Which Type of Government Stimulus is Better for Recessions?
Measuring the Effects of Monetary and Fiscal Policy Shocks on Economic Conditions

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Abstract

This paper examines the effectiveness of monetary and fiscal policy during the 2007-2009 Global Financial Crisis and the 2020 COVID-19 recession using vector autoregression (VAR) models. Balance sheet expansions (monetary policy) and government transfers (fiscal policy) are compared in terms of their dynamic impact on industrial production, real GDP per capita, inflation, and unemployment. The results show that government transfers produced faster and more consistent effects on output and employment, while balance sheet expansions became more impactful in the COVID-19 period. Government spending had limited influence in either window. These findings highlight the importance of timely, targeted fiscal support and the growing role of unconventional monetary policy in economic stabilization.

Introduction

In response to the deep economic disruptions caused by the 2007–2009 Global Financial Crisis and the 2020 COVID-19 pandemic, U.S. policymakers implemented large-scale monetary and fiscal interventions aimed at stabilizing output, preserving employment, and safeguarding household well-being. These crises prompted an unprecedented reliance on unconventional tools, most notably the Federal Reserve's quantitative easing (QE) programs and expansive fiscal stimulus measures such as direct transfers, expanded unemployment benefits, and public sector employment support. While both policy levers were designed to provide macroeconomic stability, there remains substantial debate around their relative effectiveness and potential unintended consequences.

QE, which involves large-scale asset purchases by the central bank, was introduced as a means to lower long-term interest rates and stimulate private investment when conventional monetary policy reached the zero lower bound (ZLB). At the same time, fiscal stimulus packages—ranging from tax rebates to massive increases in federal outlays—were implemented to boost demand, protect vulnerable populations, and cushion the labor market against deeper declines. These coordinated efforts succeeded in averting deeper recessions, but the magnitude and persistence of their effects have varied across time, policy type, and economic sector.

This paper investigates whether monetary and fiscal policy shocks differed in their ability to influence key indicators of macroeconomic performance during these two crisis episodes. In particular, it compares the effects of balance sheet expansions and fiscal transfers on output and what may broadly be termed "quality of life," which includes real GDP per capita, inflation, and labor market conditions. While prior research has demonstrated that monetary interventions like QE can impact asset prices and inflation expectations, it remains unclear whether they yield equivalent real-sector outcomes as targeted fiscal support—especially in contexts of heightened inequality or labor market frictions. Moreover, the potential for inflationary spillovers and long-run distortions raises questions about the sustainability of these tools.

Focusing on the Great Financial Crisis and the COVID-19 recession, this study aims to identify disparities in the short- and long-run effects of monetary versus fiscal policy using VAR models. The analysis explores not only the direct response of output to each type of shock but also their effects on employment and price stability, offering insight into the mechanisms through which policy tools shape economic recovery. By evaluating these episodes side-by-side, the paper contributes to a better understanding of when and how different macroeconomic interventions are most effective—and what trade-offs may emerge in their application.

Review of the Literature

A substantial body of research has examined the macroeconomic effects of unconventional monetary and fiscal policies in the wake of the 2008 financial crisis and the COVID-19 pandemic. Wu and Xia (2016) develop a shadow federal funds rate to quantify the effects of monetary policy at the ZLB. They find that unconventional tools like QE continued to exert significant macroeconomic influence even when the nominal policy rate was constrained, highlighting the importance of these tools during liquidity traps. Similarly, D'Amico et al. (2013) provide empirical evidence that large-scale asset purchases were effective in lowering long-term interest rates and stimulating investment and employment. Inoue and Rossi (2019) further show that both conventional and unconventional monetary policy have statistically significant effects on exchange rates, reinforcing the view that QE influences broader financial conditions and not just domestic output.

Hollmayr and Kühl (2019) emphasize that the impact of QE is not purely a monetary phenomenon; its effectiveness depends in part on the fiscal stance. Their results support a view of monetary–fiscal interaction, where coordinated policies amplify one another. This idea is echoed by Hallett, Rannenberg, and Schreiber (2017), who find that the effectiveness of the 2009 U.S. fiscal stimulus was heavily dependent on monetary accommodation. They argue that, contrary to early critiques, the multiplier effects of fiscal policy would have been significantly underestimated without accounting for the Fed's sustained accommodative stance. Liu (2024) cautions, however, that while QE has provided needed liquidity, it also introduces potential risks to central bank credibility and market expectations, particularly during the exit phase from accommodative policies. Her analysis stresses the need for clear communication and planning to prevent instability during policy normalization.

Fiscal policy alone has also been studied extensively. Cavallo (2005) explores the differential effects of various components of government spending and finds that government employment expenditures behave more like transfer payments, having muted effects on consumption and labor supply. Bachmann and Sims (2011) examine the role of consumer confidence in transmitting government spending shocks. They find that confidence responds more strongly during recessions, suggesting that fiscal policy is more potent in downturns, especially when spending is perceived as investment in future productivity. At the institutional level, the Hutchins Center Fiscal Impact Measure (Ahmad, Nabors, and Sheiner 2025) provides ongoing empirical tracking of how local, state, and federal fiscal policy contributes to or detracts from real GDP growth. Their findings show that fiscal policy can shift from being a drag to a stimulus depending on both policy decisions and cyclical factors.

While these studies significantly deepen understanding of monetary and fiscal tools in isolation and interaction, this paper contributes by jointly modeling balance sheet expansions and transfer-based fiscal policy using VAR methods across two distinct recession windows. Unlike prior work that tends to isolate one policy channel or rely on simulation-based models, this study uses empirical impulse response analysis to compare the dynamic effects of monetary and fiscal interventions on output, consumption, and labor market indicators. In doing so, it sheds light on how the relative influence of each policy tool evolves under different macroeconomic regimes.

Conceptual Framework

This study investigates how expansionary monetary and fiscal policy interventions influence key macroeconomic indicators during periods of economic crisis, with a specific focus on the 2007–2009 Global Financial Crisis and the 2020 COVID-19 recession. These two events represent distinct yet comparably severe economic shocks that prompted large-scale responses by U.S. policymakers. The central objective is to evaluate the dynamic effects of these interventions—particularly quantitative easing (QE) and fiscal stimulus—on economic output, inflation, unemployment, and broader measures of economic well-being.

The underlying framework is informed by macroeconomic theory, which posits that expansionary policy should increase aggregate demand, stimulate output, and reduce unemployment in the short run. Quantitative easing, implemented through large-scale asset purchases by the Federal Reserve, aims to lower long-term interest rates, support credit markets, and stimulate investment. Fiscal stimulus, particularly direct transfers, intend to inject purchasing power directly into households and businesses, boosting consumption and stabilizing employment. Both tools share the goal of mitigating downturns and accelerating recovery, but they differ in their transmission mechanisms, immediacy, and potential side effects.

This paper considers seven variables central to assessing the economic impact of these policies: the Federal Reserve's balance sheet (as a proxy for monetary stimulus), government spending and transfers (fiscal policy), industrial production (real output), real GDP per capita (productivity and living standards), change personal consumption expenditures (PCE inflation), and the unemployment rate (labor market health). By focusing on these outcomes, the analysis aims to capture both traditional macroeconomic goals—such as output stabilization and price control—and broader quality of life indicators related to income and employment.

The expectations for the results of this study are grounded in standard economic reasoning. Expansionary monetary or fiscal shocks are anticipated to raise output while reducing the unemployment rate. Inflation may also increase as a byproduct of heightened demand and liquidity, particularly if policy support is large or sustained. However, the relative effectiveness and potential trade-offs of monetary versus fiscal approaches remain contested. For example, while QE may ease financial conditions, it may do less to directly support household income or consumption compared to fiscal transfers. Conversely, fiscal interventions may be more potent in the short term but raise concerns about long-run inflation or public debt sustainability.

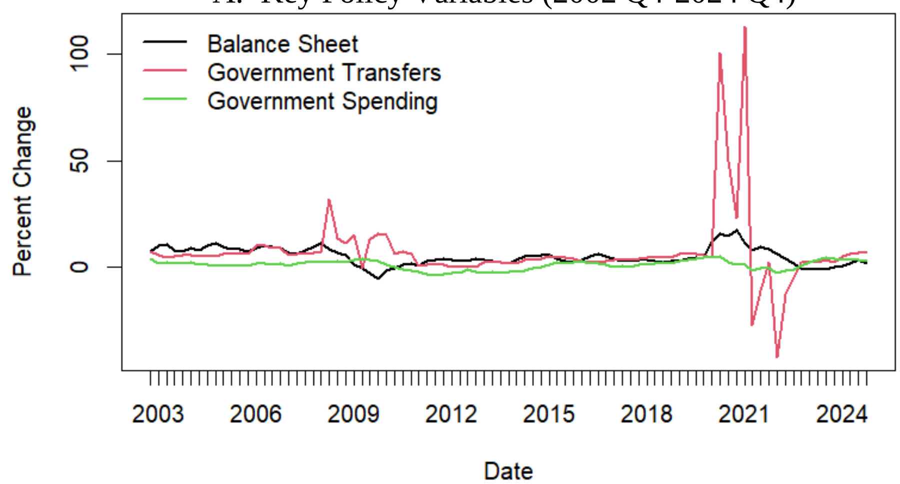
Data and Preparation

The data used in this analysis were obtained from the Federal Reserve Economic Data (FRED), maintained by the Federal Reserve Bank of St. Louis, and represent key U.S. macroeconomic indicators reported on a quarterly basis. All series were expressed as year-over-year percent changes besides the unemployment rate—which is a raw percentage points—and were seasonally adjusted when available to remove fluctuations unrelated to the business cycle. The raw data was sampled from 1985 Q1 to 2024 Q4, but this paper only focuses on the two recessions post-2002 Q4. Recession timing was aligned with the official chronology of U.S. business cycles provided by the National Bureau of Economic Research (NBER).

Industrial production, used to capture output in the industrial sector, originates from the Federal Reserve Board. Balance sheet assets, representing the total holdings of the Federal Reserve and used to measure monetary policy interventions, are compiled by the Board of Governors of the Federal Reserve System. Government transfers, which include federal social benefit payments to individuals, as well as real GDP per capita (RGDPPC) and government spending, are all produced by the Bureau of Economic Analysis (BEA). The unemployment rate is reported by the Bureau of Labor Statistics (BLS), and inflation is measured using PCE, also published by the BEA.

Figure 1. Time Series Plots of Macroeconomic Variables

A. Key Policy Variables (2002 Q4-2024 Q4)



B. Key Indicator Variables (2002 Q4-2024 Q4)

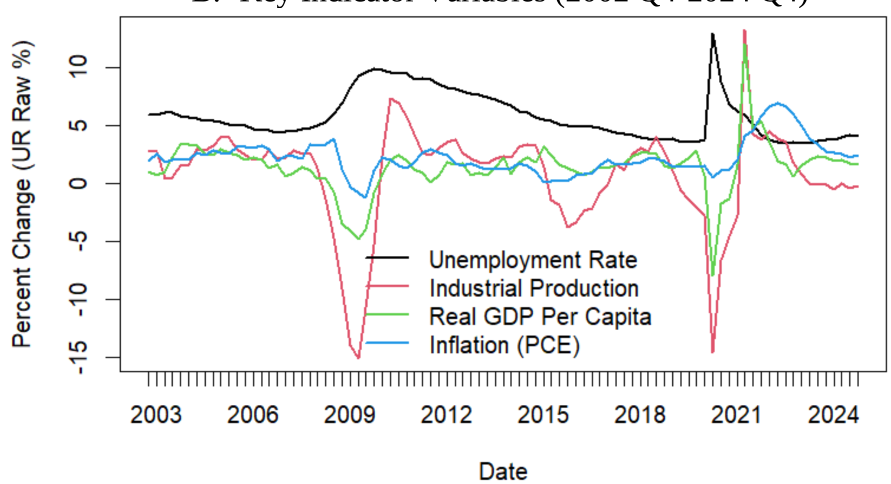


Figure 1A highlights the evolution of the primary policy instruments examined in the analysis—balance sheet assets, government transfers, and government spending. Each series remains relatively stable prior to 2008, with modest fluctuations around trend. However, both the Great Recession and the COVID-19 pandemic produce large and distinct spikes. Government transfers, in particular, show extreme surges in 2020 and 2021, exceeding 100% growth on a year-over-year basis at several points, reflecting the extraordinary scale of pandemic-era fiscal support.

Balance sheet expansion also accelerates sharply in these periods, especially following 2020, as monetary policy became increasingly reliant on asset purchases at the ZLB. Government spending, while reactive, displays a more subdued response in comparison.

Figure 1B tracks the evolution of key macroeconomic outcomes: unemployment, industrial production, real GDP per capita, and inflation. All four indicators exhibit pronounced cyclical sensitivity, with sharp contractions during the 2008-2009 and 2020-2021 downturns. The unemployment rate spikes during both recessions, reaching a peak above 10% during the Great Recession and again during the COVID-19 shock. Industrial production and real GDP per capita both experience severe declines during these periods, with especially dramatic reversals in 2020. Inflation remains relatively stable until 2021, when it rises significantly as the economy emerges from the pandemic. Taken together, these figures visually underscore the economic disruptions caused by both crises and the intensity of the fiscal and monetary responses, particularly in the COVID-19 period.

In order to isolate the macroeconomic dynamics surrounding the Great Recession and COVID-19 recession—while allowing enough pre- and post-recession data to assess the short- and medium-term effects of policy shocks—the data is split into two windows: 2002 Q4-2012 Q4 and 2014 Q4-2024 Q4. Each subsample includes 41 quarterly observations 5 years prior and after the start of a recession. The start of the Great Recession is the fourth quarter of 2007 and the fourth quarter of 2019 for the COVID-19 recession. The 41-quarter window strikes a balance between including sufficient data to reliably meet VAR assumptions while maintaining temporal focus on the relevant business cycle dynamics. It allows the preceding VAR models to capture lead and lag structures in economic relationships both before and after the onset of each recession.

To ensure the validity of the VAR models that will be utilized in this paper, all time series were subjected to Augmented Dickey-Fuller (ADF) tests for stationarity. These tests were conducted across the two key subsample periods. The variables were tested in levels as well as in first (D1) and second (D2) differences when necessary. Table 1 shows that most variables, including the balance sheet, government spending, and industrial production, were found to be non-stationary in levels but became stationary after first or second differencing. The unemployment rate, included only in the 2014-2024 models, required second differencing to meet stationarity requirements. Lag lengths for the ADF tests were selected using standard information criteria and extended up to four lags to control for autocorrelation. In cases where p-values were between 0.05 and 0.10, such as the first difference of PCE in 2014-2024, an asterisk was used to denote marginal significance for PCE in 2014-2024, indicating potential stationarity at the 10% level. Another asterisk indicated the exclusion of unemployment rate in the 2002-2012 models due to non-stationarity. See Note. 3 and 4. These results were used to determine the appropriate transformation of each variable prior to estimation, ensuring that the VAR models were specified using stationary data series.

Table 1. Augmented Dickey-Fuller Test Results

Variable	Difference	2002-2012 p-value	2014 -2024 p-value
Balance Sheet	Level	0.32	0.38
	D1	**0.02**	**0.03**
Industrial Production	Level	0.50	**0.04**
	D1	**0.01**	**0.02**
Real GDP Per Capita	Level	0.33	**0.01**
	D1	**0.01**	**0.01**
PCE (Inflation)	Level	0.08	**0.02**
	D1	**0.01**	0.07*
Government Transfers	Level	0.55	0.13
	D1	**0.01**	0.18
	D2	**0.01**	**0.01**
Government Spending	Level	0.41	**0.01**
	D1	0.16	0.10
	D2	**0.02**	**0.04**
Unemployment Rate	Level	0.22	0.42
	D1	0.45	**0.04**
	D2	0.16*	**0.01**

Note 1. Significant Augmented Dickey-Fuller p-values bolded ($p<0.05$).
Note 2. D1 indicates first difference and D2 second difference.
Note 3. * D1 and D2 PCE in 2014-2024 fails test at 0.05, but not at 0.10.
Note 4. * Unemployment rate only included in 2014-2024 models due to insignificance in 2002-2012.

The summary statistics in Table 2 reveal clear increases in volatility across key macroeconomic variables between the 2002-2012 and 2014-2024 periods, reflecting heightened economic uncertainty and more forceful policy responses in the latter window. All variables are expressed in either first or second differences to ensure stationarity, meaning the reported values represent quarter-over-quarter changes in growth rates or accelerations rather than levels. Balance sheet policy, in first differences, shows a notably higher maximum in the later period (8.06 vs. 3.88), consistent with expanded monetary interventions. Government transfers and government spending, both in second differences, exhibit significantly larger ranges post-2014, with transfer shocks reaching a maximum of 155.96 and a minimum of -229.68—up from 29.29 and -43.33 respectively—indicating substantial swings in fiscal support. Real GDP per capita and inflation also show greater dispersion, particularly GDP growth, which ranges from –8.70 to 10.48 in the later period. The most dramatic shift is observed in the unemployment rate, whose second differences span from -13.40 to 9.00 in 2014-2024, compared to a much narrower –0.70 to 0.60 range in the earlier period, highlighting the labor market turbulence that followed recent economic shocks.

Table 2. Summary Statistics

Period	Variable	Min	Mean	Max
2002-2012	D1 Balance Sheet	-4.840	-0.035	3.884
	D2 Government Transfers	-43.327	0.051	29.293
	D2 Government Spending	-2.168	-0.038	2.093
	D1 RGDPPC	-2.764	-0.010	3.214
	D1 Inflation	-2.689	0.006	2.378
	D2 Unemployment Rate	-0.700	-0.002	0.600
2012-2024	D1 Balance Sheet	-5.973	-0.080	8.061
	D2 Government Transfers	-229.678	0.013	155.959
	D2 Government Spending	-3.621	-0.032	4.365
	D1 RGDPPC	-8.695	-0.014	10.480
	D1 Inflation	-1.152	0.022	2.004
	D2 Unemployment Rate	-13.400	0.000	9.000

Empirical Methodology

The empirical analysis is based on a VAR model of order four, estimated separately across two time periods and for three types of policy shocks: balance sheet expansions, government transfers, and government spending. The VAR(4) model is specified in the standard reduced form as:

$Policy_t = \Delta BS_t \text{ or } \Delta^2 GovT_t \text{ or } \Delta^2 GovS_t$

Models 1-6

$$Y_t = \begin{bmatrix} Policy_t \\ \Delta IP_t \\ \Delta RGDPPC_t \\ \Delta PCE_t \end{bmatrix}$$

Models 7-9

$$Y_t = \begin{bmatrix} Policy_t \\ \Delta IP_t \\ \Delta RGDPPC_t \\ \Delta PCE_t \\ \Delta^2 UNRATE_t \end{bmatrix}$$

$$Y_t = c + \sum_{i=1}^{4} A_i \, Y_{t-i} + \epsilon_t$$

where Y_t is a vector of endogenous variables at time t, c is a vector of intercept terms, A_i are coefficient matrices for each lag i, and ϵ_t is a vector of reduced-form residuals. All variables are transformed to ensure stationarity, with Δ and Δ^2 denoting first and second differences, respectively. The policy variable $Policy_t$ is defined as either the first difference of the balance sheet (ΔBS_t), the second difference of government transfers ($\Delta^2 GovT_t$), or the second difference of government spending ($\Delta^2 GovS_t$).

Models 1 through 6 include four endogenous variables: the policy instrument, percent change in industrial production (ΔIP_t), real GDP per capita ($\Delta RGDPPC_t$), and PCE (ΔPCE_t). Models 7 through 9 extend this specification by including the second difference of the unemployment rate

($\Delta^2 UNRATE_t$) to capture labor market dynamics. The use of four lags was selected based on standard information criteria and allows for sufficient flexibility to capture short-term macroeconomic feedback among the variables. This structure enables the identification of dynamic responses to policy shocks while accounting for interactions across key dimensions of economic activity.

To determine the appropriate lag length for the VAR models, several standard information criteria were considered at a max lag length of six, including the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Hannan-Quinn criterion (HQ), and the Final Prediction Error (FPE). As expected, AIC frequently selected higher lag orders, occasionally favoring up to six lags due to its emphasis on model fit. In contrast, BIC tended to recommend more conservative specifications, often selecting one or two lags, reflecting its stronger penalty on model complexity. HQ and FPE offered a middle ground, commonly identifying four lags as optimal. Given the limited sample size of 41 quarterly observations per estimation window and the objective of capturing the short- to medium-term transmission of policy shocks, a uniform lag length of four was adopted for all models. This choice reflects a balance between parsimony and flexibility, is supported by multiple selection criteria, and ensures consistency across model specifications and time periods.

Results

The Granger causality results presented in Table 3 offer preliminary evidence on whether the policy variables of interest—balance sheet expansions, government transfers, and government spending—jointly help explain movements in key macroeconomic indicators across the two subsample periods. In the earlier period (2002-2012), only government transfers (Model 3) show clear Granger-causal effects on multiple outcome variables, including industrial production ($p = 0.00$) and inflation ($p = 0.07$), with a borderline result for real GDP per capita ($p = 0.30$). Balance sheet policy (Model 1) and government spending (Model 2) do not meet conventional thresholds for significance, suggesting limited predictive power of these instruments in that period. These results align with the broader narrative that fiscal transfers played a more direct role in shaping macroeconomic outcomes during the Great Recession, while monetary policy was more gradual in its transmission.

In contrast, during the 2014-2024 period, Granger causality is much more pronounced. Both balance sheet shocks (Models 4 and 7) and government transfers (Models 6 and 9) demonstrate consistent and significant predictive relationships across all three indicator variables—industrial production, real GDP per capita, and inflation—with p-values at or below the 0.05 level in nearly every case. Moreover, when unemployment is included (Models 7–9), both balance sheet and transfer models exhibit significant Granger causality for labor market outcomes, further supporting their role in influencing real activity. Government spending, however, fails to show significant Granger causality in any model specification during this later period, suggesting that it played a comparatively passive or reactive role relative to the other policy tools.

These findings reinforce the structural implications explored in the impulse response functions (IRFs) presented in the next section. The joint significance of balance sheet and transfer variables across multiple macroeconomic dimensions validates their inclusion in the VAR framework and supports the interpretation of the IRFs as meaningful dynamic responses. Conversely, the weak Granger evidence for government spending across both periods bolsters its use as a counterfactual, helping to isolate the effects of more active policy instruments. Overall, the Granger results provide a statistical foundation for interpreting the direction, timing, and persistence of the policy transmission mechanisms shown in the IRFs.

Table 3. Granger-Causality Test Results for Endogenous Variables Across Models

Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
	2002-2012			**2014-2024**					
Balance Sheet	0.09	-	-	**0.00**	-	-	**0.00**	-	-
Government Spending	-	0.06	-	-	0.78	-	-	0.29	-
Government Transfers	-		**0.00**	-	-	**0.00**	-	-	**0.02**
Industrial Production	**0.03**	**0.02**	**0.00**	0.21	**0.00**	**0.00**	0.40	**0.00**	**0.03**
Real GDP Per Capita	**0.02**	0.32	0.30	0.21	**0.00**	**0.00**	0.33	**0.00**	**0.00**
Inflation	**0.00**	**0.00**	**0.07**	0.07	**0.02**	**0.00**	**0.01**	**0.00**	**0.01**
Unemployment Rate	-	-	-	-	-	-	**0.04**	**0.00**	**0.00**

Note. Significant Granger-causality p-values bolded ($p<0.05$).

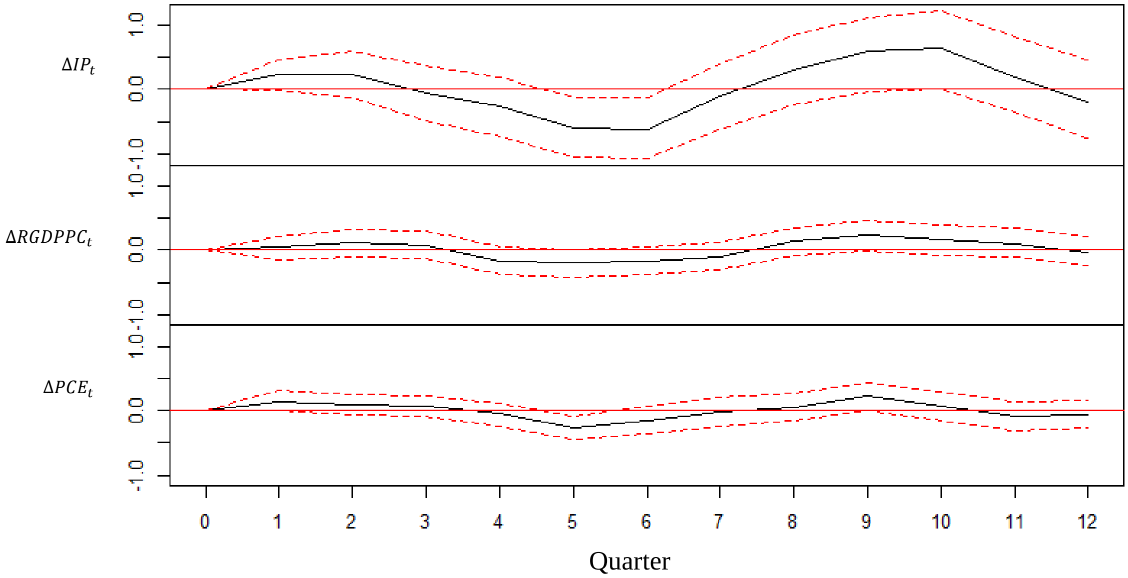
Figure 2A shows the response to a one-percentage-point increase in the quarterly change of the Federal Reserve's balance sheet. Because all series are expressed in differences of their year-over-year growth rates, the axes measure quarter-to-quarter changes in those growth rates, in percentage points. Industrial production falls significantly below zero beginning in quarter 2, reaches its lowest value of roughly –0.6 percentage points in quarter 4, and then swings positive and significant in quarters 8 through 10, peaking near +1.0 percentage points. In contrast, the responses of real GDP per capita and inflation remain statistically indistinguishable from zero at the 95% confidence level throughout the 12-quarter horizon. These dynamics align with the Granger-causality result for the balance sheet shock ($p = 0.09$), which suggests only weak joint predictive power for the broader system of real and price variables.

Figure 2B reports the impulse response to a one-percentage-point increase in the acceleration of government transfers. Industrial production again dips initially—marginally significantly in quarter 1—and then rebounds positively and significantly in quarters 6 through 8, with a peak of about +0.15 percentage points. Neither GDP per capita growth nor inflation exhibits a significant response at any horizon. Compared to the large and delayed effects of balance sheet shocks, government transfers produce a faster, more predictable impact on production, though of smaller magnitude. This finding is consistent with the strong Granger-causality results for transfers, confirming that fiscal interventions had more immediate and statistically robust predictive content for real economic activity during the 2002-2012 period. In contrast, monetary policy appears to transmit more slowly and with greater volatility, while fiscal policy operates through a more direct and stabilizing channel. Acceleration in transfers also led to a slight bump in inflation for the first quarter.

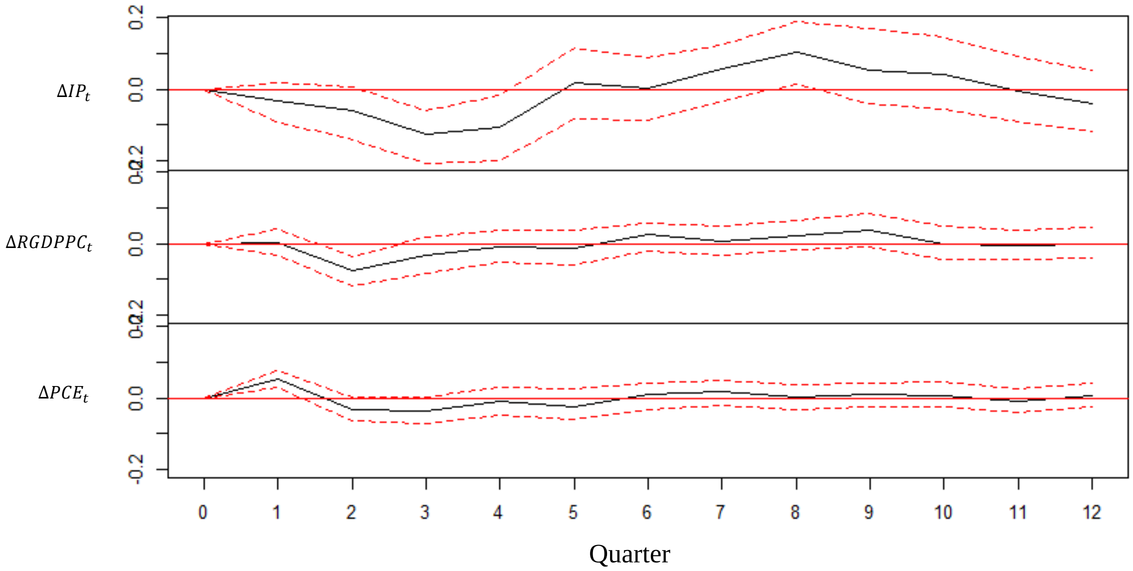
Figure 3 presents impulse response functions for the 2014-2024 period following a one-percentage-point increase in the quarterly change of the Federal Reserve's balance sheet (Figure 3A) and in the acceleration of government transfers (Figure 3B). As in previous figures, all variables are expressed in either first or second differences of year-over-year growth rates, so the responses are interpreted as quarter-to-quarter changes in growth rates (in percentage points). The solid black line represents the estimated response, and the red dashed lines indicate 95% bootstrap confidence intervals based on 1,000 replications.

Figure 2. Balance Sheet & Government Transfers Impulse Response Functions (2002-2012)

A. Model 1: ΔBS_t Shock



B. Model 3: $\Delta^2 GovT_t$ Shock

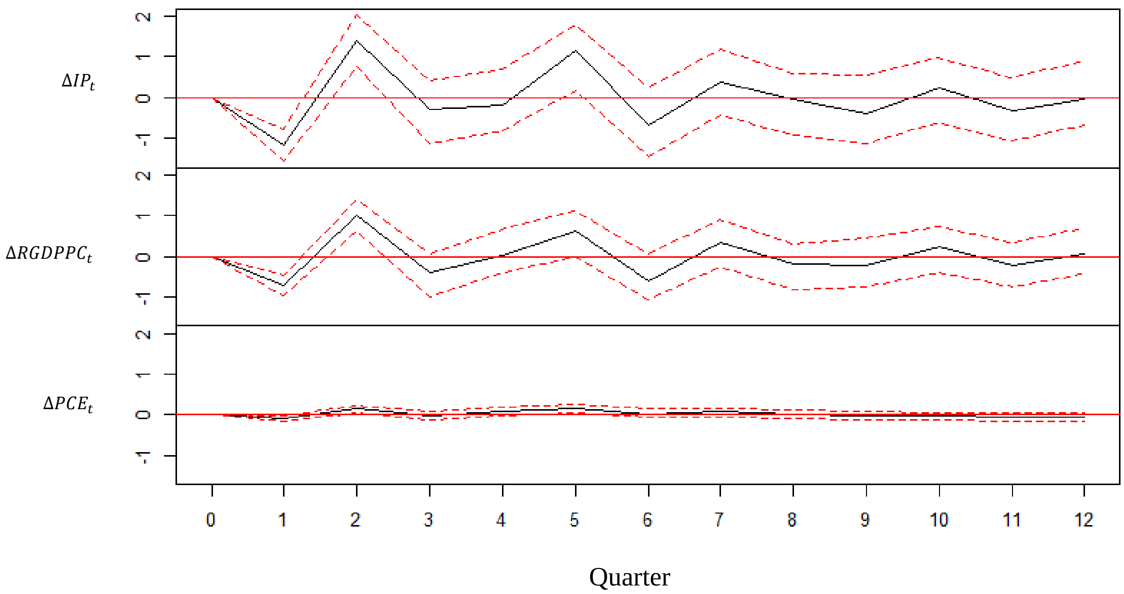


In Figure 3A, the response to a balance sheet shock is strong, fast, and statistically significant. Industrial production rises immediately, reaching a significant peak in quarter 2 of about +1.8 percentage points, followed by another significant increase around quarter 5. Real GDP per capita follows a similar path, with significant increases in quarters 2 through 6. Inflation, however, remains statistically indistinguishable from zero throughout the horizon. These responses suggest that monetary policy became more powerful and responsive in the later period, consistent with the Granger-causality results that showed a significant predictive role for balance sheet changes during 2014-2024. The magnitude and persistence of the effects on real activity support the interpretation that unconventional monetary tools had meaningful influence during this time.

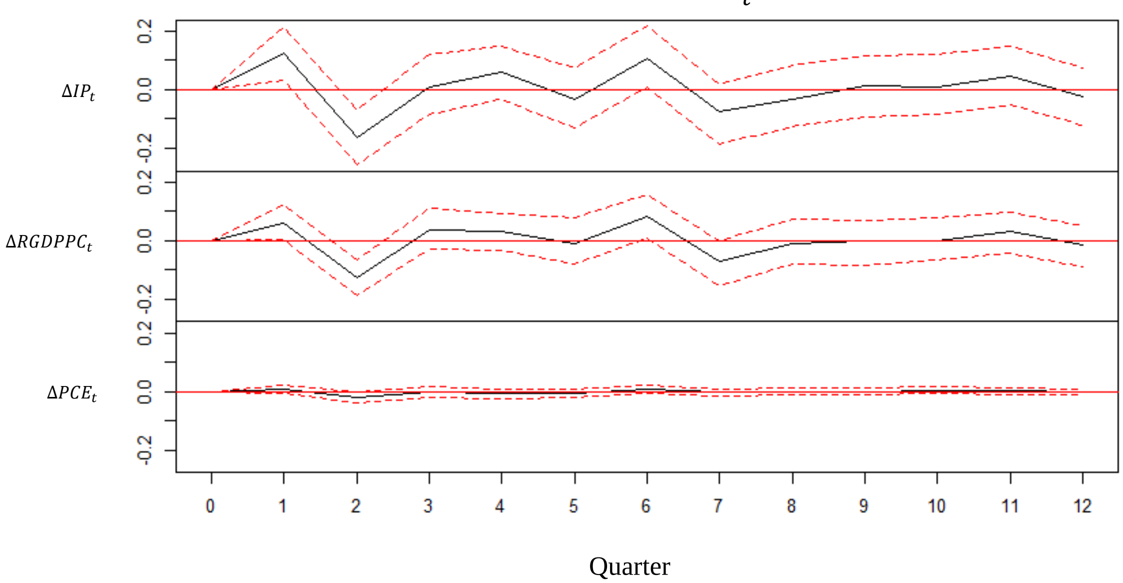
In contrast, Figure 3B shows the impulse response to a government transfer shock. Industrial production again rises sharply in quarter 2, with significant effects persisting through quarter 5. Real GDP per capita shows a more delayed but still significant positive response in quarters 4 through 7. As in the balance sheet model, inflation remains statistically flat. These results confirm that government transfers also had substantial short-term effects on real activity during the post-2014 period, though the timing and amplitude of the effects differ slightly from those observed under monetary policy shocks.

Figure 3. Balance Sheet & Government Transfers Impulse Response Functions (2014-2024)

A. Model 4: ΔBS_t Shock



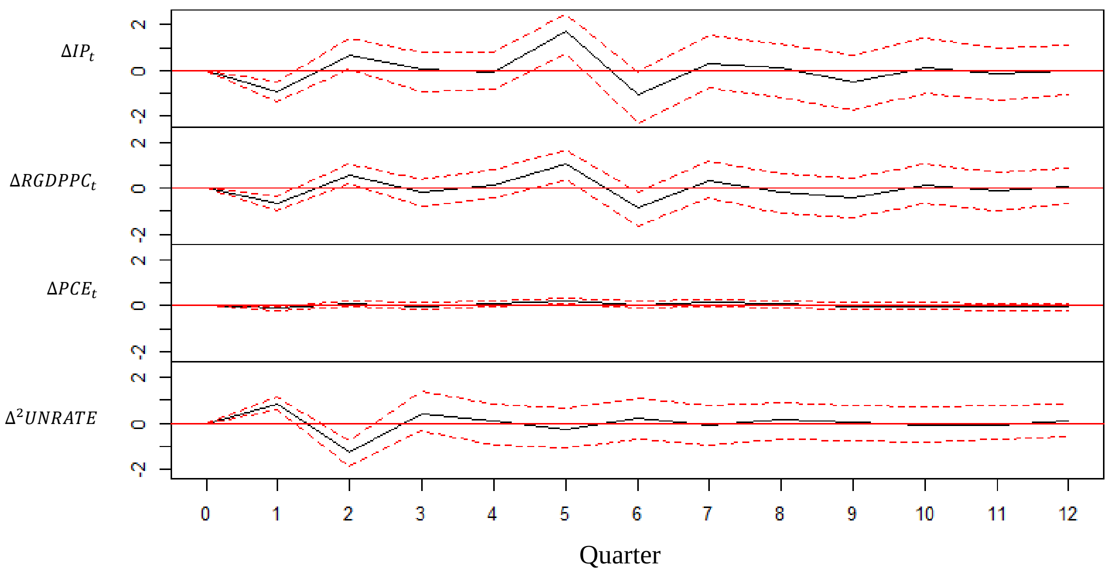
B. Model 6: $\Delta^2 GovT_t$ Shock



Together, these results indicate that both monetary and fiscal interventions were highly effective in stimulating real economic outcomes during the 2014-2024 period. Compared to the 2002-2012 window, the responses here are stronger, more immediate, and more persistent—consistent with the larger magnitude and more targeted deployment of these tools in response to the COVID-19 crisis. While inflation remains largely unaffected by either policy instrument, both industrial production and real GDP growth exhibit statistically significant and economically meaningful reactions, underscoring the central role these policies played in shaping the post-crisis recovery

Figure 4. Balance Sheet & Government Transfers IRFs with Unemployment Rate (2014-2024)

A. Model 7: ΔBS_t Shock



B. Model 9: $\Delta^2 GovT_t$ Shock

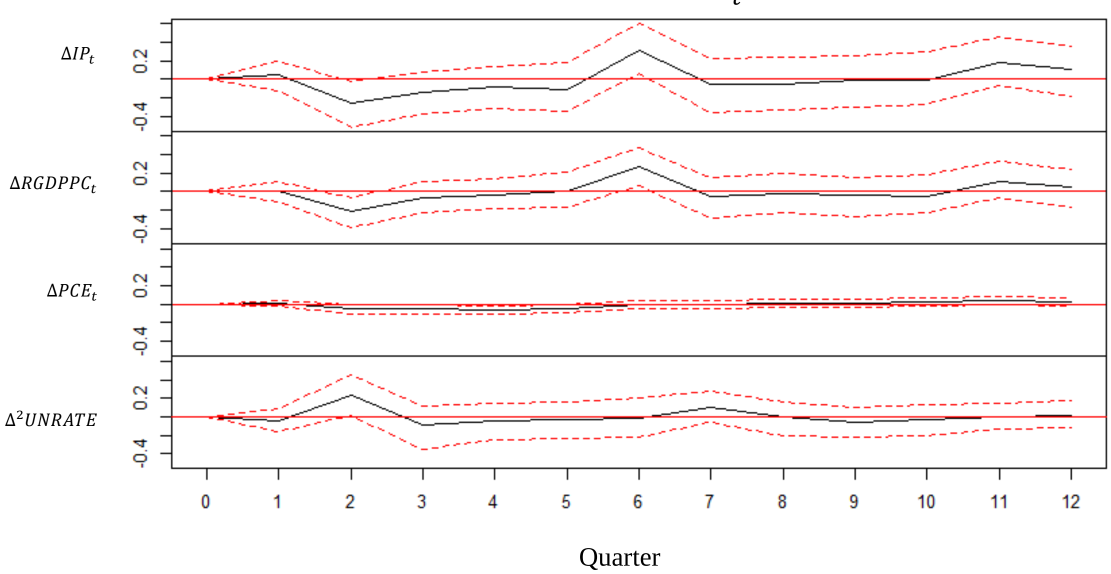


Figure 4 presents impulse response functions from VAR models that include the unemployment rate, capturing the effects of balance sheet (Figure 4A) and government transfer (Figure 4B) shocks on key macroeconomic indicators during the 2014-2024 period. In Figure 4A, a one-percentage-point increase in the quarterly change of the balance sheet results in statistically significant increases in both industrial production and real GDP per capita beginning in quarter 2, with effects peaking around quarters 4 and 5. Inflation remains statistically insignificant across the horizon. The unemployment rate declines sharply and significantly in quarters 2 and 3, suggesting that monetary policy not only supported output but also contributed meaningfully to short-term improvements in labor market conditions. These dynamics are consistent with the Granger-causality results, which indicated strong joint significance for balance sheet shocks in this period.

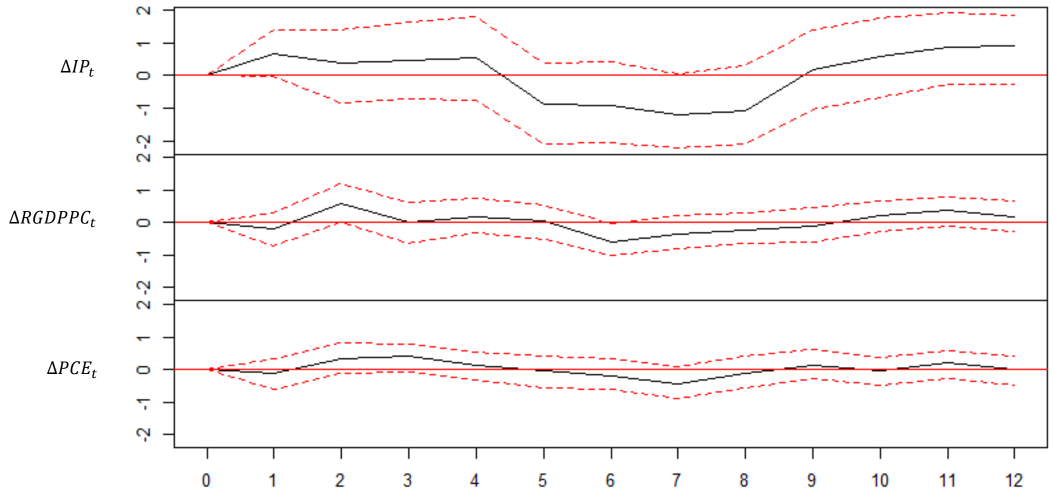
Figure 4B shows that government transfers produce a similarly strong and sustained real response. Industrial production increases significantly beginning in quarter 2, while real GDP per capita rises modestly but persistently through the middle quarters. The unemployment rate falls significantly in quarters 2 through 4, reaching a peak reduction of approximately 0.2 percentage points, highlighting the effectiveness of transfer payments in supporting employment. As in the balance sheet model, inflation remains statistically flat. Compared to monetary policy, the response to fiscal transfers is smoother and more gradual, but the impact on the labor market is comparably strong. Together, these results reinforce the interpretation that both policy tools were actively and effectively deployed in the post-crisis period, with clear and timely benefits for output and employment.

Figure 5 presents the impulse response functions for shocks to government spending, which serves as the counterfactual policy instrument in this analysis. Figure 5A shows the response to a one-percentage-point increase in the acceleration of government spending during the 2002-2012 period. None of the three macroeconomic indicators—industrial production, real GDP per capita, or inflation—display statistically significant responses over the 12-quarter horizon. The responses fluctuate within the 95% confidence bands throughout, indicating weak and inconsistent effects. These results are in line with the Granger-causality findings, where government spending in this period did not significantly predict macroeconomic outcomes. The flat and statistically insignificant IRFs support its use as a neutral benchmark for isolating the effects of more active monetary and fiscal policies during the same period.

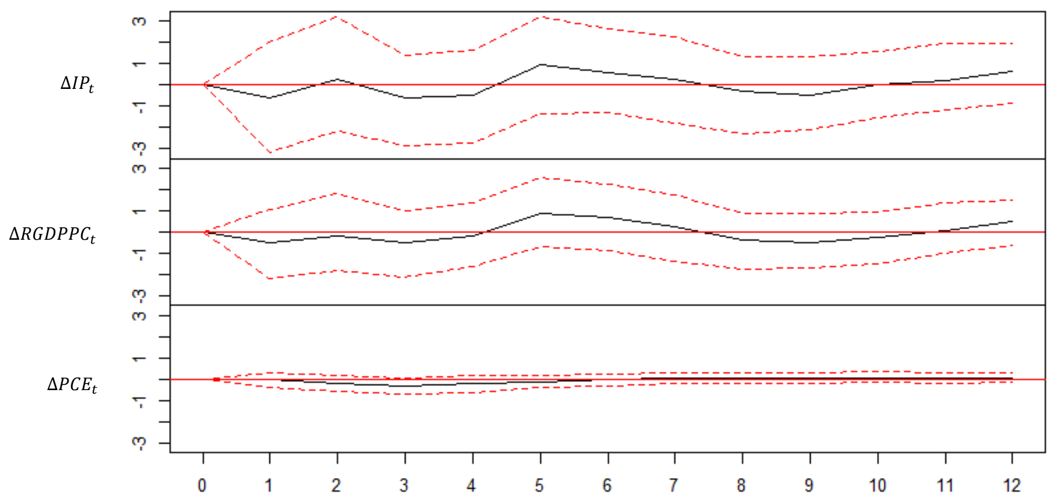
Figures 5B and 5C show the results for the 2014-2024 period, with and without the inclusion of unemployment, respectively. Across both models, the responses of industrial production, real GDP per capita, and inflation remain insignificant, showing only small deviations from baseline and confidence bands that consistently encompass zero. In Panel C, which includes the second-differenced unemployment rate, there is no observable impact on labor market outcomes either. These results further reinforce the interpretation of government spending as a passive policy variable during this period. Despite the broader macroeconomic volatility of the 2014-2024 window, government spending does not appear to have generated any meaningful or dynamic response in the real economy. Together, these findings justify the treatment of government spending as a counterfactual in this study and underscore the comparative effectiveness of balance sheet expansion and government transfers as active stabilization tools.

Figure 5. Government Spending Counterfactual Impulse Response Functions

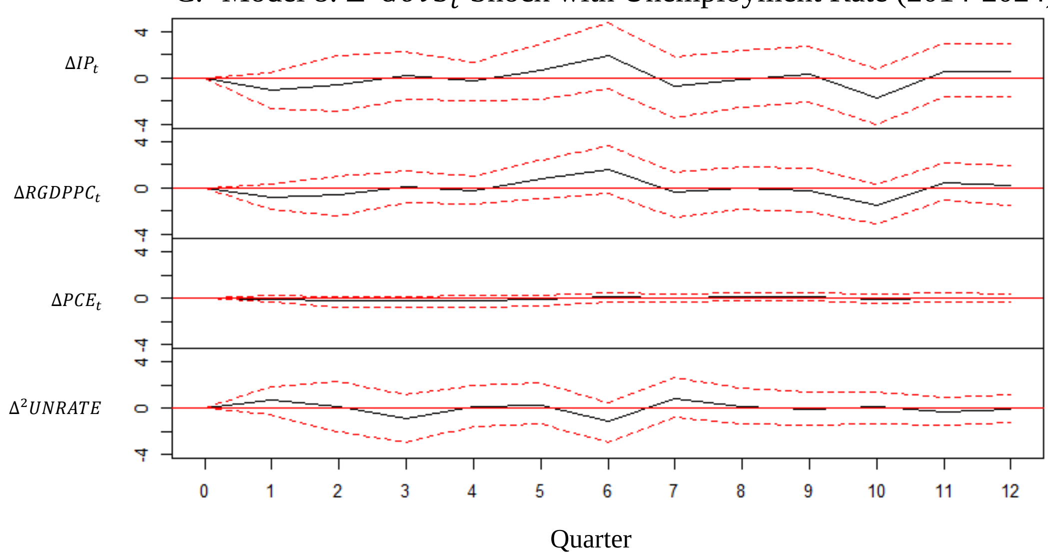
A. Model 2: $\Delta^2 GovS_t$ Shock (2002-2012)



B. Model 5: $\Delta^2 GovS_t$ Shock (2014-2024)



C. Model 8: $\Delta^2 GovS_t$ Shock with Unemployment Rate (2014-2024)



Conclusion

This paper set out to compare the relative effectiveness of balance sheet expansions and government transfers—representing monetary and fiscal policy, respectively—during the Great Recession (2002-2012) and the COVID-19 recession (2014-2024). Using VAR models with impulse response analysis and Granger causality testing, the results indicate that fiscal transfers consistently produced faster and more stable improvements in real economic activity, particularly in industrial production and employment, while monetary policy—though sometimes slower or more volatile in its effects—also demonstrated significant real-sector influence during the later period. Government spending, in contrast, showed little predictive power or dynamic effect in any period, reinforcing its role as a counterfactual in the analysis.

The findings align closely with theoretical expectations and the empirical literature discussed earlier. As emphasized by Bachmann and Sims (2011) and the Hutchins Center (Ahmad, Nabors, and Sheiner 2025), fiscal interventions are especially potent during downturns when targeted toward household support. The strong performance of transfers in both periods supports this view, while the more robust role of balance sheet policy in the 2014-2024 period corresponds with literature highlighting the growing impact of QE at the zero lower bound (Wu and Xia 2016; D'Amico et al. 2013). The results also reinforce claims about the importance of monetary-fiscal coordination (Hollmayr and Kühl 2019), especially during crisis periods requiring aggressive stimulus. However, the lack of inflationary effects across all models—despite large interventions—raises important questions about the channels through which these policies operate, and about assumptions linking stimulus to price instability.

That said, several limitations must be acknowledged. First, while the VAR framework captures short- and medium-term dynamics effectively, it does not address endogeneity or structural identification without additional restrictions. Second, the use of differenced data, though necessary for stationarity, alters the interpretation of magnitudes and makes level-based policy comparisons more abstract. Third, the relatively short windows of analysis (41 quarters) may limit the robustness of some estimates, particularly in capturing longer-term or lagged effects. Finally, while this study isolates monetary and fiscal shocks independently, future work could explore their interaction—especially given the literature's emphasis on policy coordination. It was also peculiar that inflation did not show the expected increasing response to expansionary shocks, potentially revealing area for improvement in the model specifications.

Overall, the evidence supports the view that both balance sheet expansions and fiscal transfers were effective tools in stabilizing output and employment, particularly in the wake of the COVID-19 shock. Their relative performance depended on the period, policy instrument, and economic environment, suggesting that macroeconomic stabilization is best achieved through a flexible, multi-pronged approach tailored to the crisis at hand.

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R Code

```
#====================================
# Change file paths for your machine
#====================================
rm(list =ls()) # Clear environment
directory <- "C:/Users/coule/OneDrive - Bentley University/Spring 2025"
project <- "/EC382/Final Project/data"
mainpath <- (file.path(directory, project))

setwd(file.path(mainpath)) # Set working directory


#====================================
# Install and load required packages
#====================================
#install.packages("readxl")
#install.packages("dplyr")
#install.packages("lubridate")
#install.packages("vars")
#install.packages("urca")
#install.packages("zoo")
library(readxl) # For loading excel data
library(dplyr) # For data filtering
```

```
library(lubridate) # For date differencing
library(vars) # For vector autoregressions
library(tseries) # For setting ts vars
library(urca) # For Zivot-Andrews test
library(zoo) # For adf_diff test


#======================
# Load and prepare data
#======================
df <- read_excel("monetary_fiscal.xlsx", sheet = "Quarterly") # Load data
df$date <- as.Date(df$date) # Set dates to date type

df$date <- as.yearqtr(df$date, format = "%Y:0%q") # format the date column

df <- df %>%
  mutate(
    d_bs = c(NA, diff(bs)),
    d_gov = c(NA, diff(gov)),
    d_unrate = c(NA, diff(unrate)),
    d_indpro = c(NA, diff(indpro)),
    d_rgdppc = c(NA, diff(rgdppc)),
    d_pce = c(NA, diff(pce)),
    d_transfers = c(NA, diff(transfers)),

    # Second differences for gov, unrate, and transfers
    d2_gov = c(NA, diff(d_gov)),
    d2_unrate = c(NA, diff(d_unrate)),
    d2_transfers = c(NA, diff(d_transfers)),
    d2_pce = c(NA, diff(d_pce))
  )


#===================================
# Plot variables of interest
#===================================
# Define recession start dates
recession_1990_start <- as.yearqtr("1990 Q3") # Not used
recession_2001_start <- as.yearqtr("2001 Q1") # Not used
recession_2007_start <- as.yearqtr("2007 Q4")
recession_2020_start <- as.yearqtr("2019 Q4")

# Extract 5 years before and 5 years after for each recession
df_recession_1990 <- df%>% # Not used
  filter(date >= (recession_1990_start - 5) & date <= (recession_1990_start + 5))
df_recession_2001 <- df%>% # Not used
  filter(date >= (recession_2001_start - 5) & date <= (recession_2001_start + 5))
df_recession_2007 <- df%>%
  filter(date >= (recession_2007_start - 5) & date <= (recession_2007_start + 5))
df_recession_2020 <- df%>%
  filter(date >= (recession_2020_start - 5) & date <= (recession_2020_start + 5))


#===================================
# Plot dependent variables
#===================================
df_plot <- df[df$date >= as.yearqtr("2002 Q4") & df$date <= as.yearqtr("2024 Q4"), ]
```

```
# Plot all variables on the same chart
matplot(x = df_plot$date,
        y = df_plot[, c("bs", "transfers", "gov")],
        type = "l", lty = 1, lwd = 2, col = 1:6,
        xlab = "Date", ylab = "Percent Change",
        main = "Key Dependent Macroeconomic Variables (2002 Q4 – 2024 Q4)")

# Add legend with proper labels
legend("topleft",
       legend = c("Balance Sheet", "Government Transfers", "Government Spending"),
       col = 1:6, lty = 1, lwd = 2, bty = "n")


#====================================
# Plot independent variables
#====================================
# Filter data
df_plot <- df[df$date >= as.yearqtr("2002 Q4") & df$date <= as.yearqtr("2024 Q4"), ]

# Plot all variables on the same chart
matplot(x = df_plot$date,
        y = df_plot[, c("unrate", "indpro", "rgdppc", "pce")],
        type = "l", lty = 1, lwd = 2, col = 1:6,
        xlab = "Date", ylab = "Percent Change (UR Raw %)",
        main = "Key Independent Macroeconomic Variables (2002 Q4 – 2024 Q4)")

# Add legend with proper labels
legend("bottom",
       legend = c("Unemployment Rate", "Industrial Production", "Real GDP Per
      Capita", "Inflation (PCE)"),
       col = 1:6, lty = 1, lwd = 2, bty = "n")


#====================================
# Test for stationary over 4 periods
#====================================
# Define concise function to run Adf_diff tests per window
run_adf_block <- function(df) {
  print(adf.test(df$bs))
  print(adf.test(df$d_bs))
  print(adf.test(df$gov))
  print(adf.test(df$d_gov))
  print(adf.test(df$d2_gov))
  print(adf.test(df$unrate))
  print(adf.test(df$d_unrate))
  print(adf.test(df$d2_unrate))
  print(adf.test(df$indpro))
  print(adf.test(df$d_indpro))
  print(adf.test(df$rgdppc))
  print(adf.test(df$d_rgdppc))
  print(adf.test(df$pce))
  print(adf.test(df$d_pce))
  print(adf.test(df$d2_pce))
  print(adf.test(df$transfers))
  print(adf.test(df$d_transfers))
  print(adf.test(df$d2_transfers))
```

```
}

# Run for each recession window
run_adf_block(df_recession_1990) # Not used
run_adf_block(df_recession_2001) # Not used
run_adf_block(df_recession_2007)
run_adf_block(df_recession_2020)


#==============================================
# Summary Statistics in 2007 and 2020 Periods
#==============================================
summary(df_recession_2007)
summary(df_recession_2020)


# ==================================
# Select Optimal Lag for 9 Models
# ==================================
# Prepare data for d_bs during the 2007 recession M1
VAR_data_2007_bs <- na.omit(df_recession_2007[, c("d_bs", "d_indpro", "d_rgdppc",
       "d_pce")])
lag_selection_2007_bs <- VARselect(VAR_data_2007_bs, lag.max = 6, type = "const")
print(lag_selection_2007_bs$selection)

# Prepare data for d2_gov during the 2007 recession M2
VAR_data_2007_gov <- na.omit(df_recession_2007[, c("d2_gov", "d_indpro", "d_rgdppc",
       "d_pce")])
lag_selection_2007_gov <- VARselect(VAR_data_2007_gov, lag.max = 6)
print(lag_selection_2007_gov$selection)

# Prepare data for d2_transfers during the 2007 recession M3
VAR_data_2007_transfers <- na.omit(df_recession_2007[, c("d2_transfers", "d_indpro",
       "d_rgdppc", "d_pce")])
lag_selection_2007_transfers <- VARselect(VAR_data_2007_transfers, lag.max = 6)
print(lag_selection_2007_transfers$selection)

# Prepare data for d_bs during the 2020 recession M4
VAR_data_2020_bs <- na.omit(df_recession_2020[, c("d_bs", "d_indpro", "d_rgdppc",
       "d_pce")])
lag_selection_2020_bs <- VARselect(VAR_data_2020_bs, lag.max = 6)
print(lag_selection_2020_bs$selection)

# Prepare data for d2_gov during the 2020 recession M5
VAR_data_2020_gov <- na.omit(df_recession_2020[, c("d2_gov", "d_indpro", "d_rgdppc",
       "d_pce")])
lag_selection_2020_gov <- VARselect(VAR_data_2020_gov, lag.max = 6)
print(lag_selection_2020_gov$selection)

# Prepare data for d2_transfers during the 2020 recession M6
VAR_data_2020_transfers <- na.omit(df_recession_2020[, c("d2_transfers", "d_indpro",
       "d_rgdppc", "d_pce")])
lag_selection_2020_transfers <- VARselect(VAR_data_2020_transfers, lag.max = 6)
print(lag_selection_2020_transfers$selection)

# Prepare data for d2_gov during the 2020 recession with unrate M7
```

```
VAR_data_2020_gov_unrate <- na.omit(df_recession_2020[, c("d2_gov", "d_indpro",
       "d_rgdppc", "d_pce", "d2_unrate")])
lag_selection_2020_gov_unrate <- VARselect(VAR_data_2020_gov_unrate, lag.max = 6)
print(lag_selection_2020_gov_unrate$selection)

# Prepare data for d_bs during the 2020 recession with unrate M8
VAR_data_2020_bs_unrate <- na.omit(df_recession_2020[, c("d_bs", "d_indpro",
       "d_rgdppc", "d_pce", "d2_unrate")])
lag_selection_2020_bs_unrate <- VARselect(VAR_data_2020_bs_unrate, lag.max = 6)
print(lag_selection_2020_bs_unrate$selection)

# Prepare data for d2_transfers during the 2020 recession with unrate M9
VAR_data_2020_transfers_unrate <- na.omit(df_recession_2020[, c("d2_transfers",
       "d_indpro", "d_rgdppc", "d_pce", "d2_unrate")])
lag_selection_2020_transfers_unrate <- VARselect(VAR_data_2020_transfers_unrate,
       lag.max = 6)
print(lag_selection_2020_transfers_unrate$selection)


# ================================
# Estimate VAR Models with L4
# ================================
# 2007 models
VAR_2007_bs <- VAR(VAR_data_2007_bs, p = 4)
VAR_2007_gov <- VAR(VAR_data_2007_gov, p = 4)
VAR_2007_transfers <- VAR(VAR_data_2007_transfers, p = 4)

# 2020 models without unrate
VAR_2020_bs <- VAR(VAR_data_2020_bs, p = 4)
VAR_2020_gov <- VAR(VAR_data_2020_gov, p = 4)
VAR_2020_transfers <- VAR(VAR_data_2020_transfers, p = 4)

# 2020 models with unrate
VAR_2020_bs_unrate <- VAR(VAR_data_2020_bs_unrate, p = 4)
VAR_2020_gov_unrate <- VAR(VAR_data_2020_gov_unrate, p = 4)
VAR_2020_transfers_unrate <- VAR(VAR_data_2020_transfers_unrate, p = 4)

# View model summaries
summary(VAR_2007_bs) # Model 1
summary(VAR_2007_gov) # Model 2
summary(VAR_2007_transfers) # Model 3
summary(VAR_2020_bs) # Model 4
summary(VAR_2020_gov) # Model 5
summary(VAR_2020_transfers) # Model 6
summary(VAR_2020_bs_unrate) # Model 7
summary(VAR_2020_gov_unrate) # Model 8
summary(VAR_2020_transfers_unrate) # Model 9


# ================================
# Impulse Response Functions
# ================================
run_irf <- function(var_model, impulse_var, n_ahead = 12) {
  # Identify all variables in the model except the impulse
  response_vars <- setdiff(colnames(var_model$y), impulse_var)

  # Run IRF
```

```
  irf_result <- irf(var_model,
                    impulse = impulse_var,
                    response = response_vars,
                    n.ahead = n_ahead,
                    ortho = FALSE,
                    runs = 1000)

  return(irf_result)
}


# 2007 Recession Period IRFs
irf_2007_bs <- run_irf(VAR_2007_bs, impulse_var = "d_bs")
plot(irf_2007_bs)
irf_2007_bs # Model 1

irf_2007_gov <- run_irf(VAR_2007_gov, impulse_var = "d2_gov")
plot(irf_2007_gov)
irf_2007_gov # Model 2

irf_2007_transfers <- run_irf(VAR_2007_transfers, impulse_var = "d2_transfers")
plot(irf_2007_transfers)
irf_2007_transfers # Model 3

# 2020 Recession Period IRFs
irf_2020_bs <- run_irf(VAR_2020_bs, impulse_var = "d_bs")
plot(irf_2020_bs)
irf_2020_bs # Model 4

irf_2020_gov <- run_irf(VAR_2020_gov, impulse_var = "d2_gov")
plot(irf_2020_gov)
irf_2020_gov # Model 5

irf_2020_transfers <- run_irf(VAR_2020_transfers, impulse_var = "d2_transfers")
plot(irf_2020_transfers)
irf_2020_transfers # Model 6

# 2020 Recession Period with Unrate IRFs
irf_2020_bs_unrate <- run_irf(VAR_2020_bs_unrate, impulse_var = "d_bs")
plot(irf_2020_bs_unrate)
irf_2020_bs_unrate # Model 7

irf_2020_gov_unrate <- run_irf(VAR_2020_gov_unrate, impulse_var = "d2_gov")
plot(irf_2020_gov_unrate)
irf_2020_gov_unrate # Model 8

irf_2020_transfers_unrate <- run_irf(VAR_2020_transfers_unrate, impulse_var =
       "d2_transfers")
plot(irf_2020_transfers_unrate)
irf_2020_transfers_unrate # Model 9


# ================================
# Granger Causality Tests
# ================================
run_granger_tests <- function(var_model) {
  var_names <- colnames(var_model$y)
```

```r
  granger_results <- data.frame(Cause = character(), P_Value = numeric(),
       stringsAsFactors = FALSE)

  for (cause_var in var_names) {
    test <- causality(var_model, cause = cause_var)$Granger
    p_val <- test$p.value
    granger_results <- rbind(granger_results, data.frame(Cause = cause_var, P_Value =
       p_val))
  }

  return(granger_results)
}

# Run Granger causality for each model
granger_2007_bs <- run_granger_tests(VAR_2007_bs)
granger_2007_bs # Model 1
granger_2007_gov <- run_granger_tests(VAR_2007_gov)
granger_2007_gov # Model 2
granger_2007_transfers <- run_granger_tests(VAR_2007_transfers)
granger_2007_transfers # Model 3

granger_2020_bs <- run_granger_tests(VAR_2020_bs)
granger_2020_bs # Model 4
granger_2020_gov <- run_granger_tests(VAR_2020_gov)
granger_2020_gov # Model 5
granger_2020_transfers <- run_granger_tests(VAR_2020_transfers)
granger_2020_transfers # Model 6

granger_2020_bs_unrate <- run_granger_tests(VAR_2020_bs_unrate)
granger_2020_bs_unrate # Model 7
granger_2020_gov_unrate <- run_granger_tests(VAR_2020_gov_unrate)
granger_2020_gov_unrate # Model 8
granger_2020_transfers_unrate <- run_granger_tests(VAR_2020_transfers_unrate)
granger_2020_transfers_unrate # Model 9
```