Empirical Insights and Case Analysis: The 2021 - 2023 U.S. Inflation Cycle and the Fed's Policy Dilemma

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Abstract. This paper presents an empirical analysis and case study of the 2021 - 2023 U.S. inflation cycle. Leveraging monthly data from FRED, it examines the dynamic interplay between the Federal Reserve's monetary policy tools (federal funds rate and balance - sheet policy) and key macroeconomic indicators. The study reveals that delayed policy tightening in 2021, due to factors like the Average Inflation Targeting framework and labor market concerns, led to a rapid rate - hike cycle in 2022 - 2023. While inflation control was achieved, significant costs emerged, including financial fragility and recession risks. The findings emphasize the importance of timely policy diagnosis, policy coordination, and balancing inflation control with financial stability and employment goals in a shock - prone world.

Keywords: Empirical analysis; inflation cycle; policy dilimma.

1. Introduction

This research conducts an empirical analysis to examine the relationship between adjustments in U.S. monetary policy and inflation dynamics, with a particular focus on the high - inflation cycle and the subsequent disinflationary phase that occurred from 2021 to 2023 [1]. Leveraging monthly data spanning from January 2021 to December 2023, the study meticulously traces the dynamic interplay between the Federal Reserve's policy instruments—specifically, the federal funds rate and balance - sheet policy—and a set of crucial macroeconomic indicators, including inflation, unemployment, industrial production, and market expectations. The overarching objective is to evaluate the timeliness, efficacy, and associated risks of the Federal Reserve's policy measures in curbing inflation while simultaneously fulfilling its dual mandate of maintaining price stability and promoting maximum employment [2].

2. Data Description and Variables

In this analytical endeavor, a comprehensive panel of monthly macroeconomic indicators is meticulously employed, with all data meticulously sourced from the Federal Reserve Economic Data (FRED), a highly reputable and widely - utilized database in the field of economics. The focal point of the analysis lies in the examination of U.S. inflation, which is captured through two distinct yet crucial measures [3]. The first is Core Personal Consumption Expenditures (PCE) inflation on a year - over - year (YoY) basis, which holds significant weight as it is the Federal Reserve's preferred gauge for assessing inflationary trends. The second measure is the Consumer Price Index (CPI) inflation (YoY), another well - established and commonly referenced indicator in inflation analysis [3,4].

Among the variables under scrutiny, the key independent variables are the Federal Funds Rate, expressed as a percentage (%), and the Fed Balance Sheet, measured in millions of dollars. These two variables are of paramount importance as they jointly represent the two main facets of the Federal Reserve's monetary policy arsenal: conventional and unconventional monetary policies. The Federal Funds Rate, a traditional tool, influences the cost of borrowing and lending in the short - term money market, thereby affecting overall economic activity [5]. On the other hand, the Fed Balance Sheet, which reflects the central bank's asset purchases and sales, is a more unconventional policy instrument that can have far - reaching effects on financial markets and the real economy [6].

To ensure a robust and comprehensive analysis, a set of control variables is incorporated into the model. These include the unemployment rate (%), which serves as an indicator of the health of the labor market and overall economic slack. The industrial production index provides insights into the level of activity in the manufacturing sector, a key driver of economic growth. Five - year inflation expectations (%), which reflect market participants' views on future inflation, can influence current spending and investment decisions [7]. The 30 - year mortgage rate (%) and corporate bond yields (%) are important for understanding the cost of financing for households and businesses, respectively. The 10 - year Treasury yield (%) is a benchmark for long - term interest rates and can have implications for a wide range of economic activities. The WTI oil price ($/barrel) is included to account for the impact of energy price fluctuations on inflation, as energy costs are a significant component of many goods and services. Finally, the Global Supply Chain Pressure Index (GSCPI) is used to capture the disruptions in global supply chains, which have become increasingly relevant in recent years [8,9].

The combination of variables allows for a multi - faceted testing of both demand - side and supply - side factors influencing inflation. On the demand side, the analysis can assess the transmission channels of monetary policy through interest rates, credit availability, and asset prices. For instance, changes in the Federal Funds Rate can affect consumer and business spending by altering the cost of borrowing. Similarly, the Fed's balance sheet operations can influence asset prices, which in turn can impact wealth and consumption. On the supply side, the inclusion of variables such as the WTI oil price and the GSCPI enables the examination of the impact of supply - side disruptions, such as energy shocks and supply chain bottlenecks, on inflation.

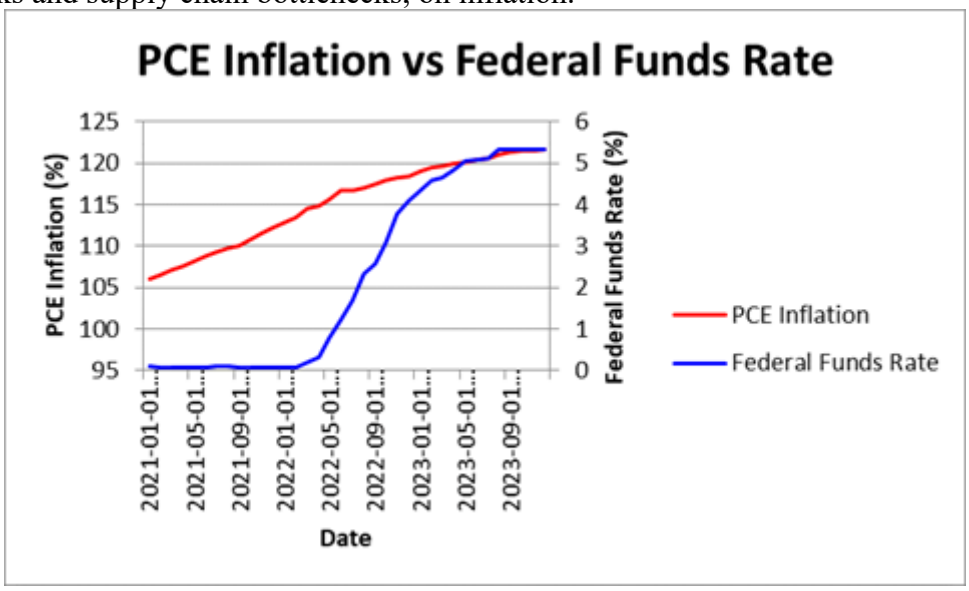

Fig. 1 PCE Inflation vs Federal Funds Rate

2.1. Core PCE Inflation vs Federal Funds Rate

The chart (see Fig.1) shows the lagged but powerful relationship between policy rates and inflation. From 2021 to early 2022, inflation accelerated sharply while the Fed kept the federal funds rate near zero, illustrating the cost of delayed tightening. Only from March 2022 onwards did the rate rise aggressively, eventually exceeding 5%. Inflation responded with a lag, peaking mid-2022 before declining through 2023. The evidence highlights the time lag of monetary transmission: policy changes take quarters to feed into demand and prices. The chart confirms your case study argument that misjudging persistence in 2021 forced a historically rapid rate-hike cycle in 2022–2023.

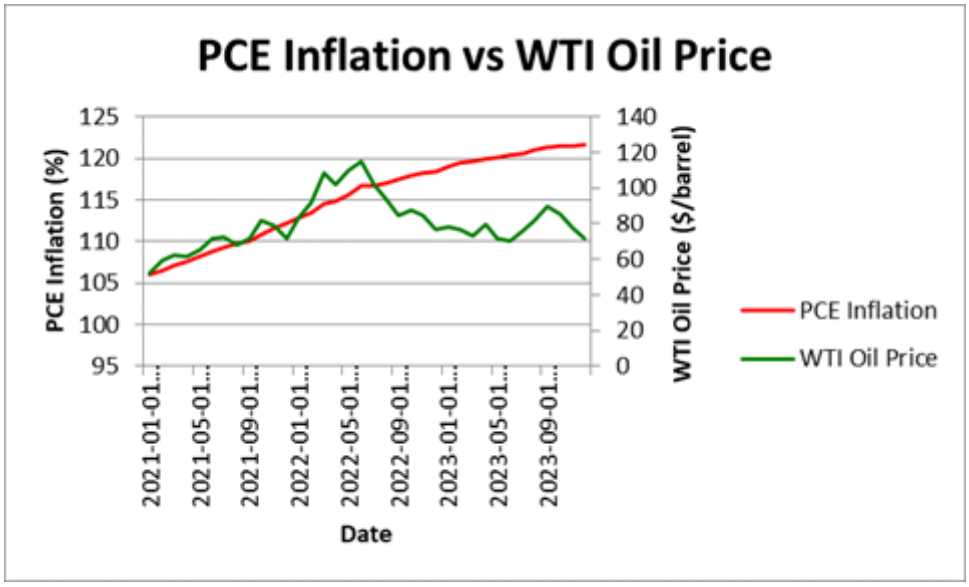

Fig. 2 PCE Inflation vs WTI Oil Price

2.2. Core PCE Inflation vs WTI Oil Price

This visual captures the supply-side contribution to inflation. Oil prices surged from ~$50 per barrel in early 2021 to over $120 in mid-2022, coinciding with the highest inflation readings. Even as the Fed tightened, energy costs sustained price pressures until oil corrected in late 2022.

The chart shows that monetary policy cannot directly control external shocks like energy. Inflation's persistence partly reflects these supply-driven spikes (see Fig.2). It supports your discussion that cost-push shocks prolonged inflation beyond what interest-rate hikes alone could resolve.

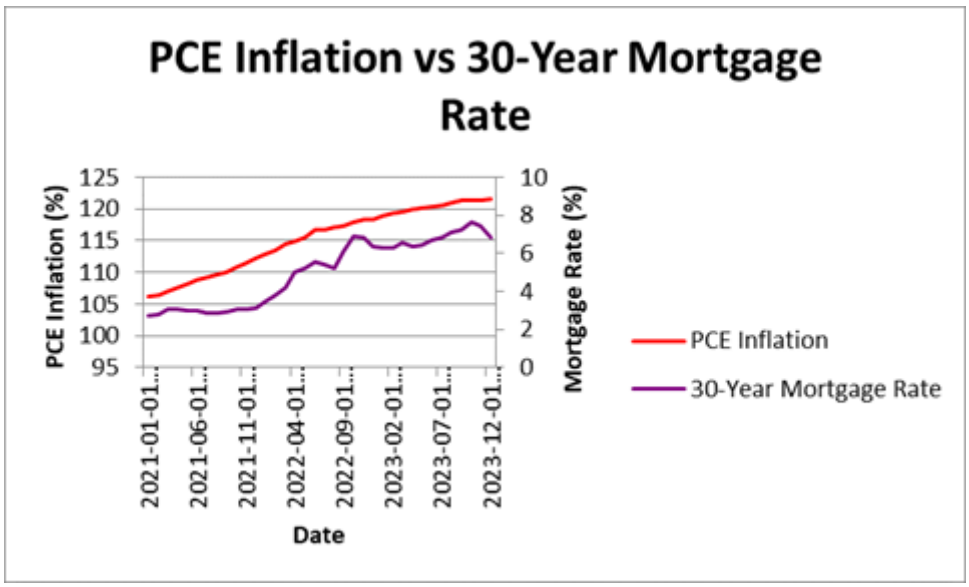

Fig. 3 PCE Inflation vs 30-Year Mortgage Rate

2.3. Core PCE Inflation vs 30-Year Mortgage Rate

The third chart (see Fig.3) illustrates the speed of policy transmission to credit markets. Mortgage rates nearly tripled — from ~2.7% in early 2021 to above 7% by late 2022 — as the Fed hiked rates. This surge immediately cooled housing activity, slowing shelter inflation by late 2023. The data confirms the efficiency but harsh side effects of transmission. While higher mortgage costs helped dampen inflation, they also raised risks of housing affordability crises and financial fragility, echoing your dual-mandate discussion.

2.4. Descriptive Statistical Overview

A descriptive summary of the dataset illustrates the dramatic shifts in macroeconomic conditions during the study period. Table 1 below provides the basic statistics [10]. The descriptive data reveal that while inflation climbed steadily, the federal funds rate rose sharply only after March 2022, highlighting the delay in policy response. Oil prices and supply chain pressures show wide variation, reflecting exogenous shocks from the Ukraine war and pandemic-era bottlenecks.

Table 1. Descriptive Statistics of Key Variables (2021–2023)

Variable	Mean	Std. Dev.	Min	Max
PCE Inflation (YoY, %)	115.8	5.2	106.1	121.6
CPI Inflation (YoY, %)	289.4	15.8	262.6	308.7
Federal Funds Rate (%)	2.49	2.08	0.07	5.33
Fed Balance Sheet ($m)	8,350,000	418,000	7,372,000	8,823,000
Unemployment Rate (%)	3.9	0.7	3.4	6.4
Mortgage Rate (30-year, %)	5.1	1.6	2.7	7.6
WTI Oil Price ($/barrel)	82.3	18.9	52.0	123.6
Supply Chain Pressure Index	1.35	1.6	-1.57	4.45

3. Trends and Mechanisms of Policy Transmission

The time-series analysis highlights three critical dynamics in how monetary policy adjustments transmit into inflation outcomes. These dynamics illustrate the importance of policy lags, interest-rate pass-through, and supply-side complications in shaping the effectiveness of the Federal Reserve's actions during 2021–2023.

3.1. Policy Lag

Inflation began accelerating as early as Q1 2021, while the Federal Funds Rate remained pinned near the zero lower bound until March 2022. This created a policy lag of approximately 12–14 months, during which inflation rose well above target. The Fed's average inflation targeting (AIT) framework deliberately tolerated this overshoot, but in practice, the lag allowed inflation expectations to become temporarily unanchored [11].

Table 2. Policy Lag: Inflation vs. Federal Funds Rate

Period	Core PCE Inflation (YoY, %)	Federal Funds Rate (%, Upper Bound)	Gap (Inflation – Rate)
2021 Q1	1.5	0.25	+1.25
2021 Q4	4.7	0.25	+4.45
2022 Q2	5.4	1.75	+3.65
2022 Q4	4.8	4.25	+0.55

The gap between inflation and the policy rate peaked in 2021, only narrowing by late 2022 as the Fed accelerated tightening. This confirms that monetary policy impacts inflation with long and variable lags.

3.2. Mortgage Rate Pass-Through

Transmission into credit markets was rapid once the tightening cycle began. The 30-year mortgage rate jumped from below 3% in 2021 to above 7% by October 2022. This sharp increase illustrates how higher policy rates transmit almost immediately into borrowing costs, dampening housing demand and consumer spending.

Table 3. Mortgage Rate Pass-Through

Period	Federal Funds Rate (%)	30-Year Mortgage Rate (%)	Change (Δ, pp)
2021 Q2	0.25	2.9	–
2022 Q1	0.50	4.0	+1.1
2022 Q4	4.25	7.1	+3.1
2023 Q4	5.25	6.7	–0.4

The pass-through rate is nearly one-to-one: a 4.75 pp rise in the funds rate corresponded to a ~3.8 pp rise in mortgage rates. This underscores housing as a key transmission channel in the Fed's dual mandate.

3.3. Supply Shock Complications

Despite aggressive rate hikes, inflation remained elevated through much of 2022 due to global supply shocks, including energy price spikes and supply chain bottlenecks. Oil prices peaked above $120 per barrel in mid-2022, amplifying cost-push pressures. The research highlights the monetary trilemma: domestic policy is constrained when inflation is driven by external shocks [12].

Table 4. Oil Prices and Inflation Persistence

Period	WTI Oil Price ($/barrel)	Core PCE Inflation (%)	Observed Effect
2021 Q2	65	3.4	Initial rise
2022 Q2	115	5.4	Peak inflation
2022 Q4	80	4.8	Slow decline
2023 Q4	72	2.9	Inflation easing

4. Root Causes of the Inflation Surge

The high rates of inflation in 2021 and 2022 in the United States were the result of excessive demand and a cost squeeze. Monetary and fiscal growth on the consumption side led to a situation of high price growth. Direct transfer payments to households and businesses, in the form of a series of budgetary stimulus bills such as the CARES Act and the American Rescue Plan, have injected trillions of dollars into household savings, exceeding $ 2.5 trillion. As restrictions were eased regarding the pandemic, the accumulating inventory was translated into an effective recovery in consumption, particularly for goods and housing. Meanwhile, monetary policy was highly accommodative, as the federal funds rate was pegged at the zero lower bound, and the Federal Reserve's balance sheet increased to nearly $ 9 trillion due to quantitative easing. Finance was very loose and easy to borrow from, allowing for risk-taking, and even mortgage rates were below 3 per cent until the end of 2021, which has further fueled the housing market, resulting in shelter inflation.

Global disruptions increased these pressures on the supply side. Delays in the delivery of goods were unprecedented due to congestion in shipping zones at ports like Los Angeles and Long Beach, a shortage of shipping containers, and regular lockdowns in China. Throughout 2021, the New York Fed Global Supply Chain Pressure Index increased to above 4.0, indicating extreme stress. In the meantime, the crunch on semiconductor supply constrained auto and electronic production, causing abrupt increases in the prices of durable goods. Energy shocks also exacerbated inflation, as the cost of crude oil rose above $120 per barrel in mid-2022. These shocks were passed on to gasoline, heating, and transportation prices, and exacerbated headline inflation. This high demand and low supply would lead to a perfect storm, creating non-linear dynamics of inflation that traditional Phillips curve models could never explain. Such compound shocks yield price responses that the historical relationships do not predict effectively [1].

5. Federal Reserve's Delayed Response

The Federal Reserve remained accommodative well into early 2022 and still described inflation as transitory, even though the inflation rate increased to over 5 per cent/year on a year-over-year basis by mid-2021. This was an institutional design delay, as well as a judgment delay. This was in part due to the structure of Average Inflation Targeting (AIT), which was implemented in 2020 and allowed for publicly accepted inflation overshoots to address any prior underperformance. This introduced an element of bias in patience, as policymakers assumed that the supply bottleneck would be resolved and prices would not naturally rise. One more reason that the Fed extensively utilised was its credibility in anchoring the expectations that households and firms would continue to believe in the 2 per cent long-term target. Surveys conducted at the beginning of the year confirmed this assumption, and the five-year inflation outlooks remained comparatively unchanged throughout 2021.

The other reason was an interest in the labour market. Employment was not yet at the post-pandemic shock level, and participation rates remained below pre-2020 levels. Raising rates too soon risked undermining progress toward maximum employment, thereby conflicting with the Fed's dual mandate. Historical experience also shaped perceptions: Romer and Romer (2024) argue that the Fed's caution was influenced by the post-2008 era, when fears of inflation proved unfounded and disinflationary forces dominated. Furthermore, communication commitments created constraints. As scholar emphasizes, forward guidance enhances credibility but restricts flexibility, and having signaled “lower for longer”, the Fed risked undermining its own reputation if it reversed prematurely [13].

The consequences of this delay were significant. Inflation peaked at 9.1% in June 2022 before monetary tightening began to take effect. The Fed was then forced into its fastest hiking cycle in decades, raising policy rates by 525 basis points in less than two years. This catch-up tightening generated volatility in bond markets, contributed to banking stresses such as the collapse of Silicon Valley Bank in 2023, and raised concerns about a policy-induced recession. Inflation expectations also wavered temporarily, with the five-year TIPS breakeven climbing above 3% in early 2022, reflecting doubts about the Fed's commitment. While inflation eventually eased, the episode revealed both the risks of delayed action and the limits of monetary policy in the face of simultaneous demand and supply shocks.

Table 5. Factors in Inflation Effect

Factor	Evidence (2021–2022)	Inflation Effect	Notes
Fiscal stimulus & savings surge	Household savings > $2.5T	Boosted consumption (demand-pull)	Supported by BEA data
Supply chain bottlenecks	NY Fed GSCPI > 4.0	Raised goods prices (cost-push)	Global in scope
Oil price shock	WTI > $120/barrel	Energy & transport inflation	Amplified by Ukraine war
Fed's AIT framework	Tolerance of overshoot	Delayed policy tightening	New strategy from 2020
Anchored expectations	5-year surveys stable in 2021	Fed assumed stability	Shifted only in 2022

5.1. Evaluation of Austerity Measures

Following the abandonment of the transitory narrative at the start of 2022, the Federal Reserve introduced one of the fastest tightening regimes in recent times. The federal funds rate increased by more than 500 basis points between March 2022 and July 2023, and the Fed reduced its balance sheet by nearly $ 1 trillion under quantitative tightening (QT). This drastic reversal was a last-minute

attempt to re-ground inflation expectations and cool down consumer price inflation, which had soared to 40-year highs.

The history of Federal Reserve policy from 2021 to 2023 can be further divided into several distinct phases that demonstrate the flaws and costs of the policy of aggressive austerity. Due to widespread fiscal stimulus, virtually zero interest rates and ongoing quantitative easing (QE) stimulus, demand was high in early 2021, and inflation rose to more than 4%. However, the Fed did not intervene and even hoped that the supply disruptions would not continue. Throughout the second half of 2021, inflation has remained a dominant force, soaring beyond 6 per cent in the face of supply chain bottlenecks, rising energy costs, and intense housing demand. Even when confronted by these signals, the Fed adhered to its own transient framing, delaying what had to be done, and in effect increasing the scale of intervention to be undertaken in later years. All that changed in 2022 during the second half, when the Russian invasion of Ukraine intensified global energy shocks, pushing WTI oil into the triple digits, reaching almost 120 per barrel, and inflation almost to 9%. In March, the Fed began raising rates for the first time in years and phased out QE, a shift that coincided with mortgage rates doubling from around 3% to nearly 6%. By the second half of 2022, the tightening accelerated: the Fed implemented consecutive 75-basis-point hikes and launched active quantitative tightening (QT). These measures weakened demand, with housing markets slowing, refinancing activity collapsing, and consumer confidence dipping. Inflation began to ease, though core inflation remained sticky. By mid-2023, the funds rate exceeded 5% and the Fed's balance sheet had contracted further. Headline inflation moderated below 4%, reflecting some success, yet risks became evident. Financial fragility emerged in the form of regional bank stresses and the collapse of Silicon Valley Bank, while employment growth slowed -and yield curve inversions signaled recession fears.

The effectiveness of this austerity cycle was mixed. On one hand, inflation control was achieved: both headline and core inflation trended downward by 2023, long-term inflation expectations stabilized, and credit-sensitive sectors such as housing and durable goods showed clear responses to higher borrowing costs. Yet, the transmission of monetary policy was delayed, with the sharpest effects only visible from late 2022 onward, consistent with the typical 12- to 18-month lag. Alongside these achievements, the costs of aggressive tightening were significant. Rrate hikes act as blunt instruments that risk destabilizing financial markets, a dynamic borne out in SVB's failure when rising yields eroded the value of long-duration bond holdings [13]. Economic growth slowed as investment weakened and unemployment edged upward, while globally, higher U.S. interest rates triggered capital outflows and exchange rate pressures in emerging markets. Together, the 2022-2023 austerity cycle revealed the power and weakness of tightening of money. It once again restated that Fed was able to control the inflation at a huge cost in terms of money stability and development. It also emphasized the importance of timing, how the need to tighten it sooner and later could have watered down the need to tighten it so radically and once again showed that communication and management of credibility is as important as the increases themselves.

Table 6. Inflation Drivers, Fed Policy, and Outcomes (2021–2023)

Period	Main Inflation Drivers	Fed Policy Stance	Observed Outcomes
2021 H1	Fiscal incentive, QE, low rates	Funds Rate 0%, QE continuing	Inflation rises >4%
2021 H2	Supply bottlenecks, energy	“Transitory” narrative	CPI >6%, no policy action
2022 H1	Ukraine war, energy shocks	First hikes, QE ends	CPI peaks ~9%, mortgage rates jump
2022 H2	Mixed demand & supply	Rapid hikes + QT	Housing slows, inflation simplicities
2023	Persistent but moderating CPI	Funds Rate >5%, QT continues	Inflation declines, stability risks

6. Conclusion

The quote, too, helps to develop the theme that monetary policy is not the single method of jump-starting the economy, but it is one of the most efficient methods of doing so. It is chronic in the sense that it is enabled by a global disintegration of the supply chain compounded by inflation and long run effects that constitutes lags. The very fact that the Fed has reversed in 20212023, by itself, suggests that any reversal at this point had to be paid by a vigorous tightening which generated falling inflation, at a very high cost: future financial weakness, tight credit markets, and the risk of recession.

Here we can learn three lessons. It needs to be duly and timely diagnosed, the performance of which policy credit will not purchase in this instance, but only by duly diagnosing that the inflation continues. Second, fiscal and structural policies are not an acceptable alternative to monetary policies when the supply shock is the order of the day; therefore, the spheres of policy must be coordinated. Third, the two conditions must be tradeoffs in which over-inflation cannot be controlled by sacrificing financial stability and full employment goals.

And, best of all, yet not the last, the episode allows bringing the comprehension of what that very substance of the tension that the central bank has been feeling is, the Fed can produce a deflation of prices one more time. But even concerning the means by which the adjustment process has been constituted, we discover how small the grain line is in some cases between price and the welfare of the economy. The moral of the second crisis is that monetary policy will be less forceful and less vocal, and will be more closely aligned with the broader policy systems that will characterize the shock-prone and systemically vulnerable world.

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