MERCATUS WORKING PAPER

HOW MUCH DID MACROECONOMIC POLICY MATTER?

A NEW DECOMPOSITION OF THE US INFLATION SURGE OF 2021–22

David Beckworth, ***Mercatus Center***
Patrick Horan, ***Fiscal Lab on Capitol Hill***

MERCATUS.ORG

MERCATUS CENTER
George Mason University

SUGGESTED CITATION

David Beckworth and Patrick Horan, "How Much Did Macroeconomic Policy Matter? A New Decomposition of the US Inflation Surge of 2021–22," Mercatus Working Paper, Mercatus Center at George Mason University, July 2025.

ABSTRACT

Many economists have argued that both supply and demand shocks contributed substantially to the recent inflation surge in the United States. By contrast, we argue that aggregate demand explains the bulk of inflation. We illustrate the relative importance of demand and supply shocks in two ways. First, we decompose deviations of nominal GDP from a Congressional Budget Office benchmark into inflation deviations from target and output deviations from potential output. Second, using a New Keynesian model of the US economy, we estimate a structural vector autoregression with long-run restrictions that identifies temporary supply shocks, permanent supply shocks, and aggregate demand shocks. We find that demand contributed to more than 60 percent of the excess inflation in 2021 and more than 85 percent of the excess inflation in 2022. These results indicate that the inflation surge was largely the result of macroeconomic policy choices rather than rare events beyond the control of policymakers.

METADATA

Keywords: inflation, nominal GDP, demand shocks, supply shocks, structural vector autoregression

JEL codes: E3, E52

AUTHOR CONTACT INFORMATION

David Beckworth, dbeckworth@mercatus.gmu.ed

Patrick Horan, patrick.horan476@gmail.com

ACKNOWLEDGMENTS

We thank Marijn Bolhuis, Jeffrey Lacker, and Jack Salmon for helpful comments.

DISCLAIMER

How Much Did Macroeconomic Policy Matter?

A New Decomposition of the US Inflation Surge of 2021–22

Introduction

What explains the inflation surge of 2021–22 and its subsequent decline? Many commentators point to what Gagnon and Rose (2024) call the "trinity" of shocks as the key drivers to this inflationary episode. First, there was a pandemic-induced shock to consumer preferences that combined with supply constraints to cause durable goods prices to dramatically rise. Second, the Russia–Ukraine War created a massive commodity shock, which caused the price of nondurable goods such as gasoline and food to also skyrocket. Finally, there was a highly accommodative monetary and fiscal policy that led to tight labor markets and, in turn, caused service prices to rise.

Many studies broadly support this trinity view and find that the preference, supply, and commodity shocks are the primary drivers of inflation over the 2021–22 period. The inflation surge, consequently, was a series of unfortunate events largely beyond the control of policymakers (Ball et al. 2022; Bernanke and Blanchard 2023, 2024; Dao et al. 2024; Steinsson 2024; Shapiro, forthcoming). Others, however, see the tight labor markets or, more generally, the highly accommodative fiscal and monetary stimulus as the dominant force behind the inflation. They argue that the inflation associated with the preference, supply, and commodity shocks was largely an *endogenous* manifestation of an overheated economy fueled by excess aggregate demand pressure. From this perspective, inflation was not a rare and unpredictable event but a foreseeable consequence of macroeconomic policy choices.

Some of these observers point to the sheer size of the fiscal support. Furman (2023, 2025) notes that the American Rescue Plan Act, passed in early 2021, added $1.9 trillion to an economy that needed only $650 billion at the end of 2020, according to the Congressional Budget Office (CBO). This influx was on top of the existing $1.5 trillion in excess savings waiting to be spent that households had accumulated from federal support in 2020. Summers (2021) similarly observes that the fiscal injections were three times what were needed and, given capacity constraints, would cause the "bathtub to overflow" and create inflation. The fact that total dollar spending by the end of 2022 was 9 percent above prepandemic CBO projections while the GDP deflator was 8 percent above them indicates that most of the fiscal support was indeed channeled into higher prices rather than increased real output.[1]

Others, including Leeper and Anderson (2023), Bianchi et al. (2023), and Cochrane (2025), point to the non-Ricardian nature of these large fiscal injections—they would not require future fiscal offsets—that was communicated to the public by the government. This messaging likely encouraged recipients to view transfers as permanent income gains rather than future obligations, thereby increasing consumption and accelerating inflationary pressure.

Many of these observers, such as Cochrane (2024) and Furman (2025), also push back on the claim that preference, supply, and commodity shocks played a meaningful role in the inflation surge. These shocks alone can only determine where in the economy that price pressures will emerge, but not the overall magnitude of inflation. To translate into economy-wide inflation, these shocks would need to be accompanied by monetary and fiscal policy responses that raised the

[1] The CBO projections are those reported in August 2019. Total dollar spending here is measured by nominal GDP.

level of aggregate demand. In other words, in the absence of supportive macroeconomic policies during the pandemic, these shocks would have simply caused total dollar spending to shift between sectors rather than raising its level and causing inflation to surge.[2] This perspective can also explain the association between inflation expectations and supply shocks observed during this pandemic: Households rightly anticipated that macroeconomic policy would accommodate the shocks, which, in turn, shaped their inflation expectations.[3]

All these observations suggest that a reasonable case can be made that aggregate demand policy was the key factor behind the inflation surge in the early 2020s. This understanding finds empirical support from studies using the fiscal theory of the price level (Barro and Bianchi 2023; Cochrane 2023), the New Keynesian (NK) theory with nonlinear Phillips curves (Domash and Summers, 2022; Benigno and Eggertsson 2023), the quantity theory of money (Hetzel 2022; Ireland 2022, 2023; Hendrickson 2023; Reynard 2023; Horan 2024), and medium-scale dynamic stochastic general equilibrium models (di Giovanni et al. 2024; Giannone and Primiceri 2024; Faria-e-Castro 2025).

This paper adds to the growing evidence of the importance of aggregate demand policy by combining two distinct approaches. First, we replicate and extend Furman's (2023) decomposition, but we do so with ex-post estimates of potential real GDP. This exercise offers a straightforward, empirical gauge of how much "excess" nominal spending has been absorbed by higher prices versus higher real output. Second, we build on this decomposition through a structural NK framework, one that explicitly distinguishes between aggregate demand shocks, temporary supply shocks, and permanent supply shocks. By identifying and estimating these shocks in a vector autoregression, we can rigorously assess their respective roles in the inflation episode and verify that, once output closed in on its capacity, most of the additional nominal spending manifested in higher prices rather than sustained real gains. The results provide fresh support for the claim that inflation in the early 2020s was driven primarily by a demand-side policy overshoot, rather than a unique sequence of supply disruptions.

Although our findings underscore how macroeconomic policy choices shape whether price pressures are short-lived or develop into sustained inflation, they do not speak to the normative questions about such policy choices. Some observers regard the inflation surge as suboptimal, citing the burden it placed on households and policymakers (Eggertsson and Kohn 2023; Irwin 2024; Wheat and Eckard 2025). Others, including Andolfatto and Martin (2025), acknowledge that while the large fiscal stimulus played an important role in the inflation surge, it was an acceptable tradeoff for delivering pandemic-era income insurance. Hall and Sargent (2023) similarly view the inflation surge as a form of "war-time finance" amid a major public health war. This debate is important, but the question addressed in our paper is narrower: What role did aggregate demand policy play in the inflation surge?

---

[2] This argument harkens back to a famous Bernanke et al. (1997) paper that shows the bulk of inflation's sustained rise in the 1970s came from macroeconomic policy accommodation to the oil price shocks of that period rather than from the shocks themselves.

[3] Beaudry et al. (2024), for example, find inflation expectations and broad-based supply shocks can generate persistent inflation. However, this finding implicitly assumes there is enough macroeconomic policy accommodation to let higher inflation expectations feed into actual inflation.

The Furman Decomposition

As a first step toward answering the question of how important aggregate demand policy was to the rise and fall of inflation over the 2020–24 period, we replicate the Furman (2023) decomposition of the nominal GDP (NGDP) surge into its effects on real GDP and the price level. Furman notes that NGDP, a measure of total dollar spending in the economy, is a macroeconomic policy choice. As a result, its surge in 2021–22 was not an endogenous response to a "series of unfortunate events" but the "original sin" caused by excessive fiscal and monetary policy (Furman 2023, 1). This nominal spending surge had to go somewhere, and Furman argues it went largely into the price level since real GDP remained near its prepandemic trend path after 2021. In other words, potential real GDP appears to have been largely inelastic to running the economy hot during the pandemic, and this inelasticity forced the elevated aggregate demand pressures into prices.

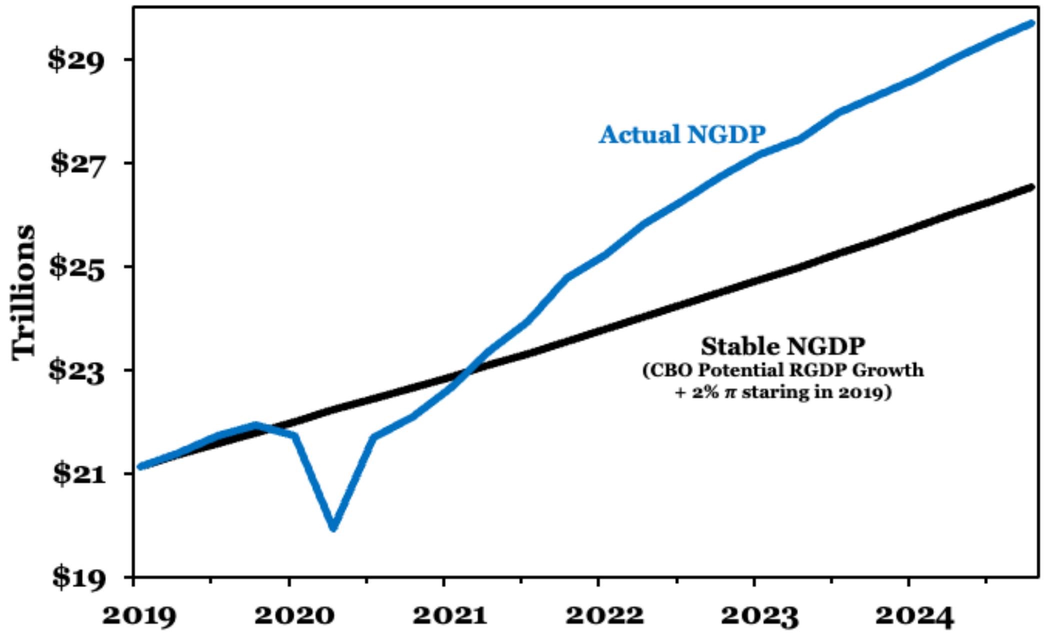
To evaluate this claim, we first define aggregate demand in log levels as $n_t = p_t + y_t$, where n_t is NGDP, p_t is the price level, and y_t is real GDP. Next, note that since the Federal Reserve explicitly targets inflation there is an implicit target path for the price level, p_t^*. The Fed also desires that that economy be at its natural rate level, y_t^N. These two observations together point to an implicit target path for aggregate demand: $n_t^* = p_t^* + y_t^N$. Now take the difference between the actual and implicitly targeted values of NGDP: $n_t - n_t^* = (p_t - p_t^*) + (y_t - y_t^N)$. We can simplify this equation by defining $\hat{n}_t = n_t - n_t^*$, $\hat{p}_t = p_t - p_t^*$, and $\hat{y}_t = y_t - y_t^N$ so that we have the following equation:

Furman decomposition: $$\hat{n}_t = \hat{p}_t + \hat{y}_t \quad (1)$$

This equation shows that the NGDP gap, $\hat{n}_t$, is equal to the price-level gap, $\hat{p}_t$, plus the output gap, $\hat{y}_t$. The objective, then, is to come up with estimates for $\hat{n}_t$, $\hat{p}_t$, and $\hat{y}_t$ that satisfy the equation. Furman constructs the decomposition by comparing the prepandemic CBO projections of n_t, p_t, and y_t to their actual values during the 2020–23 period to create estimates of $\hat{n}_t, \hat{p}_t,$ and $\hat{y}_t$.

We use the ex-post CBO estimates of potential real GDP from January 2025, instead, to construct the decomposition. Our use of the ex-post CBO estimates minimizes concerns about forecasts and real-time measures of potential real GDP. We start our analysis in 2019 Q1, when $\hat{y}_t = 0$, and from there construct a counterfactual NGDP growth path that is equal to the CBO's potential real GDP growth rate plus 2 percent for the Fed's inflation target. This stable NGDP growth path is depicted in figure 1 and summarized in table 1, along with the actual level of NGDP. These exhibits vividly illustrate the collapse in total dollar spending in the first half of 2020. The shortfall reaches $2.3 trillion in 2020 Q2 and then rebounds quickly in 2021. The rebound, however, overshoots the stable growth path by $1.25 trillion dollars by the end of 2021. The overshoot continues to grow so that, by the end of 2024, NGDP is $3.2 trillion above its counterfactual stable growth path. So where did all the excess nominal spending go?

FIGURE 1. Dollar size of the US economy



Note: CBO = Congressional Budget Office; NGDP = nominal gross domestic product; RGDP = real gross domestic product.

TABLE 1. CBO counterfactual NGDP

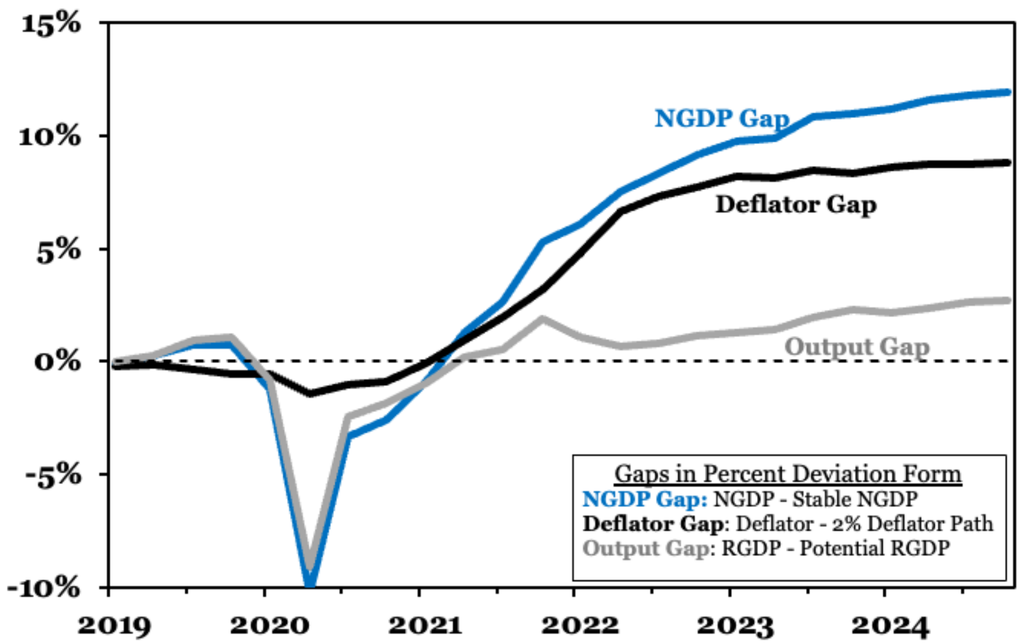
	US$ billions		
Quarter	CBO stable NGDP	Actual NGDP	NGDP gap
2020 Q1	21,999	21,728	−271
2020 Q2	22,217	19,935	−2,281
2020 Q3	22,434	21,685	−749
2020 Q4	22,653	22,069	−584
Rest of period			
2021 Q4	23,531	24,777	1,246
2022 Q4	24,496	26,734	2,238
2023 Q4	25,491	28,297	2,806
2024 Q4	26,541	29,701	3,160

Note: CBO = Congressional Budget Office; NGDP = nominal gross domestic product.

To answer this question, we construct a counterfactual price-level path by growing the GDP deflator by 2 percent per year, starting in 2019 Q1. The percent deviation of the actual GDP deflator from this stable price-level path is the price-level gap, $\hat{p}_t$. The output gap, $\hat{y}_t$, is the percent deviation of actual real GDP from the CBO potential real GDP. Finally, the NGDP gap, $\hat{n}_t$, is the percent deviation of actual NGDP from the stable NGDP growth path outlined in figure 1. Since these are estimates, the deflator gap and output gap will approximately sum up to the NGDP gap.

Figure 2 and table 2 show the results of this Furman decomposition. They reveal, first, that the sharp collapse in nominal spending in 2020 was primarily borne by the output gap. Conversely, they also show that the 2021–22 surge in nominal spending was largely absorbed by the deflator gap. More precisely, the NGDP gap was −10.27 percent at the end of 2020 Q2, with the output gap bearing −9.10 percent of it. By 2022 Q4, however, the NGDP gap was 9.14 percent, and 7.75 percent of it went into the deflator gap. This latter pattern continued over the next two years such that by 2024 Q4 the NGDP gap hit 11.91 percent and the deflator gap reached 8.79 percent. To be clear, the output gap also grew over this time and reached 2.66 percent in 2024 Q4. Nonetheless, most of this aggregate demand pressure manifested itself in a growing deflator gap.

FIGURE 2. Macroeconomic gaps



Note: NGDP gap % = deflator gap % + output gap %. NGDP = nominal gross domestic product; RGDP = real gross domestic product.

TABLE 2. Furman decomposition

Quarter	CBO NGDP gap (%)	Deflator gap for 2% target path (%)	CBO output gap (%)
2020 Q1	−1.23	−0.57	−0.81
2020 Q2	−10.27	−1.43	−9.10
2020 Q3	−3.34	−1.05	−2.45
2020 Q4	−2.58	−0.90	−1.87
	Rest of period		
2021 Q4	5.30	3.20	1.87
2022 Q4	9.14	7.75	1.11
2023 Q4	11.01	8.35	2.27
2024 Q4	11.91	8.79	2.66

Note: CBO = Congressional Budget Office; NGDP = nominal gross domestic product.

The answer, then, to the question as to where most of the excess $3.2 trillion in nominal spending went is the price level. As Furman (2025) notes, "[r]eal GDP could not have gone up much more than it did given the constraints on the productive capacity of the economy. The excess [nominal spending] took the form of higher prices."

Furman (2025) also argues that shocks to consumer preferences, global supply chains, and commodities "determined where those price increases showed up in the economy, but they did not drive the overall average price increase." This observation suggests that while supply-side disruptions influenced relative price movements, the broad-based rise in the price level was primarily the result of excess aggregate demand. In other words, absent the fiscal and monetary expansion, supply shocks alone would likely have resulted in sectoral reallocations of spending rather than a sustained increase in overall inflation.

Although the decomposition does not formally distinguish between demand-driven inflation and price increases from supply shocks, the decomposition is nonetheless consistent with a causal relationship between excess aggregate demand pressures and inflation. The data suggest that once real output recovered to its trend, additional nominal spending was absorbed primarily by prices rather than further output growth. This pattern is what we would expect if nominal demand were the primary driver of inflation rather than a passive response to external shocks.

Furman, in other words, is arguing for an explicit causality in the decomposition:

Causal Furman decomposition: $$\hat{n}_t \Rightarrow \hat{p}_t + \hat{y}_t \quad (2)$$

This equation implies that excess nominal spending caused the observed changes in the price level and output gap, rather than merely reflecting them. However, this inference relies on the assumption that potential real GDP was relatively inelastic over this period. While this assumption seems reasonable given the ex-post realizations of potential real GDP, a properly specified macroeconomic model is needed to verify these findings. The next section does just that by looking at an NK model that can identify demand and supply shocks.

Macroeconomic Model

The standard New Keynesian model, the workhorse of modern macroeconomics, provides a useful framework to motivate the three shocks that are of interest to this study: an aggregate demand shock, a temporary supply shock, and a permanent supply shock. Once these shocks are identified, one can do a proper decomposition of the price level over the 2020–24 period to see which shocks were most consequential to the inflation surge and subsequent disinflation.

To get these shocks, start with the standard three equations of the NK model where $\hat{y}_t$ is the output gap, r_t^n is the natural real interest rate, i_t^n is neutral nominal interest rate and defined as $i_t^n = E_t\{\pi_{t+1}\} + r_t^n$, and $\Delta n_t = \pi_t + \Delta y_t$:[4]

IS (investment saving) curve: $$\hat{y}_t = E_t\{\hat{y}_{t+1}\} - \frac{1}{\sigma}[i_t - E_t\{\pi_{t+1}\} - r_t^n] + \epsilon_t^{IS} \quad (3)$$

Phillips curve: $$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa\hat{y}_t + \epsilon_t^{PC} \quad (4)$$

Taylor rule: $$i_t = i_t^n + \phi_n(\Delta n_t - \Delta n_t^*) + \epsilon_t^{MP} \quad (5)$$

This model has both forms of supply shocks. The cost-push shock, ϵ_t^{PC}, in the Phillips curve is the temporary supply shock. It has no lasting effect on the real economy. The permanent supply shock can be seen by first defining the output gap as $\hat{y}_t = y_t - y_t^n$, where y_t is the natural log of output and y_t^n is the natural log of the natural output level and is defined as $y_t^n = y_{t-1}^n + \varepsilon_t^n$. The shock ε_t^n permanently affects the level of output and therefore is the permanent supply shock.[5]

On the demand side of the economy, note that there are two existing demand shocks in the model: ϵ_t^{IS} and ϵ_t^{MP}. These shocks need to be linearly combined to create an aggregate demand shock. To this end, observe that in this Taylor rule, the central bank is explicitly targeting aggregate demand growth, Δn_t^*, as measured by nominal GDP, $\Delta n_t = \pi_t + \Delta y_t$. This formulation is used for the convenience of constructing an aggregate demand shock, but as Hendrickson (2012), Binder (2020), and Orphanides (2025) show, it provides a useful approximation of what the Fed has effectively targeted in practice.

If we substitute the Taylor rule into the IS curve and solve for aggregate demand growth, Δn_t, we get the following equation: $\Delta n_t = \Delta n_t^* + \frac{\sigma}{\phi_n}[E_t\{\hat{y}_{t+1}\} - \hat{y}_t] - \frac{1}{\phi_n}\epsilon_t^{MP} + \frac{\sigma}{\phi_n}\epsilon_t^{IS}$.[6] Now define the aggregate demand shock as a linear combination of the ϵ_t^{IS} and ϵ_t^{MP} shocks, or $\epsilon_t^{AD} = -\frac{1}{\phi_n}\epsilon_t^{MP} + \frac{\sigma}{\phi_n}\epsilon_t^{IS}$. The NK model can now be stated in terms of an aggregate demand curve, a Phillips curve, and a natural output equation:

Aggregate demand curve: $$\Delta n_t = \Delta n_t^* + \frac{\sigma}{\phi_n}[E_t\{\hat{y}_{t+1}\} - \hat{y}_t] + \epsilon_t^{AD} \quad (6)$$

Phillips curve: $$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa\hat{y}_t + \epsilon_t^{PC} \quad (7)$$

---

[4] See Gali (2015) and Walsh (2017) for a textbook treatment of the New Keynesian model, including the derivation of the three equations.

[5] Our model, a derivation of the standard New Keynesian model, is linear in its equations. Some observers, such as Benigno and Eggertsson (2023), argue that there were important nonlinearities on the slack term in the Phillips curve during this inflation surge. If so, the results from this exercise can be seen as a baseline estimate since it would understate the true extent of aggregate demand's contribution to the inflation surge.

[6] Note, that after substituting in the Taylor rule into the IS curve, the interest rate gap term drops out since $i_t^n = E_t\{\pi_{t+1}\} + r_t^n$.

Natural output: $$y_t^n = y_{t-1}^n + \varepsilon_t^n \quad (8)$$

Aggregate demand growth is now equal to its targeted growth rate, Δn_t^*; expected changes in the output gap, $\frac{\sigma}{\phi_n}[E_t\{\hat{y}_{t+1}\} - \hat{y}_t]$; and an aggregate demand shock, ϵ_t^{AD}. Note that this aggregate demand shock has embedded in it shocks to both monetary policy via ϵ_t^{MP} and shocks to fiscal policy via ϵ_t^{IS}.

This version of the model is useful for two reasons. First, the model can be defined in terms of macroeconomic variables that the Fed cares about: output growth, the output gap, and inflation. Second, it provides the shocks needed to answer the questions of this paper. Specifically, the aggregate demand and temporary supply shocks cannot permanently affect the output level, whereas the permanent shock is able to do so. If we define $\Delta n_t^* = \pi^* + \Delta y_t^n$, where π^* is an implicit inflation target embedded in Δn_t^*, then the permanent supply shock can only temporarily affect the inflation rate. Likewise, the aggregate demand shock and temporary supply can also only temporarily push the inflation rate away from π^*. All shocks, however, can permanently affect the price level. These are all standard implications of an NK model that includes a credible inflation target. This model, therefore, is ideal for assessing the causes of the inflation surge in terms of the three aggregate-level shocks and is used to motivate the empirical strategy in the next section.

Empirical Model

In this section, the three structural shocks outlined in the previous section are identified and estimated in a structural vector autoregression (VAR). Their impacts on real GDP and inflation via impulse response functions (IRFs) are then checked to make sure they are consistent with the NK model. Finally, the identified shocks can then be used to conduct a decomposition of inflation to see the contribution that each shock played in the inflation process since 2021.

VAR with long-run restrictions

The VAR is estimated in reduced form and then identified by using the Blanchard and Quah (BQ) long-run identifying restrictions.[7] This identifying strategy imposes long-run restrictions on certain relationships in the VAR's estimated system of equations while remaining agnostic about the other relationships.[8] This approach allows for a direct and intuitive way to identify shocks that have no permanent effect on the output level (the aggregate demand and temporary aggregate supply shock) and to identify the one that does have a persistent effect (the permanent supply shock).

Motivated by the macroeconomic model described in the previous section, the vector of endogenous variables in the VAR consists of output growth, the output gap, and inflation: $x_t = (\Delta y, \hat{y}_t, \pi_t)'$. The BQ restrictions are imposed in the following manner: First, the estimated shock to output growth, Δy, is allowed to permanently affect the output level and is therefore identified as the permanent supply shock, ε_t^n. Second, the estimated shock to inflation, π_t, is restricted so that it cannot permanently affect the output level or the output gap. As a result, this shock is identified as

---

[7] Blanchard and Quah (1989) first used long-run restrictions to identify aggregate demand and supply shocks. This paper, therefore, follows in the spirit of their original application.

[8] The BQ identification approach has been widely used across a number of macroeconomic applications, including identifying technology shocks (Gali 1999; Francis and Ramey 2005), explaining real-exchange rate variation (Lastrapes 1992; Clarida and Gali 1994), identifying monetary shocks (Lastrapes 2006; Beckworth et al. 2012), and assessing different monetary regimes (Beckworth 2007; Bordo et al. 2010). See Herwatz (2019) for a discussion of the ongoing relevance of BQ restrictions.

the aggregated demand shock, ϵ_t^{AD}. Finally, since ϵ_t^{AD} and ε_t^{n} are identified and accounted for in terms of their effect on the output gap, $\hat{y}_t$, the estimated shock to the output gap must be the temporary supply shock, ϵ_t^{PC}. The shock is constrained so that it cannot permanently affect the output level, a restriction consistent with the notion of a temporary supply shock having a nonlasting impact on the output gap. All the shocks are allowed to permanently affect the price level, but whether they do is determined by the data since the identifying restrictions are agnostic on this point.

To see how the shocks are imposed empirically, one can transform the structural VAR into a structural moving average form.[9] This exercise allows one to see the mapping between the endogenous variable and the structural shocks. The structural vector moving average (VMA) model can be represented in matrix form as follows:

$$x_t = (D_0 + D_1 L + D_2 L^2 + \cdots)u_t = D(L)u_t, \tag{9}$$

where L denotes the lag operator, D_i are coefficient matrices that represent the dynamic multipliers of the structural shocks, and u_t is a vector of structural shocks.[10] Taking the infinite horizon sum of *D(L)*, *D(1)*, and given the ordering of variables in $x_t = (\Delta y, \hat{y}_t, \pi_t)'$, one can summarize the relationship between the endogenous variables and a single set of shocks from the infinite past as follows:

$$x_t = D(1)u_{t-\infty} = \begin{bmatrix} d_{11} & 0 & 0 \\ d_{21} & d_{22} & 0 \\ d_{31} & d_{32} & d_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_{t-\infty}^{n} \\ \epsilon_{t-\infty}^{PC} \\ \epsilon_{t-\infty}^{AD} \end{bmatrix} \tag{10}$$

For the shocks and endogenous variables where zeros are imposed in $D(1)$, there are no long-run relationships. Consequently, $\epsilon_{t-\infty}^{AD}$ cannot permanently affect Δy or $\hat{y}_t$. Likewise, $\epsilon_{t-\infty}^{PC}$ cannot have a lasting impact on Δy. However, $\varepsilon_{t-\infty}^{n}$ is allowed to permanently influence Δy. All shocks are allowed to permanently affect π_t, but whether they do depends on the data. This identification strategy, in other words, is agnostic on the relationship between the shocks and inflation.

Per the definitions in the NK model in the previous section, the variables Δy and π_t are constructed as the first difference of the natural log of real GDP and the GDP deflator, respectively. The output gap is calculated as the percent difference between real GDP and potential real GDP.

This VAR is estimated using the sample period 1950 Q1–2024 Q4 with data from the FRED (Federal Reserve Economic Data) database. The likelihood ratio test for lag lengths indicates that 10 lags are needed. In addition, the Lagrange multiplier test for serial correlation shows that 10 lags are needed to get white noise in the residuals.[11] Consequently, 10 lags are used in estimating the VAR.[12]

---

[9] The structural VAR can be specified as $A_0 x_t = A_1 x_{t-1} + \cdots + A_p x_{t-p} + u_t$, where x_t is the vector of endogenous variables, $A_0, \ldots, A_p$ are $n \; x \; n$ structural parameters matrices, and u_t is $n \; x \; 1$ vector of uncorrelated structural shocks that are assume to be multivariate normal with mean zero.

[10] The relationship between this VMA and the VAR is $D_0 = A_0^{-1}, D_i = (A_0^{-1}A_i)' A_0^{-1}$.

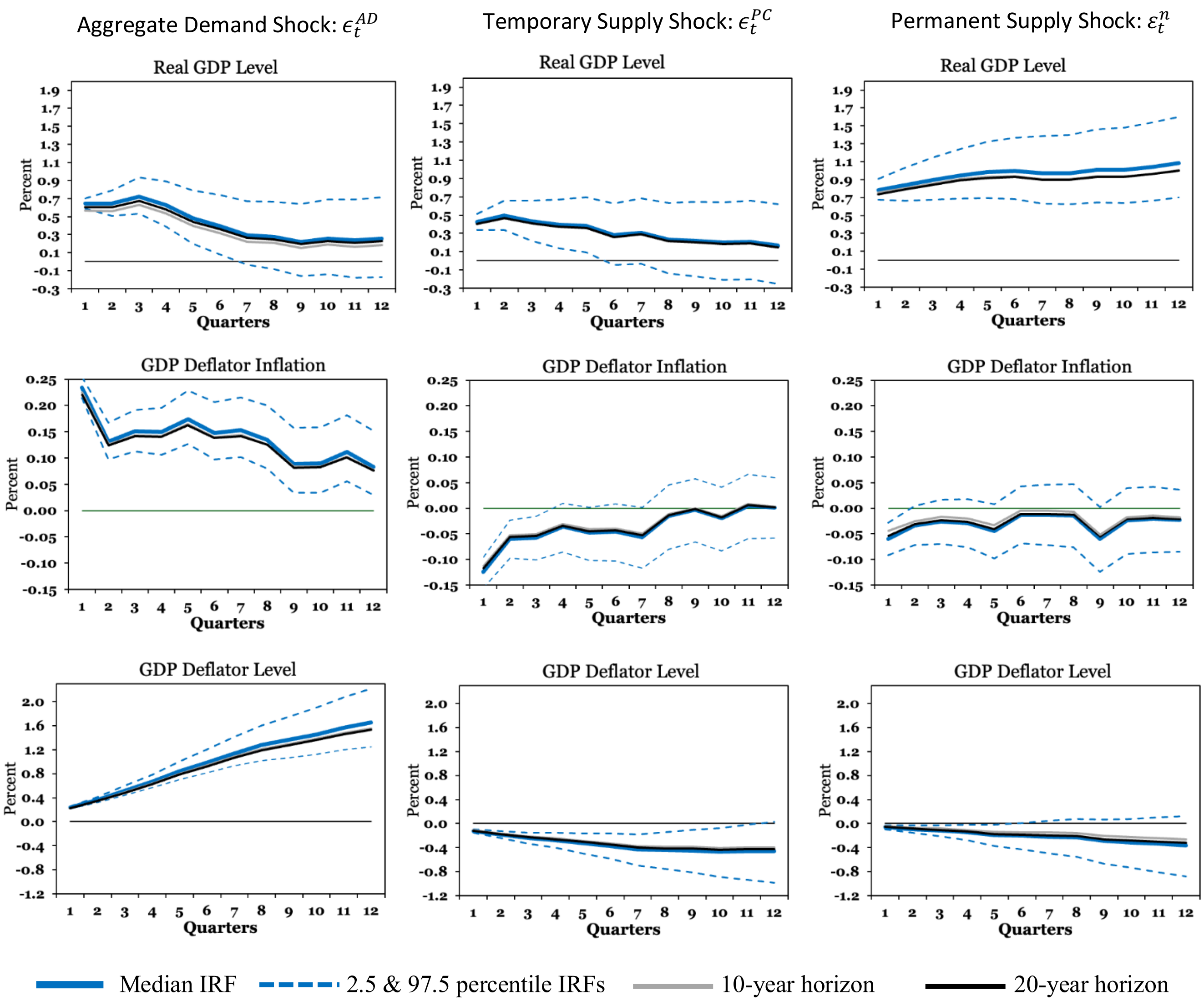
[11] These lag lengths are consistent with those of Romer and Romer (2004), who also look at a long historical period and find lag lengths of up to three years are useful in identifying the full effect of a monetary policy shock. In this context, though, we are identifying the long and variable lags of macroeconomic policy, which reflects both monetary and fiscal policy.

[12] The VAR, IRFs, and historical decompositions are estimated using the RATS (Regression Analysis of Time Series) econometric software from Estima.

Impulse response functions

With the model estimated, impulse response functions can be produced that show the effect of the shocks on real GDP and inflation. The IRFs are reported in figure 3 for a positive one-standard deviation shock. The solid blue line shows the median IRF while the dashed blue lines show 2.5 and 97.5 percentile IRFs. The first row shows that the IRFs are consistent with the expected outcomes of real GDP to the three shocks in the New Keynesian model. The positive aggregated demand and temporary supply shocks have a positive but limited effect on real GDP, while the positive permanent supply shock does have a persistent positive effect on the level of real economic activity.

FIGURE 3. Impulse response function shocks



Note: IRF = impulse response function.

The inflation IRFs, displayed in the second row, also show a response consistent with the NK model. The positive aggregate demand shock raises the inflation rate and slowly returns to zero. The positive temporary supply shock lowers the inflation rate, but it returns relatively quickly to zero. Both shocks create statistically and economically significant departures from zero that are consistent with theory. The positive permanent shock also lowers the inflation rate, but other than the first quarter, the IRF is statistically insignificant with a small magnitude. The effect on the price level—the sum of the inflation response—is provided in the final row.

One way to interpret the two supply shocks is that the Federal Open Market Committee (FOMC) is "looking through" and ignoring the effect of the temporary supply shock on inflation—and therefore allowing it to permanently affect the price level—while adjusting monetary policy to the permanent shock since it affects potential real GDP and, therefore, the FOMC's reaction function. Consequently, the permanent shock has a smaller and less persistent effect on inflation and the price level than the temporary supply shock.

Since this paper is concerned about the role that negative temporary supply shocks played in generating the inflation surge, one can invoke the fact that the VAR is a linear model and simply flip the signs of the IRF to see what a negative standard deviation temporary supply shock would do to real GDP and inflation. This exercise would show that a negative temporary supply shock temporarily raises inflation before coming back down.

In summary, all of the shocks and their IRFs are consistent the theoretical implications of the NK model. However, the BQ approach is not without its critics, especially Faust and Leeper (1997). They argue that the dynamic relationships estimated from a finite sample generally do not contain information about infinite horizons. Therefore, conclusions drawn from such an exercise may be fragile.

Lastrapes (1998) and Beckworth et al. (2012) show that one can assess whether BQ IRFs are robust to this critique by comparing the IRFs from the infinite-horizon restrictions to those estimated at long but finite horizons. If the IRFs from the finite-horizon restrictions are similar to those from the infinite horizon, then the BQ IRFs are robust to the Faust and Leeper (1997) critique. To do this assessment, we impose long-run finite restrictions on the *D(L)* structural VMA representation described previously such that the sum of k dynamic multiplier matrices,

$$x_t = (D_0 + D_1L + D_2L^2 + \cdots D_kL^k + D_{k+1}L^{k+1} + \cdots)u_t, \quad (11)$$

is zero for the same elements that are zero in $D(1)$. That is, the same long-run restrictions are imposed as before, but they now are applied only to a finite k-number of horizons. Here, the finite long-run restrictions are imposed at $k = 40$ quarters and $k = 80$ quarters or, equivalently, at 10 and 20 years. These horizons are long run by most definitions and are also finite. The 10-year and 20-year IRFs are also reported in figure 3 as gray and black lines, respectively. These lines are very similar to the infinite-horizon IRF and in many cases are indistinguishable. The reported BQ IRFs are, therefore, robust to the Faust and Leeper (1997) critique.

Historical decomposition of shocks

Having examined the IRFs, we now turn to historical decompositions, which allow us to see the relative contributions of each structural shock to the observed fluctuations in the variables of the VAR. Specifically, we use the historical decomposition to see the role that the aggregate demand, temporary supply, or permanent supply shocks played in shifting the path of inflation over the 2020–24 period.

The historical decomposition is constructed by taking the deviations of actual inflation from the baseline forecast of inflation created by the estimated structural model and then assessing the role that the three structural shocks played in creating these departures. This approach allows us to determine the relative importance of each structural shock during this inflation episode. More formally, recall that the structural VMA is $x_t = D(L)u_t = \sum_{j=0}^{\infty} D_j u_{t-j}$, where u_{t-j} is the vector of structural shocks from period $t-j$. We can further decompose this process into a baseline forecast—the projected path one would get if all the structural shocks were zero—and the realization of the individual structural shocks at time $t-j$:

$$x_t = \hat{x}_t^{base} + \sum_{k=1}^{K} \sum_{j=0}^{t} D_j \, e_k \varepsilon_{t-j}^{(k)} \tag{12}$$

Here, $\hat{x}_t^{base}$ is the baseline forecast, $\varepsilon_{t-j}^{(k)}$ is the realization of the *k*th structural shock at time $t-j$, and e_k is a selector vector—zeros everywhere except a "1" in the *k*th position—that picks out shock k from u_{t-j}. Note that $\sum_{j=0}^{t} D_j \, e_k \varepsilon_{t-j}^{(k)}$ is equal to the cumulative effect of shock *k* up to time *t*. Define this cumulative effect as $\sum_{j=0}^{t} D_j \, e_k \varepsilon_{t-j}^{(k)} = \Delta x_t^{(k)}$. Then, for a certain structural *k* shock, the historical decomposition can be understood as the following:

$$x_t = \hat{x}_t^{base} + \Delta x_t^{(k)}. \tag{13}$$

That is, we can add the cumulative contribution of an individual shock to the history of an endogenous variable relative to the baseline forecast. In our case, we specifically assess the contributions of the aggregate demand, temporary supply, and permanent supply shocks to inflation compared to its baseline forecast. We apply this decomposition to the period 2020–24.[13]

The results of this historical decomposition for the annual inflation rate are reported figure 4 and table 3.[14] The inflation surge began in 2021 when the GDP deflator rose to 4.52 percent, well above the forecasted inflation rate of 1.92 percent. Almost two-thirds of the excess inflation was due to the inflationary effect of the aggregate demand shock, which added 1.61 percentage points to inflation. The temporary and permanent supply shocks also added a nontrivial 0.98 percentage points to inflation. Inflation hit 7.09 percent in 2022 but was forecasted to be only 2.03 percent. The aggregate demand shock created 4.40 percentage points of the 5.06 percentage points excess inflation. Supply shocks, therefore, were far less consequential to inflation in 2022. Inflation fell to 3.60 percent in 2023 and 2.40 percent in 2024. Most of the decline was due to aggregate demand shocks getting smaller. However, the temporary supply shock lowered inflation by 1.23 percentage points and 0.88 percentage points in 2023 and 2024, respectively. Overall, this historical decomposition indicates that most of the inflation and subsequent disinflation was driven by the aggregate demand shock.

---

[13] The estimated structural shocks are reported in the appendix.

[14] The annual inflation rates are calculated as the average of the year-on-year inflation rates for each of the quarters in the year.

FIGURE 4. GDP deflator inflation

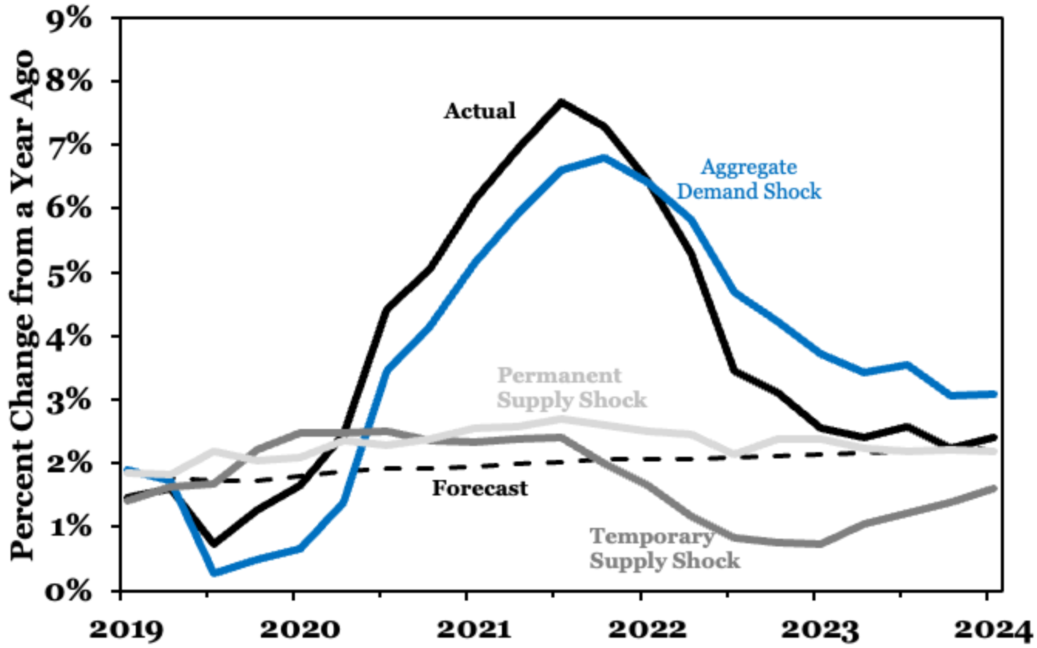


TABLE 3. Vector autoregression historical decomposition exercise for year-over-year inflation

		Contributions to actual inflation			
Year	Actual inflation (%)	Forecasted inflation (%)	Aggregate demand shock (%)	Temporary supply shock (%)	Permanent supply shock (%)
2020	1.31	1.76	−0.97	0.24	0.28
2021	4.52	1.92	1.61	0.51	0.47
2022	7.09	2.03	4.40	0.08	0.56
2023	3.60	2.11	2.51	−1.23	0.24
2024	2.40	2.19	1.09	−0.88	0.01

Note: Actual inflation percentage = Forecasted inflation + Inflation from the three shocks.

To foster comparison with the Furman decomposition, we have also conducted this structural decomposition for the price level. Figure 5 and table 4 report this historical decomposition. Here, the cumulative effect of the aggregate demand shocks on the price level are evident. By the end of 2024, the GDP deflator level was 8.63 percent above its forecasted level and aggregate demand shocks had contributed 8.91 percentage points to that gap. The temporary supply shock offset that somewhat, but it, in turn, was largely offset by the permanent supply shock. The results of this structural decomposition are like those found in the Furman decomposition. In both decompositions, the price level is almost 9 percent higher than its expected growth path and is largely driven by the aggregate demand shock in the historical decomposition or the NGDP gap in the Furman decomposition.

FIGURE 5. GDP deflator level

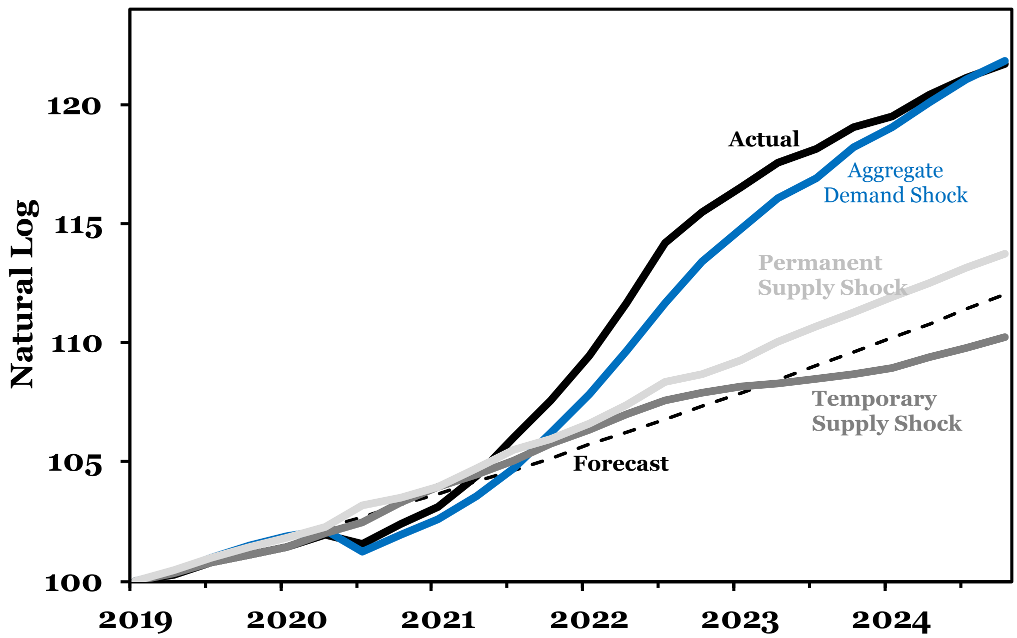


TABLE 4: Vector autoregression historical decomposition exercise for the price level

		Contributions to price-level deviations		
Quarter	Price-level deviations from forecast (%)	Aggregate demand shock (%)	Temporary supply shock (%)	Permanent supply shock (%)
2020 Q4	−0.54	−1.08	0.25	0.29
2021 Q4	3.55	2.01	0.63	0.87
2022 Q4	7.99	6.35	0.24	1.31
2023 Q4	8.43	8.00	−1.14	1.55
2024 Q4	8.63	8.91	−1.75	1.51

Note: Price-level deviations from forecast = Deviations from the three shocks.

Over the past three years, high inflation has prompted extensive discussion over whether the Federal Reserve can achieve a "soft landing," where inflation falls to target without the economy falling into recession. Monetary theory posits that a central bank credibly committed to reducing inflation can bring reduced inflation without causing a fall in output, while a noncredible central bank can only bring inflation down through a "shocking" monetary policy, which leads to a fall in output (see, for example, Sargent 1982; Barro and Gordon 1983; Clarida et al. 1999). Since the disinflation from late 2022 through 2024 came from a slowing in demand without an accompanying recession, one could conjecture that the Fed's monetary policy during this period could be considered credible.[15]

Conclusion

The analysis in this paper demonstrates that the surge in nominal GDP during 2021–22—driven largely by expansive fiscal and monetary policies—resulted predominantly in higher price levels rather than a commensurate increase in real output. The Furman decomposition reveals that once actual real GDP converged with its potential, the excess nominal spending was absorbed primarily by the price level, manifesting as a significant deflator gap. This outcome is further reinforced by the impulse response functions and historical decompositions from our structural VAR analysis, which collectively indicate that aggregate demand shocks had a more persistent and substantial effect on inflation than the supply disruptions.

The findings underscore the limited elasticity of potential real GDP in response to aggregate demand surges, suggesting that once output reaches its capacity, additional nominal spending inevitably contributes to inflation. Our results are also in line with Jordà et al. (2024), who use long-run historical data across a variety of countries to find that while excessively contractionary monetary policy produces hysteresis, excessively expansionary monetary policy merely produces higher inflation.

Our findings stress the critical need to calibrate macroeconomic policies to avoid excessive aggregate demand pressures, thereby preventing sustained inflationary episodes without real economic gains. The findings also suggest that one simple cross-check FOMC officials could do is to look at consensus forecasts of nominal GDP to see if it is projected to deviate from some stable growth path. For example, the FOMC could look at CBO forecasts or simple trends of NGDP. It could also look at more sophisticated measures, such as the Mercatus Center's NGDP gap, which measures the percentage difference between actual NGDP and an estimated neutral level of NGDP.[16]

[15] For example, Bundick and Smith (2024) argue that longer-term inflation expectations in the United States have stayed well anchored despite high inflation. The Fed's interest rate hikes of 2022 and 2023 were plausibly a fulfillment of these expectations. Alternatively, disinflation could be viewed through a fiscal theory of the price level where the size of future primary deficits has fallen but is still above its pre-2021 level.

[16] The Mercatus NGDP gap measure and information on its construction can be found at https://www.mercatus.org/ngdp-gap.

References

Andolfatto, David, and Fernando M. Martin. 2025. "Monetary Policy and the Great COVID-19 Price Level Shock." Working Paper 2025-004. Federal Reserve Bank of St. Louis.

Ball, Laurence, Daniel Leigh, and Prachi Mishra. 2022. "Understanding US Inflation During the Covid-19 Era." *Brookings Papers on Economic Activity* 53 (2): 1–80.

Barro, Robert J., and Francesco Bianchi. 2023. "Fiscal Influences on Inflation in OECD Countries, 2020–2022: Tests of the Fiscal Theory of the Price Level." Manuscript, Harvard University, September.

Barro, Robert J., and David B. Gordon. 1983. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12 (1): 101–21.

Beaudry, Paul, Chenyu Hou, and Franck Portier. 2024. "The Dominant Role of Expectations and Broad-Based Supply Shocks in Driving Inflation." NBER Working Paper 32322, National Bureau of Economic Research, April 2024.

Beckworth, David. 2007. "The Postbellum Deflation and Its Lessons for Today." *North American Journal of Economics and Finance* 18 (2): 195–214.

Beckworth, David, Kenneth P. Moon, and Holland Toles. 2012. "Can Monetary Policy Influence Long-Term Interest Rates? It Depends." *Economic Inquiry* 50 (4) 1080–96.

Benigno, Pierpaolo, and Gauti B. Eggertsson. 2023. "It's Baaack: The Surge in Inflation in the 2020s and the Return of the Non-linear Phillips Curve." NBER Working Paper 31197. National Bureau of Economic Research, April.

Bernanke, Ben, and Olivier Blanchard. 2023. "What Caused the U.S. Pandemic-Era Inflation?" Hutchins Center Working Paper 86. Brookings Institution, June.

Bernanke, Ben, and Olivier Blanchard. 2024. "An Analysis of Pandemic-Era Inflation in 11 Economies." Hutchins Center Working Paper 91. Brookings Institution, May.

Bernanke, Ben, Mark Gertler, and Mark Watson. 1997. "Systematic Monetary Policy and the Effects of Oil Price Shocks." *Brookings Papers on Economic Activity* 28 (1)**:** 91–157.

Bianchi, Francesco, Renato Faccini, and Leonardo Melosi. 2023. "A Fiscal Theory of Persistent Inflation." *Quarterly Journal of Economics* 138 (4): 2127–79.

Binder, Carola C. 2020. "NGDP Targeting and the Public." *Cato Journal* 40 (2): 321–42.

Blanchard, Oliver, and Danny Quah. 1989. "The Dynamic Effects of Aggregate Demand and Supply Disturbances." *American Economic Review* 79 (4): 655–73.

Bordo, Michael, John Landon-Lane, and Angela Redish. 2010. "Deflation, Productivity Shocks and Gold: Evidence from the 1880–1914 Period." *Open Economies Review* 21: 515–46.

Brent Bundick and Andrew Lee Smith. 2024. "Despite High Inflation, Longer-Term Inflation Expectations Remain Well Anchored." Economic Bulletin, Federal Reserve Bank of Kansas City, May 31.

Clarida, Richard, and Jordi Gali. 1994. "Sources of Real Exchange-Rate Fluctuations: How Important Are Nominal Shocks?" *Carnegie-Rochester Conference Series on Public Policy* 41 (1): 1–56.

Clarida, Richard, Jordi Gali, and Mark Gertler. 1999. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37 (4): 1661–707.

Cochrane, John H. 2023. *The Fiscal Theory of the Price Level*. Princeton University Press.

Cochrane, John H. 2024. "Inflation vs. Prices." *The Grumpy Economist* (blog). November 17. https://www.grumpy-economist.com/p/inflation-vs-prices.

Cochrane, John H. 2025. "Inflation and the Macroeconomy." *The Grumpy Economist* (blog). January 4. https://www.grumpy-economist.com/p/inflation-and-the-macroeconomy.

Dao, Mai Chi, Pierre-Olivier Gorinchas, Daniel Leigh, and Prachi Mishra . 2024. "Understanding the International Rise and Fall of Inflation." *Journal of Monetary Economics* 148: 103658.

di Giovanni, Julian, Şebnem Kalemli-Özcan, Alvaro Silva, and Muhammed A. Yıldırım. 2024. "Pandemic-Era Inflation Drivers and Global Spillovers." Staff Report 1080 (rev. ver.). Federal Reserve Bank of New York, July.

Domash, Alex, and Lawrence Summers. 2022. "A Labor Market View on the Risks of a U.S. Hard Landing." *Journal of Policy Modeling* 44 (4): 758–67.

Eggertsson, Gauti B., and Don Kohn. 2023. "The Inflation Surge of the 2020s: The Role of Monetary Policy." Hutchins Center Working Paper 87. Brookings Institution, August.

Faria-e-Castro, Miguel. 2025. "A Look at Inflation in Recent Years Through the Lens of a Macroeconomic Model." Federal Reserve Bank of St. Louis, January 6.

Faust, Jon, and Eric M. Leeper. 1997. "When Do Long-Run Identifying Restrictions Give Reliable Results?" *Journal of Business and Economics Statistics* 15 (3): 345–53.

Francis, Neville, and Valerie A. Ramey. 2005. "Is the Technology-Driven Real Business Cycle Hypothesis Dead? Shocks and Aggregate Fluctuations Revisited." *Journal of Monetary Economics* 52 (8): 1379–99.

Furman, Jason. 2023. "Jason Furman's Comments on Ben Bernanke and Olivier Blanchard's 'What Caused the U.S. Pandemic-Era Inflation?'" Comments presented at "The Fed: Lessons Learned from the Past Three Years," Brookings Institution, May 23.

Furman, Jason. 2025. "The Post-Neoliberal Delusion and the Tragedy of Bidenomics." *Foreign Affairs*, March–April 2025.

Gagnon, Joseph E., and Asher Rose. 2024. "The Trinity of COVID Era Inflation in G7 Economies." PIIE Working Paper 24-21. Peterson Institute for International Economics, December.

Gali, Jordi. 1999. "Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?" *American Economic Review* 89 (1): 249–71.

Gali, Jordi. 2015. *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications*. 2nd ed. Princeton University Press.

Giannone, Domenico, and Giorgio E. Primiceri. 2024. "The Drivers of Post-Pandemic Inflation." NBER Working Paper 32859. National Bureau of Economic Research, August.

Hall, George J., and Thomas J. Sargent. 2023. "Financing Big US Federal Expenditures Surges: COVID-19 and Earlier US Wars." In *How Monetary Policy Got Behind the Curve—And How to Get Back*, edited by Michael D. Bordo, John H. Cochrane, and John B. Taylor. Hoover Institution Press.

Hendrickson, Joshua. 2012. "An Overhaul of Federal Reserve Doctrine: Nominal Income and the Great Moderation." *Journal of Macroeconomics* 34 (2): 304–17.

Hendrickson, Joshua. 2023. "Is the Quantity Theory Dead? Lessons from the Pandemic." Mercatus Special Study. Mercatus Center at George Mason University, January.

Herwartz, Helmut. 2019. "Long-Run Neutrality of Demand Shocks: Revisiting Blanchard and Quah (1989) with Independent Structural Shocks." *Journal of Applied Econometrics* 34 (5): 811–19.

Hetzel, Robert L. 2022. "Learning from the Pandemic Monetary Policy Experiment." Mercatus Special Study. Mercatus Center at George Mason University, April.

Horan, Patrick. 2024. "Money, Output and Prices: 1967–2022." *Quarterly Review of Economics and Finance* 97 (October): 101870.

Ireland, Peter N. 2022. "The Recent Surge in Money Growth: What Would Milton Friedman Say?" *Journal of Applied Corporate Finance* 34 (2): 65–81.

Ireland, Peter N. 2023. "US Monetary Policy, 2020–23: Putting the Quantity Theory to the Test." *Journal of Applied Corporate Finance* 35 (3): 42–48.

Irwin, Neil. 2024. "Democrats' $1.9 Trillion Bet That Blew Up." *Axios*, November 10.

Jordà, Òscar, Sanjay R. Singh, and Alan M. Taylor. 2024. "The Long-Run Effects of Monetary Policy." NBER Working Paper 26666 (rev. ver.). National Bureau of Economic Research, September.

Lastrapes, William D. 1992. "Sources of Fluctuations in Real and Nominal Exchange Rates." *Review of Economics and Statistics* 74 (3): 530–39.

Lastrapes, William D. 1998. "International Evidence on Equity Prices, Interest Rates and Money." *Journal of International Money and Finance* 17 (3): 377–406.

Lastrapes, William D. 2006. "Inflation and the Distribution of Relative Prices: The Role of Productivity and Money Supply Shocks." *Journal of Money, Credit and Banking* 38 (8): 2159–98.

Leeper, Eric, and Joe Anderson. 2023. "A Fiscal Accounting of Covid Inflation." Mercatus Special Study. Mercatus Center at George Mason University, December.

Orphanides, Athanasios. 2025. "Enhancing Resilience with Natural Growth Targeting." *Southern Economic Journal* 91 (4): 1420–39.

Reynard, Samuel. 2023. "Central Bank Balance Sheet, Money and Inflation." *Economics Letters* 224 (March): 111028.

Romer, Christina D., and David H. Romer. 2004. "A New Measure of Monetary Shocks: Derivation and Implications." *American Economic Review* 94 (4): 1055–84.

Sargent, Thomas J. 1982. "The Ends of Four Big Inflations." In *Inflation: Causes and Effects*, edited by Robert E. Hall. University of Chicago Press.

Shapiro, Adam Hale. Forthcoming. "Decomposing Supply- and Demand-Driven Inflation. *Journal of Money, Credit and Banking*.

Steinsson, Jón. 2024. "Thoughts on Fed Policy and the Fed's Framework." Presented at the Hoover Monetary Policy Conference "Getting Global Monetary Policy on Track," Stanford University, May 3.

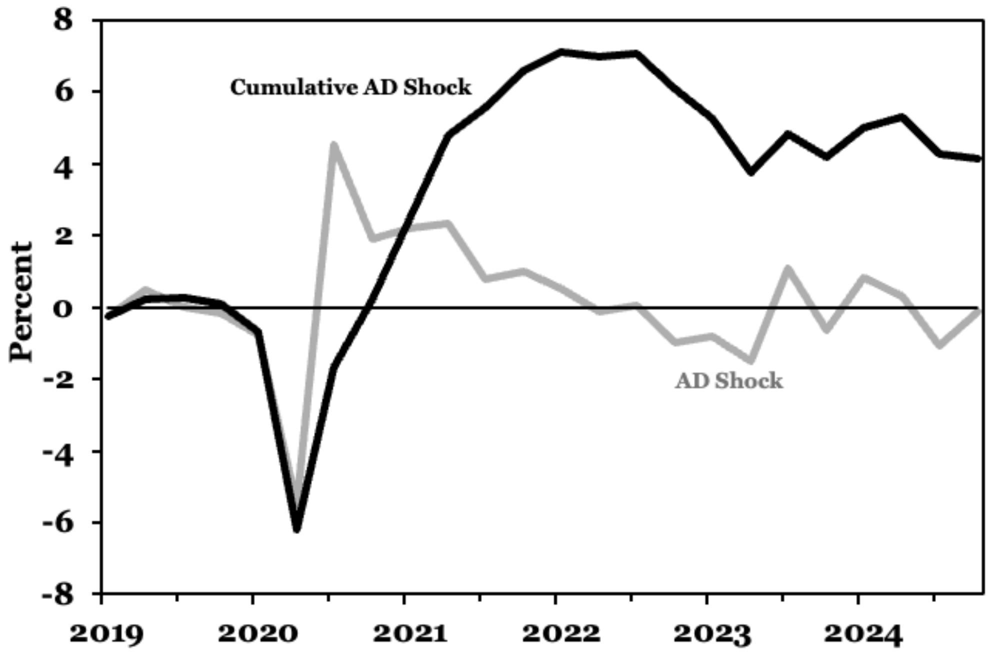
Summers, Lawrence. 2021. "The Biden Stimulus Is Admirably Ambitious. But It Brings Some Big Risks Too." *Washington Post*, February 4.

Walsh, Carl. 2017. *Monetary Theory and Policy*. 4th ed. MIT Press.

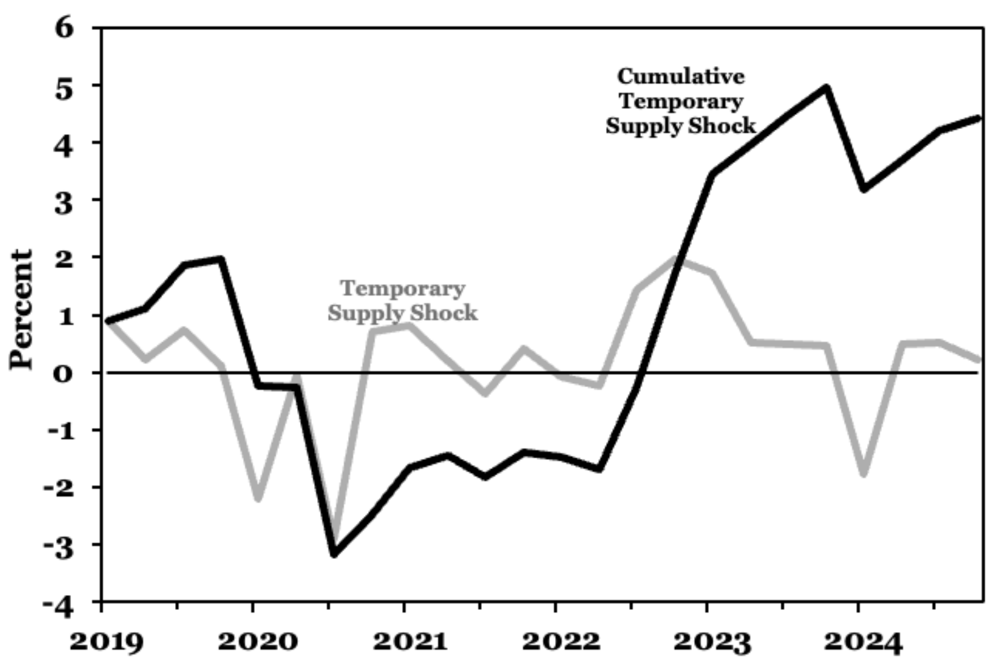
Wheat, Chris, and George Eckard. 2025. "Sizing Up Real Income Gains, December 2019 to March 2025." JPMorganChase Institute.

Appendix

APPENDIX FIGURE 1. Aggregate demand shock



APPENDIX FIGURE 2. Temporary supply shock



APPENDIX FIGURE 3. Permanent supply shock