundations and grantmaking and giving establishments, gross output	DFXORG
Social advocacy establishments, gross output	DSAORG
Civic and social organizations, gross output	DCIORG
Professional advocacy, gross output	DSNGRG
(Less) Outpatient services to households	DOUSRG
(Less) Nonprofit hospitals services to households	DNPHRG
(Less) Nonprofit nursing homes services to households	DNPNRG
(Less) Recreation services to households	DRCRRG
(Less) Education services to households	DEDRRG
(Less) Social services to households	DSSRRG
(Less) Religious organizations' services to households	DRELRG
(Less) Foundations and grantmaking and giving services to households	DGIVRG
(Less) Services of social advocacy establishments to households	DSASRG
(Less) Civic and social organizations' services to households	DCISRG
(Less) Professional advocacy services to households	DSNRRG

Appendix B   Check for corectness of the decomposition



Note: The inflation rates are calculated as logarithmic growth.