ONLINE APPENDIX
The U.S. Economy After COVID-19:
The Transmission Mechanisms of Monetary Policy *

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July 11, 2023

A   Introduction

This Appendix contains five parts. Part B provides an overview of our four monetary tightening cycles (MTCs) discussed in the paper. We highlight some key aspects leading to the output contraction and reduction in inflation. Part C presents several estimates for the timing and magnitude of the variation in *GDP* components upon a cumulative increase in the federal funds effective rate, *FFR*. Part D is concerned with the dynamics of unemployment, wages, and inflation. We reexamine several formulations of the Phillips curve under various lags for the real wage adjusted for *TFP* growth. Part E goes over current economic conditions to assess the effects of *FFR* hikes on economic activity and inflation. For the policy tradeoff between the output contraction and the reduction in inflation in present times, we contemplate various benchmark estimates as well as upper and lower bounds for the proposed interest rate hikes.

B   Overview of Our Four Monetary Tightening Cycles (MTCs)

Inflation Shocks. Inflation in the 1960s is generally attributed to loose monetary and fiscal polices. These policy trends are usually blamed for the collapse of the Bretton Woods system

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in 1971; e.g., Bordo (2020). Rather than reversing, such inflationary pressures intensified in the 1970s but were overshadowed by the surge in crude oil prices—as well as food. Double-digit inflation rates were then observed by the end of the decade—triggering a sharp jump in the *FFR* at the beginning of the 1980s. Finally, the MTC just before the Great Recession of 2007-2009 seems a natural policy response to the housing bubble and soaring energy costs. Between January 2002 and June 2008 the price of crude oil was steadily going up—increasing about 600 percent over this time period.

Across our four MTCs discussed in the paper we can observe a greater response of fiscal policy over time, a greater role of international trade possibly because of the emergence of globalization, and a more fragile or impacted financial system possibly because of greater leverage and financial sophistication, while the Fed has also been increasingly more active in the provision of credit and liquidity to the economy; e.g., quantitative easing. Fiscal policy has become progressively more accommodating over time. As shown in Table 2 of the paper the increment in the budget deficit over *GDP* was 2.30 percent for the MTC between 1967-Q3 and 1969-Q3, and monotonically this increment went up to 6.38 percent for the Great Recession of 2007-2009. Likewise, the increment in government expenditure over *GDP* was 0.29 percent for the MTC between 1967-Q3 and 1969-Q3, and monotonically this increment went up to 2.44 percent for the Great Recession of 2007-2009. International trade has also become more sensitive over these monetary tightening cycles—dampening the output contraction and the variation in inflation. In the MTC between 1967-Q3 and 1969-Q3 the increment in net exports was 0.38 percent of *GDP*, and monotonically this increment went up to 3.16 percent for the Great Recession of 2007-2009. Table 2 of the paper also reports various financial indicators and measures of risk. As our measure of the credit spread (CS), we use the Moody's seasoned Baa corporate Bond yield relative to yield on ten-year treasury constant maturity. The *CS* went up 145 basis points in the MTC between 1967-Q3 and 1969-Q3, and monotonically this increment went up to 397 basis points for the Great Recession of 2007-2009. All other financial indicators in Table 2 drop in the MTC between 2004-Q2 and 2006-Q3 reflecting various aspects of higher government intervention and expected lower economic growth.

Effects of FFR Hikes on Economic Activity and Inflation over the MTCs. In the MTC taking place between 1967-Q3 and 1969-Q3, the cumulative increase in the *FFR* was 509 basis points, whereas the reduction in *CPI*-headline (*CPI-HL*) inflation was 3.20 percentage points and in *CPI*-core (*CPI-C*) inflation was 3.63 percentage points. Crude oil prices were low and steadily going down. Because of solid economic growth and investment, the unem-

ployment rate just reached 6.1 percent and our measure of output contraction $\Delta BP(GDP)$ was only 3.43 percentage points. Hence, the relatively large increase in the FFR translated into a relatively mild recession with moderate reduction in headline and core inflation. In contrast, in the MTC between 1972-Q1 and 1974-Q3, crude oil prices were higher but failed to go down. The unemployment rate reached about 9 percent and our measure of output contraction $\Delta BP(GDP)$ was 7.67 percentage points after a considerable fall in investment. High unemployment paved the way to a much bigger reduction in inflation: the cumulative increase in the FFR was 854 basis points and the reduction in $CPI\text{-}HL$ inflation was 6.86 percentage points and in $CPI\text{-}C$ inflation was 5.41 percentage points. In these two MTCs the drops in headline and core inflation—both PCE and CPI inflation—were commensurate as energy costs remained quite stable over these tightening cycles.

Crude oil prices, however, went down at the end of the remaining two MTCs. High unemployment rates in both episodes appear to be another important fact reshaping the relatively faster response of nominal wages and inflation. There were actually two systematic monetary tightenings between 1977-Q1 and 1981-Q2. We are just looking at their combined effects because of the lagging effects of monetary policy. For instance, Romer and Romer (1989, p. 168) write: "In the postwar era the maximum depressing effect of anti-inflationary shifts in monetary policy occurs after roughly *two and one half years,* and there appears to be only a limited tendency for real activity to then return toward its pre-shock path." This whole monetary tightening cycle generated a small relative effect of the interest hike on output.[1] The cumulative increase in FFR was about 1300 basis points while the drop in our output measure was 6.85 percentage points and the drop in $CPI\text{-}C$ inflation was 10.05 percentage points. There was a fiscal boost of the Reagan Administration with pronounced tax cuts (cf., the Economic Recovery Tax Act of 1981) and higher government expenditure which may have dampened the output contraction; see Table 1 in the paper. Also, the FFR dropped sharply at the end of this tightening cycle. The relatively large reduction in inflation seems due to several factors: (i) an unemployment rate over 10 percent causing a drop in nominal wage growth of about 7.21 percentage points; (ii) the progressive fall in crude oil prices immediately after the peak in April 1980; and (iii) further credibility issues at the start of the Reagan-Volcker eras; e.g., Hazell *et al.* (2022).

The MTC between 2004-Q2 and 2006-Q3—extending into the financial crisis—was prompted

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[1]From the IS-transmission mechanism of monetary policy, the contractionary effects of interest rate hikes are driven by the response of investment. The bulk of investment in this MTC was nonresidential fixed investment, which could be quite insensitive to interest rate increases. Housing investment responded accordingly to the interest rate hike, but there was a much weaker response from the consumption sector.

by soaring energy inflation and one of the biggest housing bubbles. (Between January 2000 and January 2006, the S&P/Case-Shiller U.S. National Home Price Index went from 100 to 184.6.) The unemployment rate peaked at 10 percent in October 2009, and over 15 million people were unemployed. Inflation did not really rise at the beginning of the monetary cycle. Hence, the drop in inflation was relatively small and the drop in output was bigger. The cumulative increase in the *FFR* was 424 basis points while the average of the two measures of core inflation only decreased 2.05 percentage points, and our filtered measure of output decreased 5.10 percentage points. In 2004-2007 there was a timely monitoring of inflation, and hence the ensuing variation in core inflation turned out to be quite small. Crude oil prices peaked in July 2008 but imploded to about one-third of these peak values by December 2008. The housing bubble may have delayed the contractionary effects of monetary policy. After the housing bubble crash, the relative output fall was much larger than in other MTCs—in spite of considerable government outlays.

C   Timing and Magnitude of the Variation in *GDP* Components upon *FFR* Hikes

Table 1 presents the timing and magnitude of the impact of *FFR* increases upon the ratio of nominal personal consumption expenditures of nondurable goods and services over nominal gross domestic product, $(C_{ndur} + C_{srv})/Y$, the ratio of nominal gross private domestic investment and nominal personal consumption expenditures of durable goods over nominal gross domestic product, $(I + C_{dur})/Y$, the unemployment rate, U, and the 10-year U.S. Treasury bond yield, *GB10*. All these economic variables—including the *FFR*—are measured in percentage points. Each time interval spans from the start of the associated MTC till the fourth quarter of the last recessionary year in that cycle: 1967-Q3–1970-Q4, 1972-Q1–1975-Q4, 1977-Q1–1982-Q4, and 2004-Q2–2009-Q4.

The first three MTCs display similar patterns for the evolution of the *GDP* components and unemployment. The main changes for the ratios $(C_{ndur} + C_{srv})/Y$ and $(I + C_{dur})/Y$ happen between two and six quarters after the *FFR* increase (from *s=2* to *s=6*), for *U* happen between six quarters and eight quarters (from *s=6* to *s=8*). In contrast, in the Great Recession of 2007-2009 these lags occur after fourteen quarters (*s=14*). The response of *GB10* tends to be contemporaneous or with a lag of at most four quarters (*s=4*). Observe that significant coefficients with the highest R^2 have been highlighted.

Table 2 reproduces the regressions results reported in Table 1 for filtered data—under a band-

pass filter isolating frequencies for each variable between 6 and 32 quarters. In this latter table we also report regression results for an *extended period* 1960-Q1–2022-Q3 encompassing our four MTCs. The dynamic responses over our MTCs are commensurate to the ones observed in our previous Table 1. For the extended period 1960-Q1–2022-Q3, both the estimated coefficients and associated R^2 are smaller, while the lag structure accords with the same patterns observed for the MTCs.

Table 1: Timing and Magnitude of the Variation in Economic Activity upon Increases in the FFR

Dependent Variables	Forecasting Horizons							
	$s=0$	$s=2$	$s=4$	$s=6$	$s=8$	$s=10$	$s=12$	$s=14$
1967-Q3–1970-Q4								
$(C_{ndur}+C_{srv})/Y$	0.11	0.36	0.32	0.25	0.02	-0.10	-0.24	-0.18
	(0.83)	(4.12)	(4.12)	(2.98)	(0.28)	(-1.06)	(-3.06)	(-3.49)
	[0.05]	[0.59]	[0.59]	[0.42]	[0.01]	[0.09]	[0.44]	[0.50]
$(I+C_{dur})/Y$	0.04	-0.33	-0.31	-0.19	0.19	0.43	0.65	0.49
	(0.27)	(-3.19)	(-2.91)	(-1.22)	(1.04)	(2.06)	(4.43)	(8.11)
	[0.00]	[0.46]	[0.41]	[0.11]	[0.08]	[0.26]	[0.62]	[0.85]
U	-0.02	0.22	0.46	0.53	0.42	0.19	-0.06	-0.22
	(-0.18)	(1.40)	(3.44)	(5.60)	(5.57)	(2.60)	(-0.85)	(-5.23)
	[0.00]	[0.14]	[0.49]	[0.72]	[0.72]	[0.38]	[0.06]	[0.69]
$GB10$	0.37	0.41	0.23	-0.07	-0.24	-0.28	-0.08	0.11
	(3.94)	(8.68)	(2.44)	(-0.76)	(-3.20)	(5.06)	(-1.04)	(1.49)
	[0.56]	[0.86]	[0.33]	[0.04]	[0.46]	[0.68]	[0.08]	[0.16]
1972-Q1–1975-Q4								
$(C_{ndur}+C_{srv})/Y$	-0.02	0.16	0.25	0.16	0.09	0.01	-0.03	0.02
	(-0.17)	(1.99)	(4.00)	(3.04)	(2.21)	(0.27)	(-0.49)	(0.36)
	[0.00]	[0.22]	[0.53]	[0.39]	[0.26]	[0.00]	[0.02]	[0.01]
$(I+C_{dur})/Y$	0.15	-0.29	-0.50	-0.45	-0.21	0.09	0.36	0.33
	(0.92)	(-2.00)	(-5.77)	(-4.64)	(-1.30)	(0.49)	(1.74)	(1.96)
	[0.06]	[0.22]	[0.70]	[0.60]	[0.11]	[0.02]	[0.18]	[0.21]
U	-0.21	0.09	0.33	0.40	0.31	0.11	-0.07	-0.10
	(-1.61)	(0.60)	(2.54)	(4.39)	(3.99)	(1.31)	(-0.72)	(-1.13)
	[0.15]	[0.02]	[0.31]	[0.58]	[0.53]	[0.11]	[0.03]	[0.08]
$GB10$	0.11	0.09	0.15	0.11	0.06	-0.06	-0.11	-0.11
	(1.56)	(1.67)	(5.32)	(3.85)	(2.06)	(-1.98)	(-3.37)	(-1.99)
	[0.15]	[0.17]	[0.66]	[0.51]	[0.23]	[0.22]	[0.45]	[0.22]
1977-Q1–1982-Q4								
$(C_{ndur}+C_{srv})/Y$	0.09	0.19	0.24	0.2	0.21	0.12	0.06	0.04
	(1.72)	(3.41)	(4.69)	(6.97)	(6.14)	(2.99)	(1.63)	(1.04)
	[0.12]	[0.35]	[0.50]	[0.69]	[0.29]	[0.11]	[0.05]	[0.05]
$(I+C_{dur})/Y$	-0.14	-0.31	-0.37	-0.37	-0.25	-0.04	0.09	0.15
	(-1.67)	(-4.07)	(-6.22)	(-6.45)	(-3.29)	(-0.53)	(1.09)	(1.94)
	[0.11]	[0.43]	[0.64]	[0.65]	[0.33]	[0.01]	[0.05]	[0.15]
U	0.07	0.21	0.31	0.35	0.31	0.19	0.08	-0.02
	(0.98)	(2.82)	(5.67)	(9.45)	(7.13)	(3.38)	(1.31)	(-0.28)
	[0.04]	[0.27]	[0.59]	[0.80]	[0.69]	[0.34]	[0.07]	[0.00]
$GB10$	0.57	0.52	0.41	0.26	0.15	0.09	-0.04	-0.12
	(9.28)	(8.74)	(5.93)	(3.09)	(1.83)	(1.11)	(-0.53)	(-1.33)
	[0.79]	[0.77]	[0.61]	[0.30]	[0.13]	[0.05]	[0.01]	[0.07]
2004-Q2–2009-Q4								
$(C_{ndur}+C_{srv})/Y$	-0.38	-0.32	-0.20	-0.09	-0.00	0.09	0.15	0.18
	(-3.85)	(-2.81)	(-1.62)	(-0.74)	(-0.01)	(0.85)	(1.83)	(3.88)
	[0.41]	[0.27]	[0.11]	[0.03]	[0.00]	[0.03]	[0.14]	[0.42]
$(I+C_{dur})/Y$	1.10	1.01	0.68	0.23	-0.17	-0.49	-0.65	-0.64
	(4.81)	(3.57)	(2.09)	(0.68)	(-0.54)	(-1.93)	(-3.51)	(-5.14)
	[0.52]	[0.38]	[0.17]	[0.02]	[0.01]	[0.15]	[0.37]	[0.56]
U	-0.75	-0.88	-0.80	-0.52	-0.16	0.18	0.42	0.52
	(-6.83)	(-6.74)	(-4.35)	(-2.21)	(-0.63)	(0.75)	(2.22)	(3.86)
	[0.69]	[0.68]	[0.47]	[0.19]	[0.02]	[0.03]	[0.19]	[0.41]
$GB10$	0.26	0.20	0.16	0.06	0.05	0.12	0.17	0.22
	(6.77)	(3.79)	(2.19)	(0.68)	(0.56)	(1.23)	(1.79)	(2.80)
	[0.68]	[0.41]	[0.18]	[0.02]	[0.01]	[0.07]	[0.13]	[0.27]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s FFR_t + \epsilon_t$, $s = 0, 2, 4, 6, 8, 10, 12, 14$, where X_{t+s} represents the dependent variables $(C_{ndur}+C_{srv})/Y$, $(I+C_{dur})/Y$, U, and $GB10$. We report OLS estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. $\boldsymbol{C_{ndur}}$: Nominal personal consumption expenditures of nondurable goods. $\boldsymbol{C_{srv}}$: Nominal personal consumption expenditures of services. $\boldsymbol{I}$: Nominal gross private domestic investment, $\boldsymbol{C_{dur}}$: Nominal personal consumption expenditures of durable goods. $\boldsymbol{Y}$: Nominal gross domestic product. $\boldsymbol{U}$: Unemployment rate. $\boldsymbol{GB10}$: Market yield on U.S. Treasury securities at 10-year constant maturity. $\boldsymbol{FFR}$: Federal funds effective rate. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Table 2: Timing and Magnitude of the Variation in Economic Activity upon Changes in the *FFR*. Filtered Data

Dependent Variables	Forecasting Horizons							
	$s=0$	$s=2$	$s=4$	$s=6$	$s=8$	$s=10$	$s=12$	$s=14$
1960-Q1–2022-Q3								
$BP((C_{ndur}+C_{srv})/Y)$	-0.11	-0.01	0.10	0.15	0.13	0.07	-0.00	-0.06
	(-5.58)	(0.59)	(5.33)	(8.62)	(7.23)	(3.75)	(-0.08)	(-3.00)
	[0.11]	[0.00]	[0.10]	[0.23]	[0.18]	[0.06]	[0.00]	[0.04]
$BP((I+C_{dur})/Y)$	0.25	0.01	-0.29	-0.44	-0.39	-0.22	0.01	0.18
	(6.00)	(0.20)	(-7.18)	(-12.35)	(-10.44)	(-5.12)	(0.19)	(4.07)
	[0.13]	[0.00]	[0.17]	[0.39]	[0.31]	[0.09]	[0.00]	[0.07]
$BP(U)$	-0.33	-0.21	0.06	0.27	0.34	0.29	0.16	0.01
	(-10.97)	(-5.96)	(1.53)	(7.99)	(10.85)	(8.57)	(4.25)	(0.38)
	[0.33]	[0.12]	[0.01]	[0.21]	[0.33]	[0.23]	[0.07]	[0.00]
$BP(GB10)$	0.25	0.29	0.19	0.05	-0.06	-0.11	-0.10	-0.07
	(9.99)	(11.65)	(6.58)	(1.69)	(-1.89)	(-3.67)	(-3.32)	(-2.38)
	[0.29]	[0.35]	[0.15]	[0.01]	[0.01]	[0.05]	[0.04]	[0.02]
1967-Q3–1970-Q4								
$BP((C_{ndur}+C_{srv})/Y)$	-0.23	0.046	0.24	0.21	0.17	0.13	0.00	-0.17
	(-3.19)	(0.43)	(3.76)	(3.17)	(1.89)	(1.03)	(0.01)	(-2.08)
	[0.05]	[0.59]	[0.59]	[0.42]	[0.01]	[0.09]	[0.44]	[0.50]
$BP((I+C_{dur})/Y)$	0.36	-0.06	-0.38	-0.37	-0.33	-0.19	0.11	0.34
	(5.25)	(-0.52)	(-5.19)	(-3.56)	(-1.89)	(0.79)	(0.49)	(2.79)
	[0.00]	[0.46]	[0.41]	[0.11]	[0.08]	[0.26]	[0.62]	[0.85]
$BP(U)$	-0.29	-0.23	0.01	0.22	0.34	0.33	0.19	0.03
	(-13.00)	(-2.51)	(0.13)	(2.36)	(5.68)	(3.01)	(1.09)	(0.14)
	[0.00]	[0.14]	[0.49]	[0.72]	[0.72]	[0.38]	[0.06]	[0.69]
$BP(GB10)$	0.06	0.32	0.34	0.14	-0.08	-0.23	-0.23	-0.16
	(0.76)	(9.26)	(4.24)	(1.02)	(-0.55)	(-1.90)	(-4.08)	(-2.44)
	[0.56]	[0.86]	[0.33]	[0.04]	[0.46]	[0.68]	[0.08]	[0.16]
1972-Q1–1975-Q4								
$BP((C_{ndur}+C_{srv})/Y)$	-0.10	0.09	0.22	0.19	0.10	0.01	-0.01	0.01
	(-1.37)	(1.28)	(4.22)	(5.74)	(2.98)	(0.22)	(-0.16)	(0.17)
	[0.12]	[0.10]	[0.56]	[0.70]	[0.39]	[0.00]	[0.00]	[0.00]
$BP((I+C_{dur})/Y)$	0.20	-0.19	-0.51	-0.56	-0.37	-0.04	0.23	0.27
	(1.09)	(-0.99)	(-4.22)	(-13.76)	(-3.55)	(-0.27)	(1.45)	(1.94)
	[0.08]	[0.06]	[0.56]	[0.93]	[0.47]	[0.00]	[0.13]	[0.21]
$BP(U)$	-0.34	-0.09	0.20	0.36	0.33	0.15	-0.03	-0.07
	(-3.91)	(-0.75)	(1.71)	(4.56)	(5.67)	(2.06)	(-0.40)	(-0.82)
	[0.52]	[0.04]	[0.17]	[0.59]	[0.69]	[0.23]	[0.01]	[0.04]
$BP(GB10)$	0.08	0.13	0.16	0.17	0.12	-0.01	-0.11	-0.14
	(1.04)	(2.17)	(5.38)	(6.92)	(2.32)	(-0.08)	(-1.67)	(-2.38)
	[0.07]	[0.25]	[0.67]	[0.77]	[0.28]	[0.00]	[0.17]	[0.29]
1977-Q1–1982-Q4								
$BP((C_{ndur}+C_{srv})/Y)$	-0.11	-0.08	0.11	0.29	0.27	0.08	-0.08	-0.09
	(-1.58)	(-1.02)	(1.42)	(4.83)	(4.25)	(1.07)	(-1.03)	(-1.33)
	[0.10]	[0.04]	[0.08]	[0.51]	[0.45]	[0.05]	[0.05]	[0.07]
$BP((I+C_{dur})/Y)$	0.06	-0.04	-0.42	-0.68	-0.53	-0.08	0.26	0.31
	(0.42)	(-0.26)	(-3.24)	(-8.43)	(-4.14)	(-0.53)	(1.80)	(2.22)
	[0.01]	[0.00]	[0.32]	[0.76]	[0.44]	[0.01]	[0.13]	[0.18]
$BP(U)$	-0.21	-0.10	0.21	0.45	0.44	0.22	-0.00	-0.13
	(-2.59)	(-0.98)	(2.18)	(8.99)	(6.88)	(2.17)	(-0.04)	(-1.24)
	[0.23]	[0.04]	[0.18]	[0.79]	[0.68]	[0.18]	[0.00]	[0.06]
$BP(GB10)$	0.26	0.53	0.37	-0.04	-0.23	-0.11	0.05	0.11
	(2.77)	(10.76)	(3.81)	(-0.32)	(-1.89)	(-0.89)	(0.39)	(0.82)
	[0.26]	[0.84]	[0.39]	[0.00]	[0.14]	[0.03]	[0.01]	[0.03]
2004-Q2–2009-Q4								
$BP((C_{ndur}+C_{srv})/Y)$	-0.23	-0.26	-0.18	-0.08	0.02	0.08	0.10	0.12
	(-6.96)	(-12.01)	(-4.03)	(-1.28)	(0.27)	(1.30)	(1.89)	(2.85)
	[0.69]	[0.87]	[0.44]	[0.07]	[0.00]	[0.07]	[0.14]	[0.28]
$BP((I+C_{dur})/Y)$	0.63	0.89	0.81	0.40	-0.11	-0.47	-0.64	-0.63
	(3.95)	(10.81)	(6.96)	(2.09)	(-0.51)	(-2.63)	(-4.41)	(-4.67)
	[0.43]	[0.85]	[0.69]	[0.17]	[0.01]	[0.25]	[0.48]	[0.51]
$BP(U)$	-0.17	-0.54	-0.69	-0.55	-0.18	0.20	0.44	0.51
	(-1.12)	(-5.03)	(-16.57)	(-5.38)	(-1.15)	(1.32)	(3.51)	(4.89)
	[0.06]	[0.55]	[0.93]	[0.58]	[0.06]	[0.08]	[0.37]	[0.53]
$BP(GB10)$	0.23	0.17	0.00	-0.18	-0.26	-0.20	-0.05	0.11
	(7.51)	(3.47)	(0.00)	(-3.32)	(-7.27)	(-3.97)	(-0.70)	(1.79)
	[0.73]	[0.36]	[0.00]	[0.34]	[0.72]	[0.43]	[0.02]	[0.13]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s BP(FFR)_t + \epsilon_t$, $s = 0, 2, 4, 6, 8, 10, 12, 14$, where X_{t+s} represents the filtered dependent variables $(C_{ndur} + C_{srv})/Y$, $(I + C_{dur})/Y$, U, and $GB10$. We report OLS estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. $\boldsymbol{C_{ndur}}$: Nominal personal consumption expenditures of nondurable goods. $\boldsymbol{C_{srv}}$: Nominal personal consumption expenditures of services. $\boldsymbol{I}$: Nominal gross private domestic investment, $\boldsymbol{C_{dur}}$: Nominal personal consumption expenditures of durable goods. $\boldsymbol{Y}$: Nominal gross domestic product. $\boldsymbol{U}$: Unemployment rate. $\boldsymbol{GB10}$: Market yield on U.S. Treasury securities at 10-year constant maturity. $\boldsymbol{BP(FFR)}$: Filtered federal funds effective rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

In addition, Table 3 presents the timing and magnitude of the FFR semi-elasticities for filtered real gross domestic product, $BP(GDP)$, filtered real gross private domestic investment and real personal consumption expenditures of durable goods, $BP(I^r + C^r_{dur})$, and filtered real personal consumption expenditures of nondurable goods and real personal consumption expenditures of services, $BP(C^r_{ndur} + C^r_{srv})$.

Again, the first three MTCs present similar patterns. The main impacts occur between four and six quarters after the FFR increase (from $s=4$ to $s=6$). For the Great Recession of 2007-2009, the main impacts occur between ten and twelve quarters (from $s=10$ to $s=12$). We observe that $(I^r + C^r_{dur})$ is over three times more elastic than GDP and roughly 10 times more elastic than $(C^r_{ndur} + C^r_{srv})$. In the first panel of Table 3, we report the corresponding results for the above extended period encompassing our four MTCs: 1960-Q1–2022-Q3. The quantitative impact of FFR hikes over our MTCs is about three times higher than in the extended period. As before, we also get considerably greater R^2 values over our MTCs, which highlights the stronger effects of systematic monetary policy interventions. Over our MTCs, the highest semi-elasticity of GDP with respect to the FFR is between -0.46 and -0.71, the highest semi-elasticity for $(I^r + C^r_{dur})$ is between -1.60 and -3.24, and the highest semi-elasticity of $(C^r_{ndur} + C^r_{srv})$ is between -0.17 and -0.23.

Table 4 reproduces the regressions results reported in Table 3 for filtered FFR data. For our MTCs, the dynamic responses are quite similar to those of Table 3. For the extended period, reported in the first panel of Table 4, we get greater semi-elasticities and R^2 than in Table 3.

Table 3: Timing and Magnitude of the *FFR* Semi-Elasticities for some *GDP* components. Filtered Data

				Forecasting Horizons				
Dependent Variables	s=0	s=2	s=4	s=6	s=8	s=10	s=12	s=14
1960-Q1–2022-Q3								
$BP(GDP)$	0.05	-0.01	-0.07	-0.09	-0.09	-0.05	-0.01	0.03
	(2.30)	(-0.41)	(-3.02)	(-4.22)	(-3.63)	(-2.14)	(-0.48)	(1.05)
	[0.02]	[0.00]	[0.04]	[0.07]	[0.05]	[0.02]	[0.00]	[0.00]
$BP(I^r + C^r_{dur})$	0.16	-0.07	-0.29	-0.39	-0.31	-0.16	-0.00	0.12
	(1.76)	(-0.74)	(-3.24)	(-4.27)	(-3.38)	(-1.64)	(-0.00)	(1.29)
	[0.01]	[0.00]	[0.04]	[0.07]	[0.04]	[0.01]	[0.00]	[0.01]
$BP(C^r_{ndur} + C^r_{srv})$	0.02	-0.01	-0.04	-0.05	-0.04	-0.02	0.00	0.03
	(1.09)	(-0.61)	(-2.02)	(-2.59)	(-2.21)	(-1.15)	(0.19)	(1.48)
	[0.00]	[0.00]	[0.02]	[0.03]	[0.02]	[0.00]	[0.00]	[0.01]
1967-Q3–1970-Q4								
$BP(GDP)$	-0.03	-0.43	-0.62	-0.45	-0.02	0.52	1.05	1.29
	(-0.15)	(-2.81)	(-8.10)	(-3.53)	(-0.09)	(1.43)	(3.31)	(11.44)
	[0.00]	[0.39]	[0.84]	[0.51]	[0.00]	[0.15]	[0.48]	[0.92]
$BP(I^r + C^r_{dur})$	0.07	-1.25	-1.77	-0.81	0.95	2.50	3.39	3.53
	(0.13)	(-3.12)	(-6.25)	(-1.19)	(1.02)	(2.40)	(3.76)	(11.22)
	[0.00]	[0.45]	[0.76]	[0.10]	[0.08]	[0.32]	[0.54]	[0.91]
$BP(C^r_{ndur} + C^r_{srv})$	0.14	0.05	-0.08	-0.17	-0.11	0.17	0.47	0.52
	(4.32)	(1.09)	(-1.87)	(-3.99)	(-0.84)	(1.05)	(4.73)	(6.22)
	[0.61]	[0.09]	[0.23]	[0.57]	[0.06]	[0.08]	[0.65]	[0.76]
1972-Q1–1975-Q4								
$BP(GDP)$	0.26	-0.39	-0.78	-0.71	-0.35	-0.04	0.05	0.07
	(0.95)	(-1.40)	(-3.96)	(-5.09)	(-2.98)	(-0.33)	(0.27)	(0.36)
	[0.06]	[0.12]	[0.53]	[0.65]	[0.39]	[0.01]	[0.00]	[0.01]
$BP(I^r + C^r_{dur})$	0.89	-1.34	-3.15	-3.24	-1.70	0.14	1.10	1.23
	(0.82)	(-1.22)	(-4.37)	(-7.67)	(-2.78)	(0.19)	(1.30)	(1.52)
	[0.04]	[0.09]	[0.58]	[0.81]	[0.37]	[0.03]	[0.11]	[0.14]
$BP(C^r_{ndur} + C^r_{srv})$	-0.07	-0.27	-0.31	-0.20	-0.08	-0.01	0.01	0.05
	(-0.55)	(-2.71)	(-4.40)	(-4.95)	(-2.07)	(-0.18)	(0.09)	(0.49)
	[0.02]	[0.34]	[0.58]	[0.64]	[0.23]	[0.02]	[0.00]	[0.02]
1977-Q1–1982-Q4								
$BP(GDP)$	0.02	-0.20	-0.41	-0.46	-0.32	-0.12	0.04	0.15
	(0.18)	(-1.93)	(-5.74)	(-7.65)	(-3.68)	(-1.16)	(0.42)	(1.49)
	[0.01]	[0.14]	[0.59]	[0.73]	[0.38]	[0.06]	[0.01]	[0.09]
$BP(I^r + C^r_{dur})$	-0.38	-0.99	-1.60	-1.64	-0.94	0.00	0.61	0.82
	(-1.03)	(-2.72)	(-6.36)	(-5.99)	(-2.38)	(0.01)	(1.58)	(2.21)
	[0.05]	[0.25]	[0.65]	[0.62]	[0.20]	[0.00]	[0.10]	[0.18]
$BP(C^r_{ndur} + C^r_{srv})$	-0.07	-0.18	-0.23	-0.21	-0.14	-0.06	0.02	0.11
	(-1.30)	(-4.21)	(-7.77)	(-5.83)	(-3.17)	(-1.24)	(0.50)	(2.59)
	[0.07]	[0.44]	[0.73]	[0.61]	[0.31]	[0.06]	[0.01]	[0.23]
2004-Q2–2009-Q4								
$BP(GDP)$	0.54	0.57	0.34	-0.00	-0.28	-0.45	-0.50	-0.37
	(6.71)	(7.50)	(2.67)	(-0.02)	(-2.12)	(-4.09)	(-4.81)	(-3.14)
	[0.68]	[0.73]	[0.25]	[0.00]	[0.18]	[0.44]	[0.52]	[0.32]
$BP(I^r + C^r_{dur})$	2.94	2.99	1.75	-0.02	-1.48	-2.35	-2.57	-1.97
	(8.23)	(8.00)	(2.68)	(-0.03)	(-2.19)	(-4.32)	(-5.19)	(-4.44)
	[0.76]	[0.75]	[0.25]	[0.00]	[0.19]	[0.47]	[0.56]	[0.36]
$BP(C^r_{ndur} + C^r_{srv})$	0.11	0.17	0.13	-0.00	-0.13	-0.19	-0.17	-0.07
	(2.80)	(5.37)	(2.99)	(-0.01)	(-2.39)	(-4.24)	(-3.39)	(-1.16)
	[0.27]	[0.58]	[0.29]	[0.00]	[0.21]	[0.46]	[0.37]	[0.06]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s FFR_t + \epsilon_t$, $s = 0, 2, 4, 6, 8, 10, 12, 14$, where X_{t+s}, denotes the filtered dependent variables GDP, $(I^r + C^r_{dur})$, and $(C^r_{ndur} + C^r_{srv})$. We report *OLS* estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **GDP**: Real *GDP*. $(\boldsymbol{I^r + C^r_{dur}})$: Sum of real gross private domestic investment and real personal consumption expenditures of durable goods. $(\boldsymbol{C^r_{ndur} + C^r_{srv}})$: Sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. **FFR**: Federal funds effective rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Table 4: Timing and Magnitude of Filtered *FFR* Semi-Elasticities for some *GDP* Components. Filtered Data

Dependent Variables	s=0	s=2	s=4	s=6	s=8	s=10	s=12	s=14
				Forecasting Horizons				
				1960-Q1–2022-Q3				
$BP(GDP)$	0.40	-0.11	-0.56	-0.75	-0.64	-0.37	-0.06	0.24
	(6.40)	(-1.58)	(-9.81)	(-15.56)	(-11.74)	(-5.72)	(-0.83)	(3.48)
	[0.14]	[0.01]	[0.28]	[0.50]	[0.36]	[0.12]	[0.00]	[0.05]
$BP(I^r + C^r_{dur})$	1.16	-0.63	-2.27	-2.80	-2.13	-0.88	0.32	1.27
	(4.59)	(-2.44)	(-10.37)	(-14.72)	(-9.52)	(-3.43)	(1.22)	(4.99)
	[0.08]	[0.02]	[0.31]	[0.47]	[0.27]	[0.05]	[0.01]	[0.10]
$BP(C^r_{ndur} + C^r_{srv})$	0.13	-0.12	-0.33	-0.41	-0.37	-0.23	-0.03	0.16
	(2.61)	(-2.40)	(-6.96)	(-9.31)	(-7.97)	(-4.51)	(-0.65)	(3.00)
	[0.03]	[0.02]	[0.17]	[0.26]	[0.21]	[0.08]	[0.00]	[0.04]
				1967-Q3–1970-Q4				
$BP(GDP)$	0.29	-0.33	-0.71	-0.73	-0.51	-0.08	0.64	1.41
	(1.26)	(-1.32)	(-4.52)	(-5.83)	(-1.56)	(-0.16)	(1.15)	(4.37)
	[0.12]	[0.13]	[0.63]	[0.74]	[0.17]	[0.00]	[0.10]	[0.61]
$BP(I^r + C^r_{dur})$	1.05	-1.12	-2.67	-2.22	-0.45	1.16	2.34	3.70
	(1.66)	(-1.74)	(-30.38)	(-3.12)	(-0.35)	(0.70)	(1.43)	(3.99)
	[0.19]	[0.20]	[0.99]	[0.45]	[0.01]	[0.04]	[0.15]	[0.57]
$BP(C^r_{ndur} + C^r_{srv})$	0.17	0.11	-0.02	-0.26	-0.39	-0.12	0.45	0.77
	(3.30)	(2.14)	(-0.26)	(-5.26)	(-3.01)	(-0.54)	(2.44)	(17.89)
	[0.48]	[0.28]	[0.01]	[0.70]	[0.43]	[0.02]	[0.33]	[0.96]
				1972-Q1–1975-Q4				
$BP(GDP)$	0.08	-0.59	-0.93	-0.78	-0.34	0.03	0.17	0.22
	(0.27)	(-2.40)	(-6.85)	(-7.44)	(-2.89)	(0.24)	(0.95)	(1.12)
	[0.01]	[0.29]	[0.77]	[0.80]	[0.37]	[0.00]	[0.06]	[0.08]
$BP(I^r + C^r_{dur})$	0.13	-2.15	-3.70	-3.39	-1.47	0.63	1.70	1.80
	(0.12)	(-2.17)	(-7.93)	(-11.77)	(-2.29)	(0.88)	(2.24)	(2.50)
	[0.00]	[0.25]	[0.82]	[0.91]	[0.27]	[0.05]	[0.26]	[0.31]
$BP(C^r_{ndur} + C^r_{srv})$	-0.15	-0.35	-0.35	-0.21	-0.06	0.03	0.07	0.12
	(-1.34)	(-4.42)	(-7.09)	(-5.69)	(-1.51)	(0.44)	(0.79)	(1.31)
	[0.11]	[0.58]	[0.78]	[0.70]	[0.14]	[0.01]	[0.04]	[0.11]
				1977-Q1–1982-Q4				
$BP(GDP)$	0.26	-0.31	-0.98	-1.19	-0.80	-0.22	0.15	0.35
	(1.10)	(-1.21)	(-6.27)	(-15.08)	(-4.07)	(-0.91)	(0.64)	(1.52)
	[0.05]	[0.06]	[0.64]	[0.91]	[0.43]	[0.04]	[0.02]	[0.10]
$BP(I^r + C^r_{dur})$	0.08	-1.41	-3.74	-4.48	-2.59	0.21	1.74	1.93
	(0.10)	(-1.51)	(-6.54)	(-12.07)	(-3.00)	(0.22)	(1.99)	(2.25)
	[0.00]	[0.09]	[0.66]	[0.87]	[0.29]	[0.00]	[0.15]	[0.19]
$BP(C^r_{ndur} + C^r_{srv})$	-0.11	-0.43	-0.57	-0.45	-0.25	-0.11	0.02	0.23
	(-0.85)	(-4.51)	(-10.46)	(-5.19)	(-2.36)	(-1.02)	(0.21)	(2.34)
	[0.03]	[0.48]	[0.83]	[0.55]	[0.20]	[0.05]	[0.00]	[0.20]
				2004-Q2–2009-Q4				
$BP(GDP)$	0.75	0.94	0.67	0.13	-0.37	-0.66	-0.73	-0.59
	(5.28)	(10.96)	(4.02)	(0.59)	(-1.77)	(-3.78)	(-4.48)	(-3.29)
	[0.57]	[0.85]	[0.44]	[0.02]	[0.13]	[0.40]	[0.49]	[0.34]
$BP(I^r + C^r_{dur})$	4.13	4.91	3.45	0.67	-1.87	-3.34	-3.75	-3.08
	(6.39)	(12.68)	(4.02)	(0.59)	(-1.76)	(-3.87)	(-4.77)	(-3.62)
	[0.66]	[0.88]	[0.44]	[0.02]	[0.13]	[0.42]	[0.52]	[0.38]
$BP(C^r_{ndur} + C^r_{srv})$	0.12	0.25	0.24	0.06	-0.18	-0.31	-0.29	-0.14
	(1.81)	(5.07)	(4.26)	(0.68)	(-2.06)	(-4.75)	(-4.16)	(-1.52)
	[0.14]	[0.55]	[0.46]	[0.02]	[0.17]	[0.52]	[0.45]	[0.10]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s BP(FFR)_t + \epsilon_t$, $s = 0, 2, 4, 6, 8, 10, 12, 14$, where X_{t+s}, denotes the filtered dependent variables GDP, $(I^r + C^r_{dur})$, and $(C^r_{ndur} + C^r_{srv})$. We report *OLS* estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **GDP**: Real *GDP*. **$(I^r + C^r_{dur})$**: Sum of real gross private domestic investment and real personal consumption expenditures of durable goods. **$(C^r_{ndur} + C^r_{srv})$**: Sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. **BP(FFR)**: Filtered federal funds effective rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 1 helps us visualize the dynamic response of the GDP components upon these cumulative FFR hikes. We observe similar dynamic patterns across our four MTCs. In particular, I and C_{dur} move quite close together, and lead GDP. The drops in both I and C_{dur} are greater than in GDP, albeit I always falls more than C_{dur}. In contrast, $C_{ndur} + C_{serv}$ experience milder contractions.

Figure 1: Response of *GDP* Components over the MTCs. Growth Rates
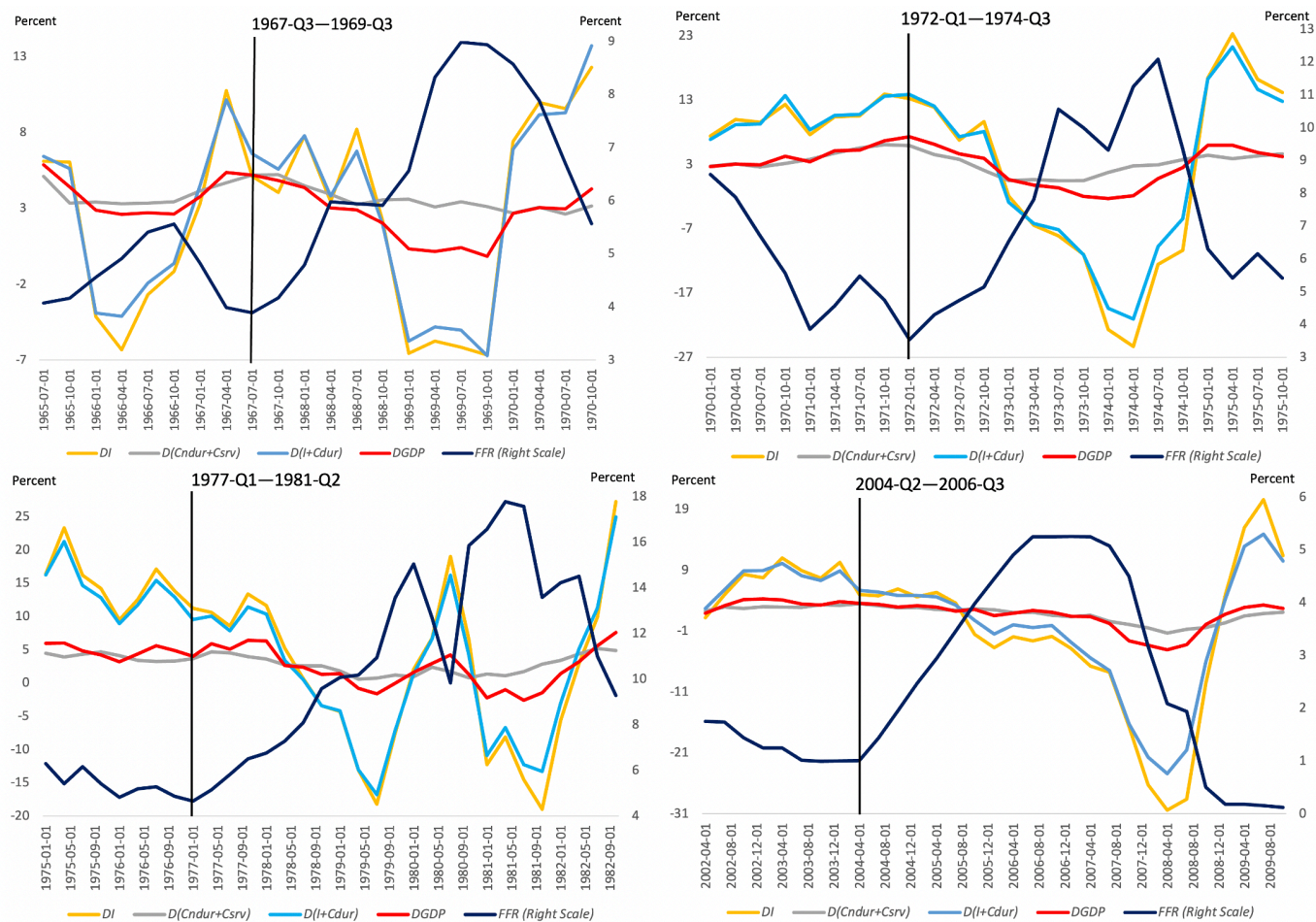
Notes: The figure depicts the evolution of DI^r, $D(C^r_{ndur}+C^r_{srv})$, $D(I^r+C^r_{dur})$, $DGDP$, and FFR, where $\boldsymbol{DI^r}$ is the growth rate of real gross private domestic investment, $\boldsymbol{D(C^r_{ndur}+C^r_{srv})}$ is the growth rate of the sum of real personal consumption expenditures of nondurable goods and real personal consumption expenditures of services, $\boldsymbol{D(I^r+C^r_{dur})}$ is the growth rate of the sum of real gross private domestic investment and real personal consumption expenditures of durable goods, $\boldsymbol{DGDP}$ is the growth rate of real gross domestic product, and $\boldsymbol{FFR}$ is the federal funds effective rate. Growth rates are reported from t to $t+4$. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

To further explore the transmission channels of *FFR* hikes on consumption, Table 5 presents the timing and magnitude of the variation in filtered consumption components, $BP(C_{dur}^r)$, $BP(C_{ndur}^r)$, and $BP(C_{srv}^r)$, upon changes in the filtered federal funds effective rate, $BP(FFR)$, and filtered real home prices, $BP(P_h^r)$. Real home prices lead consumption with lags ranging from two to six quarters (from *s=2* to *s=6*). Hence, the impact of monetary shocks on consumption and inflation can be mitigated by persistent housing appreciation. Also, consumption of durable goods is an order of magnitude more elastic to home prices than consumption of services, and twice as elastic as consumption of non-durable goods. Table 6 extends this analysis to include filtered unemployment as an additional regressor. We can then observe that unemployment may have a more immediate impact on consumption.

Table 7 highlights some correlations intended to capture the expected dynamic responses to a monetary tightening shock. For each pair of variables, the reported lag represents the maximum correlation in absolute value over some predetermined time intervals based on previous results.[2] Building on this analysis, Table 8 summarizes the lagging effects of monetary policy upon changes in the *FFR*. Panels A and D report the date *s* of the maximum response upon an *FFR* increase. In Panels B and C, for each MTC we consider the method described for Panels A and D and then compute the average lag rounded to the nearest natural number. Observe that these lead-lag patterns are quite similar for both the extended period 1954-Q3–2022-Q4 and the MTCs excluding the Great Recession of 2007-2009. Finally, using this information about these lead-lag patterns, Table 9 reports regression results for consumption on lagged *FFR*, real home prices, and unemployment. Roughly these results illustrate that a positive deviation of the real housing price with respect to its long-term trend is associated with positive deviations in consumption with respect to its long-term trend.

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[2]For instance, we discard spurious correlations over contemporary changes and over some other time intervals outside the time lags found in previous regressions.

Table 5: Time and Magnitude of the Semi-Elasticities of Consumption with Respect to the FFR and P_h^r. Filtered Data

	Forecasting Horizons				
	$s{=}0$	$s{=}2$	$s{=}4$	$s{=}6$	$s{=}8$
Dependent Variable: $BP(C_{dur}^r)$					
$BP(FFR)$	0.12	-1.09	-1.76	-1.57	-0.91
	(0.77)	(-7.18)	(-12.35)	(-10.26)	(-5.50)
$BP(P_h^r)$	1.11	0.87	0.46	-0.05	-0.59
	(10.65)	(8.40)	(4.60)	(-0.48)	(-4.90)
	[0.30]	[0.32]	[0.39]	[0.28]	[0.17]
Dependent Variable: $BP(C_{ndur}^r)$					
$BP(FFR)$	0.08	-0.19	-0.42	-0.43	-0.26
	(2.06)	(-4.59)	(-9.42)	(-9.03)	(-5.26)
$BP(P_h^r)$	0.38	0.34	0.20	0.02	-0.17
	(13.92)	(11.63)	(6.48)	(0.36)	(-4.71)
	[0.42]	[0.37]	[0.33]	[0.23]	[0.16]
Dependent Variable: $BP(C_{srv}^r)$					
$BP(FFR)$	0.15	-0.09	-0.32	-0.40	-0.35
	(3.49)	(-2.30)	(-7.93)	(-9.39)	(-7.64)
$BP(P_h^r)$	0.22	0.28	0.24	0.11	-0.05
	(7.50)	(9.82)	(8.26)	(3.39)	(-1.64)
	[0.20]	[0.28]	[0.33]	[0.27]	[0.19]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s BP(FFR)_t + \beta_2^s BP(P_h^r)_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where X_{t+s}, denotes the dependent variables $BP(C_{dur}^r)$, $BP(C_{ndur}^r)$, and $BP(C_{srv}^r)$. We report OLS estimates of β_1^s, β_2^s, t-statistics in parenthesis, and R^2 in square brackets. **$BP(C_{dur}^r)$**: Filtered real personal consumption expenditures of durable goods. **$BP(C_{ndur}^r)$**: Filtered real personal consumption expenditures of non-durable goods. **$BP(C_{srv}^r)$**: Filtered real personal consumption expenditures of services. **$BP(FFR)$**: Filtered federal funds effective rate. **$BP(P_h^r)$**: Filtered *CPI-HL* deflated S&P/Case-Shiller U.S. National Home Price Index. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data, 1954-Q3–2022-Q4. For further definitions and data sources see Section F below.

Table 6: Timing and Magnitude of the Semi-Elasticities of Consumption with Respect to the *FFR*, P_h^r, and *U*. Filtered Data

	Forecasting Horizons				
	s=0	s=2	s=4	s=6	s=8
Dependent Variable: $BP(C_{dur}^r)$					
BP(FFR)	-0.76	-1.21	-1.43	-1.27	-0.61
	(-4.65)	(-6.52)	(-8.42)	(-6.90)	(-3.09)
BP(P_h^r)	0.69	0.82	0.62	0.08	-0.46
	(6.77)	(7.09)	(5.70)	(0.67)	(-3.52)
BP(U)	-2.72	-0.35	1.03	0.92	0.91
	(-9.48)	(-1.07)	(3.44)	(2.86)	(2.59)
	[0.47]	[0.32]	[0.42]	[0.31]	[0.20]
Dependent Variable: $BP(C_{ndur}^r)$					
BP(FFR)	-0.13	-0.15	-0.20	-0.30	-0.26
	(-2.89)	(-2.93)	(-4.18)	(-5.27)	(-4.26)
BP(P_h^r)	0.28	0.36	0.30	0.07	-0.17
	(10.22)	(11.16)	(9.72)	(1.96)	(-4.29)
BP(U)	-0.66	0.14	0.66	0.41	0.01
	(-8.47)	(1.54)	(7.73)	(4.13)	(0.08)
	[0.54]	[0.38]	[0.45]	[0.28]	[0.16]
Dependent Variable: $BP(C_{srv}^r)$					
BP(FFR)	-0.24	-0.31	-0.27	-0.27	-0.25
	(-7.48)	(-6.70)	(-5.40)	(-5.38)	(-4.52)
BP(P_h^r)	0.03	0.18	0.27	0.16	-0.01
	(1.47)	(6.29)	(8.41)	(5.02)	(-0.24)
BP(U)	-1.24	-0.66	0.18	0.41	0.32
	(-21.50)	(-8.10)	(2.05)	(4.57)	(3.28)
	[0.70]	[0.42]	[0.34]	[0.32]	[0.22]

Notes: We estimate the following regressions: $X_{t+s} = \beta_0 + \beta_1^s BP(FFR)_t + \beta_2^s BP(P_h^r)_t + \beta_3^s BP(U)_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where X_{t+s}, denotes the dependent variables $BP(C_{dur}^r)$, $BP(C_{ndur}^r)$, and $BP(C_{srv}^r)$. We report *OLS* estimates of β_1^s, β_2^s, β_3^s, t-statistics in parenthesis, and R^2 in square brackets. $\boldsymbol{BP(C_{dur}^r)}$: Filtered real personal consumption expenditures of durable goods. $\boldsymbol{BP(C_{ndur}^r)}$: Filtered real personal consumption expenditures of non-durable goods. $\boldsymbol{BP(C_{srv}^r)}$: Filtered real personal consumption expenditures of services. $\boldsymbol{BP(FFR)}$: Filtered federal funds effective rate. $\boldsymbol{BP(P_h^r)}$: Filtered *CPI-HL* deflated S&P/Case-Shiller U.S. National Home Price Index. $\boldsymbol{BP(U)}$: Filtered unemployment rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data, 1954-Q3–2022-Q4. For further definitions and data sources see Section F below.

Table 7: Cross-Correlations of Economic Variables. Leads and Lags

	Leading s Periods												
	$BP(C^r_{dur})$	$BP(C^r_{ndur})$	$BP(C^r_{srv})$	$BP(I^r)$	$BP(I^r_{res})$	$BP(U)$	$BP(DCPI\text{-}HL)$	$BP(PCE\text{-}HL)$	$BP(DW)$	$BP(P^r_h)$	$BP(GDP)$	$BP(FFR)$	$BP(A)$
$BP(C^r_{dur})$	1 $s{=}0$	0.84 $s{=}0$	0.54 $s{=}2$	0.80 $s{=}0$	0.86 $s{=}{-}1$	-0.75 $s{=}2$	0.56 $s{=}5$	0.48 $s{=}5$	0.25 $s{=}7$	0.54 $s{=}0$	0.83 $s{=}1$	-0.58 $s{=}{-}4$	0.77 $s{=}0$
$BP(C^r_{ndur})$		1 $s{=}0$	0.54 $s{=}1$	0.72 $s{=}0$	0.73 $s{=}{-}1$	-0.69 $s{=}2$	0.53 $s{=}4$	0.48 $s{=}4$	0.18 $s{=}7$	0.64 $s{=}0$	0.76 $s{=}0$	-0.50 $s{=}{-}5$	0.73 $s{=}{-}1$
$BP(C^r_{srv})$			1 $s{=}0$	0.52 $s{=}0$	0.48 $s{=}{-}2$	-0.79 $s{=}0$	0.31 $s{=}2$	0.24 $s{=}1$	0.19 $s{=}8$	0.51 $s{=}{-}2$	0.69 $s{=}0$	-0.48 $s{=}{-}6$	0.50 $s{=}{-}1$
$BP(I^r)$				1 $s{=}0$	0.83 $s{=}{-}1$	0.81 $s{=}1$	0.39 $s{=}4$	0.32 $s{=}4$	0.27 $s{=}4$	0.47 $s{=}{-}1$	0.93 $s{=}0$	-0.60 $s{=}{-}6$	0.86 $s{=}{-}1$
$BP(I^r_{res})$					1 $s{=}0$	-0.68 $s{=}3$	0.52 $s{=}6$	0.45 $s{=}7$	0.27 $s{=}9$	0.62 $s{=}1$	0.79 $s{=}1$	-0.69 $s{=}{-}4$	0.79 $s{=}0$
$BP(U)$						1 $s{=}0$	-0.49 $s{=}2$	-0.42 $s{=}2$	-0.31 $s{=}4$	-0.53 $s{=}{-}2$	-0.89 $s{=}{-}1$	0.55 $s{=}{-}7$	-0.69 $s{=}{-}2$
$BP(DCPI\text{-}HL)$							1 $s{=}0$	0.96 $s{=}0$	0.32 $s{=}1$	0.36 $s{=}{-}4$	0.50 $s{=}{-}3$	-0.57 $s{=}{-}10$	0.47 $s{=}{-}6$
$BP(PCE\text{-}HL)$								1 $s{=}0$	0.32 $s{=}1$	0.29 $s{=}{-}4$	0.42 $s{=}{-}3$	-0.55 $s{=}{-}10$	0.45 $s{=}{-}6$
$BP(DW)$									1 $s{=}0$	0.11 $s{=}{-}9$	0.32 $s{=}{-}5$	-0.24 $s{=}{-}12$	0.21 $s{=}{-}8$
$BP(P^r_h)$										1 $s{=}0$	0.49 $s{=}1$	-0.38 $s{=}{-}5$	0.45 $s{=}{-}1$
$BP(GDP)$											1 $s{=}0$	-0.63 $s{=}{-}6$	0.86 $s{=}{-}1$
$BP(FFR)$												1 $s{=}0$	-0.67 $s{=}4$
$BP(A)$													1 $s{=}0$

Notes: This table reports $\rho(X_t, Z_{t+s})$ where ρ denotes the correlation coefficient between variable X_t displayed in rows and variable Z_{t+s} displayed in columns. For each pair of variables, s is chosen in order to maximize the reported correlation in absolute value over some feasible time interval of the MTC. $\boldsymbol{BP(C^r_{dur})}$: Filtered real personal consumption expenditures of durable goods. $\boldsymbol{BP(C^r_{ndur})}$: Filtered real personal consumption expenditures of non-durable goods. $\boldsymbol{BP(C^r_{srv})}$: Filtered real personal consumption expenditures of services. $\boldsymbol{BP(I^r)}$: Filtered real gross private domestic investment. $\boldsymbol{BP(I^r_{res})}$: Filtered real private residential fixed investment. $\boldsymbol{BP(U)}$: Filtered unemployment rate. $\boldsymbol{BP(DCPI\text{-}HL)}$: Filtered change in annual headline inflation from the *CPI*. $\boldsymbol{BP(DPCE\text{-}HL)}$: Filtered change in annual headline inflation from the *PCE* deflator. $\boldsymbol{BP(DW)}$: Filtered change in the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). $\boldsymbol{BP(P^r_h)}$: Filtered *CPI-HL* deflated S&P/Case-Shiller U.S. National Home Price Index. $\boldsymbol{BP(GDP)}$: Filtered real *GDP*. $\boldsymbol{BP(FFR)}$: Filtered federal funds effective rate. $\boldsymbol{BP(A)}$: Filtered *TFP*. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data, 1954-Q3–2022-Q4. For further definitions and data sources see Section F below.

Table 8: Lags in the Propagation Effects of Monetary Policy

s=2	s=3	s=4	s=5	s=6	s=7	s=8	s=10	s=11	s=12	s=13
				Panel A: 1954-Q3–2022-Q4						
		$BP(I^r_{res})$	$BP(P^r_h)$	$BP(GDP)$	$BP(U)$		$BP(DCPI\text{-}HL)$		$BP(DW)$	$BP(PCE\text{-}C)$
		$BP(C^r_{dur})$	$BP(C^r_{ndur})$	$BP(I^r)$			$BP(PCE\text{-}HL)$		$BP(DCPI\text{-}C)$	
		$BP(A)$		$BP(C^r_{srv})$						
				Panel B: Monetary Tightening Cycles						
	$BP(P^r_h)$		$BP(A)$	$BP(I^r_{res})$	$BP(GDP)$	$BP(U)$		$BP(DCPI\text{-}HL)$	$BP(DCPI\text{-}C)$	
				$BP(C^r_{dur})$	$BP(I^r)$			$BP(PCE\text{-}HL)$	$BP(PCE\text{-}C)$	
				$BP(C^r_{srv})$	$BP(C^r_{ndur})$			$BP(DW)$		
				Panel C: Monetary Tightening Cycles, Excluding the 2007-2009 Financial Crises						
$BP(P^r_h)$		$BP(I^r_{res})$	$BP(GDP)$	$BP(U)$			$BP(DCPI\text{-}HL)$	$BP(PCE\text{-}HL)$	$BP(DCPI\text{-}C)$	
		$BP(C^r_{dur})$	$BP(I^r)$				$BP(DW)$		$BP(PCE\text{-}C)$	
		$BP(C^r_{srv})$	$BP(C^r_{ndur})$							
		$BP(A)$								
				Panel D: 2007-2009 Financial Crises						
				$BP(P^r_h)$	$BP(A)$	$BP(C^r_{ndur})$	$BP(C^r_{srv})$	$BP(DCPI\text{-}HL)$	$BP(U)$	
							$BP(PCE\text{-}HL)$	$BP(DCPI\text{-}C)$	$BP(I^r_{res})$	
							$BP(DW)$	$BP(I^r)$	$BP(PCE\text{-}C)$	
								$BP(C^r_{dur})$		
								$BP(GDP)$		

Notes: In **Panels A and D**, for each variable we report the date s of the maximum response upon a $BP(FFR)$ increase. In **Panels B and C**, for each MTC we use the method described for Panels A and D and then compute the average lag rounded to the nearest natural number. $\textbf{\textit{BP(FFR)}}$: Filtered federal funds effective rate. $\textbf{\textit{BP}}(I^r_{res})$: Filtered real private residential fixed investment. $\textbf{\textit{BP}}(\textbf{\textit{C}}^{\textbf{\textit{r}}}_{\textbf{\textit{dur}}})$: Filtered real personal consumption expenditures of durable goods. $\textbf{\textit{BP(A)}}$: Filtered *TFP*. $\textbf{\textit{BP}}(\textbf{\textit{P}}^{\textbf{\textit{r}}}_{\textbf{\textit{h}}})$: Filtered *CPI-HL* deflated S&P/Case-Shiller U.S. National Home Price Index. $\textbf{\textit{BP}}(\textbf{\textit{C}}^{\textbf{\textit{r}}}_{\textbf{\textit{ndur}}})$: Filtered real personal consumption expenditures of non-durable goods. $\textbf{\textit{BP(GDP)}}$: Filtered real *GDP*. $\textbf{\textit{BP}}(\textbf{\textit{I}}^{\textbf{\textit{r}}})$: Filtered real gross private domestic investment. $\textbf{\textit{BP}}(\textbf{\textit{C}}^{\textbf{\textit{r}}}_{\textbf{\textit{srv}}})$: Filtered real personal consumption expenditures of services. $\textbf{\textit{BP(U)}}$: Filtered unemployment rate. $\textbf{\textit{BP(DCPI-HL)}}$: Filtered change in annual headline inflation from the *CPI*. $\textbf{\textit{BP(DPCE-HL)}}$: Filtered change in annual headline inflation from the *PCE* deflator. $\textbf{\textit{BP(DW)}}$: Filtered annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). $\textbf{\textit{BP(DPCE-C)}}$: Filtered annual core inflation from the *PCE* deflator. $\textbf{\textit{BP(DCPI-C)}}$: Filtered annual core inflation from the *CPI*. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. Quarterly data from 1954-Q3–2022-Q4 for all variables except for core inflation that starts on 1960-Q1. For further definitions and data sources see Section F below.

Table 9: Timing and Magnitude of the Semi-Elasticities of Consumption with Respect to the FFR, P_h^r, and U. Filtered Data. Adjusted Lag Structure

	Dependent Variable: $BP(C_{dur}^r)$	
$BP(FFR)_{t-6}$	-0.73	-1.16
	(-4.58)	(-7.64)
$BP(P_h^r)$	0.72	–
	(7.41)	–
$BP(P_h^r)_{t-1}$	–	0.73
	–	(7.23)
$BP(U)$	-1.31	–
	(-5.05)	–
R^2	[0.48]	[0.40]

	Dependent Variable: $BP(C_{ndur}^r)$	
$BP(FFR)_{t-6}$	-0.12	-0.25
	(-2.79)	(-5.89)
$BP(P_h^r)$	0.29	–
	(10.46)	–
$BP(P_h^r)_{t-1}$	–	0.31
	–	(10.88)
$BP(U)$	-0.42	–
	(-5.77)	–
R^2	[0.54]	[0.47]

	Dependent Variable: $BP(C_{srv}^r)$	
$BP(FFR)_{t-6}$	-0.04	-0.29
	(-1.22)	(-6.62)
$BP(P_h^r)$	0.06	–
	(2.83)	–
$BP(P_h^r)_{t-1}$	–	0.19
	–	(6.48)
$BP(U)$	-0.97	–
	(-16.28)	–
R^2	[0.65]	[0.34]

Notes: We estimate the following regressions $X_{t+s} = \beta_0 + \beta_1 BP(FFR)_{t-6} + \beta_2 BP(P_h^r)_t + \beta_3 BP(P_h^r)_{t-1} + \beta_4 BP(U)_t + \epsilon_t$, where X_{t+s}, denotes the dependent variables $BP(C_{dur}^r)$, $BP(C_{ndur}^r)$, and $BP(C_{srv}^r)$. We report *OLS* estimates of β_1, β_2, β_3, t-statistics in parenthesis, and R^2 in square brackets. $\boldsymbol{BP(C_{dur}^r)}$: Filtered real personal consumption expenditures of durable goods. $\boldsymbol{BP(C_{ndur}^r)}$: Filtered real personal consumption expenditures of non-durable goods. $\boldsymbol{BP(C_{srv}^r)}$: Filtered real personal consumption expenditures of services. $\boldsymbol{BP(FFR)}$: Filtered federal funds effective rate. $\boldsymbol{BP(P_h^r)}$: Filtered *CPI-HL* deflated S&P/Case-Shiller U.S. National Home Price Index. $\boldsymbol{BP(U)}$: Filtered unemployment rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data, 1954-Q3–2022-Q4. For further definitions and data sources see Section F below.

D Phillips Curves

In Table 10 we now turn to the timing and magnitude of the response of inflation and nominal wage growth upon an increase of one percentage point in the *FFR*. Although wage growth may anticipate inflation, both nominal measures are usually lagging indicators of output growth and the unemployment rate. The main response of these nominal quantities occurs between ten and twelve quarters (from $s=10$ to $s=12$) after the *FFR* increase. Table 11 reproduces the regressions results reported in Table 10 for filtered data. In the first panel of this table we introduce the extended period 1960-Q1–2022-Q3. For our MTCs, the dynamic responses are comparable to those of the previous table. Again, the associated estimates for the *FFR* hikes over our MTCs—and especially the corresponding R^2 values—tend to be higher than over the extended period 1960-Q1–2022-Q3.

Table 10: Sensitivity of Nominal Price and Wage Growth to the *FFR*

Dependent Variable	Forecasting Horizons							
	s=4	s=6	s=8	s=10	s=12	s=14	s=16	s=14
1967-Q3–1970-Q4								
DPCE-C	0.06	0.07	-0.08	-0.29	-0.41	-0.33	0.10	0.79
	(1.69)	(0.86)	(-0.69)	(-2.86)	(-6.76)	(-1.89)	(0.29)	(2.13)
	[0.19]	[0.06]	[0.04]	[0.40]	[0.79]	[0.23]	[0.01]	[0.27]
DCPI-C	0.23	-0.08	-0.44	-0.64	-0.66	-0.43	0.05	0.84
	(2.06)	(-0.45)	(-2.32)	(-4.34)	(-7.57)	(-2.46)	(0.12)	(1.76)
	[0.26]	[0.07]	[0.31]	[0.61]	[0.83]	[0.34]	[0.00]	[0.20]
DW	-0.14	-0.16	-0.22	-1.18	0.05	0.25	0.31	0.48
	(-1.48)	(-2.52)	(-3.66)	(-2.29)	(0.46)	(1.95)	(1.39)	(1.84)
	[0.15]	[0.34]	[0.53]	[0.30]	[0.02]	[0.24]	[0.14]	[0.22]
1972-Q1–1975-Q4								
DPCE-C	0.65	0.30	-0.13	-0.35	-0.25	-0.07	0.01	-0.02
	(6.52)	(2.25)	(-1.05)	(-3.87)	(-3.07)	(-1.75)	(0.25)	(-0.22)
	[0.75]	[0.27]	[0.07]	[0.52]	[0.40]	[0.18]	[0.00]	[0.00]
DCPI-C	0.80	0.44	-0.08	-0.42	-0.38	-0.21	-0.11	-0.03
	(6.03)	(2.49)	(5.70)	(-3.17)	(-3.58)	(-2.69)	(-0.84)	(-0.15)
	[0.72]	[0.31]	[0.01]	[0.41]	[0.48]	[0.34]	[0.05]	[0.00]
DW	0.44	0.18	-0.01	-0.31	-2.67	-0.01	-0.01	-0.00
	(6.22)	(1.55)	(-0.79)	(-3.33)	(-3.09)	(-1.23)	(-0.14)	(-0.05)
	[0.73]	[0.15]	[0.04]	[0.44]	[0.41]	[0.09]	[0.00]	[0.00]
1977-Q1–1982-Q4								
DPCE-C	0.03	-0.09	-0.22	-0.35	-0.42	-0.41	-0.36	-0.29
	(0.36)	(-1.18)	(-2.69)	(-4.96)	(-7.07)	(-7.05)	(-6.61)	(-5.94)
	[0.00]	[0.06]	[0.25]	[0.53]	[0.69]	[0.69]	[0.66]	[0.62]
DCPI-C	-0.01	-0.29	-0.51	-0.59	-0.62	-0.56	-0.44	-0.35
	(-0.70)	(-2.18)	(-4.48)	(-5.85)	(-6.17)	(-6.45)	(-5.39)	(-4.19)
	[0.00]	[0.18]	[0.48]	[0.61]	[0.63]	[0.65]	[0.57]	[0.44]
DW	-0.09	-0.27	-0.43	-0.52	-0.54	-0.49	-0.38	-0.19
	(-0.92)	(-2.48)	(-4.44)	(-6.60)	(8.41)	(-7.99)	(-6.23)	(-2.93)
	[0.37]	[0.22]	[0.47]	[0.66]	[0.76]	[0.74]	[0.64]	[0.28]
2004-Q2–2009-Q4								
DPCE-C	0.13	0.04	-0.06	-0.12	-0.15	-0.12	-0.05	0.03
	(2.31)	(0.69)	(-0.88)	(-2.36)	(-3.60)	(-2.81)	(-1.11)	(0.85)
	[0.20]	[0.02]	[0.04]	[0.21]	[0.38]	[0.27]	[0.05]	[0.03]
DCPI-C	0.22	0.19	0.07	-0.07	-0.16	-0.19	-0.14	-0.05
	(5.27)	(3.61)	(1.06)	(-1.14)	(-3.51)	(-4.95)	(-3.27)	(-1.08)
	[0.57]	[0.38]	[0.05]	[0.06]	[0.37]	[0.54]	[0.33]	[0.05]
DW	0.33	0.11	0.02	-0.03	-0.17	-0.13	-0.06	-0.03
	(2.84)	(0.81)	(0.17)	(-0.22)	(-1.10)	(-0.90)	(-0.43)	(-0.19)
	[0.28]	[0.03]	[0.00]	[0.00]	[0.05]	[0.04]	[0.01]	[0.00]

Notes: We estimate the following regressions $DX_{t+s} = \beta_0 + \beta_1^s FFR_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where DX_{t+s} denotes annual growth rates from $t + s - 4$ to $t + s$. We report *OLS* estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **DPCE-C**: Core (excluding food and energy) inflation from the *PCE* deflator. **DCPI-C**: *CPI*-core inflation. **DW**: Growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). **FFR**: Federal funds effective rate. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Table 11: Sensitivity of Nominal Price and Wage Growth to the *FFR*. Filtered Data

Dependent Variable	Forecasting Horizons							
	s=4	*s=6*	*s=8*	*s=10*	*s=12*	*s=14*	*s=16*	*s=18*
	1960-Q1–2022-Q3							
BP(DPCE-C)	0.29	0.13	-0.06	-0.22	-0.29	-0.26	-0.15	-0.02
	(9.65)	(3.95)	(-1.68)	(-6.70)	(-9.52)	(-8.15)	(-4.40)	(-0.67)
	[0.27]	[0.06]	[0.01]	[0.16]	[0.28]	[0.22]	[0.08]	[0.00]
BP(DCPI-C)	0.41	0.15	-0.13	-0.33	-0.42	-0.40	-0.26	-0.04
	(9.95)	(3.16)	(-2.65)	(-7.41)	(-10.14)	(-9.36)	(-5.56)	(-0.77)
	[0.29]	[0.04]	[0.03]	[0.19]	[0.30]	[0.27]	[0.12]	[0.00]
BP(DW)	0.26	0.11	-0.06	-0.19	-0.24	-0.210	-0.06	-0.08
	(5.03)	(2.14)	(-1.07)	(-3.57)	(-4.46)	(-3.77)	(-1.27)	(-0.64)
	[0.09]	[0.02]	[0.00]	[0.05]	[0.08]	[0.06]	[0.02]	[0.00]
	1967-Q3–1970-Q4							
BP(DPCE-C)	-0.03	0.14	0.09	-0.24	-0.60	-0.79	-0.57	0.22
	(-0.41)	(0.89)	(0.44)	(-1.09)	(-4.89)	(-6.89)	(-1.57)	(0.44)
	[0.01]	[0.06]	[0.02]	[0.09]	[0.67]	[0.79]	[0.17]	[0.02]
BP(DCPI-C)	0.32	0.19	-0.22	-0.59	-0.71	-0.79	-0.70	0.14
	(2.18)	(0.74)	(-0.71)	(-2.21)	(-3.91)	(-4.39)	(-1.44)	(0.21)
	[0.28]	[0.04]	[0.04]	[0.29]	[0.56]	[0.62]	[0.15]	[0.00]
BP(DW)	-0.09	-0.19	-0.36	-0.40	-0.15	0.05	-0.06	0.05
	(-0.50)	(-1.23)	(-3.72)	(-6.38)	(-1.41)	(0.32)	(-0.21)	(0.13)
	[0.02]	[0.11]	[0.53]	[0.77]	[0.14]	[0.01]	[0.00]	[0.00]
	1972-Q1–1975-Q4							
BP(DPCE-C)	0.61	0.18	-0.29	-0.51	-0.39	-0.17	-0.08	-0.09
	(6.95)	(1.10)	(-1.97)	(-4.52)	(-3.79)	(-3.11)	(-4.57)	(-1.78)
	[0.77]	[0.08]	[0.22]	[0.59]	[0.51]	[0.41]	[0.59]	[0.18]
BP(DCPI-C)	0.81	0.30	-0.31	-0.66	-0.61	-0.39	-0.25	-0.13
	(7.55)	(1.40)	(-1.36)	(-3.46)	(-4.32)	(-6.89)	(-3.84)	(-0.92)
	[0.80]	[0.12]	[0.12]	[0.46]	[0.57]	[0.77]	[0.51]	[0.05]
BP(DW)	0.38	0.11	-0.25	-0.45	-0.37	-0.16	-0.07	-0.05
	(4.01)	(0.75)	(-1.77)	(-4.17)	(-3.72)	(-3.06)	(-1.69)	(-0.80)
	[0.53]	[0.04]	[0.18]	[0.55]	[0.49]	[0.40]	[0.17]	[0.04]
	1977-Q1–1982-Q4							
BP(DPCE-C)	0.25	0.11	-0.07	-0.25	-0.33	-0.25	-0.09	0.01
	(2.45)	(0.99)	(-0.73)	(-3.29)	(-5.92)	(-3.72)	(-1.36)	(0.25)
	[0.21]	[0.04]	[0.02]	[0.33]	[0.61]	[0.38]	[0.08]	[0.00]
BP(DCPI-C)	0.03	-0.28	-0.60	-0.57	-0.39	-0.22	-0.07	0.11
	(1.52)	(-1.55)	(-4.49)	(-4.23)	(-2.44)	(-1.39)	(-0.46)	(0.80)
	[0.09]	[0.10]	[0.48]	[0.45]	[0.21]	[0.08]	[0.01]	[0.03]
BP(DW)	0.25	-0.04	-0.33	-0.45	-0.44	-0.32	-0.06	0.29
	(2.10)	(-0.35)	(-3.34)	(-6.39)	(-5.37)	(-2.82)	(-0.45)	(2.78)
	[0.16]	[0.01]	[0.34]	[0.65]	[0.57]	[0.27]	[0.01]	[0.26]
	2004-Q2–2009-Q4							
BP(DPCE-C)	0.12	0.01	-0.11	-0.18	-0.19	-0.15	-0.03	0.10
	(2.31)	(0.13)	(-1.90)	(-3.49)	(-4.02)	(-2.71)	(-0.53)	(1.77)
	[0.20]	[0.00]	[0.15]	[0.37]	[0.43]	[0.26]	[0.01]	[0.13]
BP(DCPI-C)	0.19	0.21	0.10	-0.07	-0.21	-0.24	-0.14	0.02
	(5.45)	(6.17)	(1.68)	(-1.08)	(-4.08)	(-5.55)	(-2.33)	(0.29)
	[0.59]	[0.64]	[0.12]	[0.05]	[0.44]	[0.59]	[0.20]	[0.00]
BP(DW)	0.25	-0.01	-0.19	-0.25	-0.31	-0.34	-0.21	-0.05
	(3.01)	(-0.08)	(-2.02)	(-2.71)	(-2.88)	(-3.05)	(-1.70)	(-0.39)
	[0.30]	[0.00]	[0.16]	[0.26]	[0.28]	[0.31]	[0.12]	[0.01]

Notes: We estimate the following regressions $X_{t+s} = \beta_0 + \beta_1^s BP(FFR)_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where X_{t+s} denotes filtered annual growth rates from $t+s-4$ to $t+s$ of the dependent variables *DPCE-C*, *DCPI-C*, and *DW*. We report *OLS* estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **BP(DPCE-C)**: Filtered core (excluding food and energy) inflation from the *PCE* deflator. **BP(DCPI-C)**: Filtered *CPI*-core inflation. **BP(DW)**: Filtered growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). **BP(FFR)**: Filtered federal funds effective rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

In Table 12 we can observe a significant negative relation between unemployment and our measures of real- and productivity-adjusted wage growth. The main response occurs between two and four quarters after the increase in the unemployment rate (from $s=2$ to $s=4$). Observe that the response of the productivity-adjusted real wage, *DW-DP-BP(DA)*, is usually stronger than for the real wage, *DW-DP*. This justifies our later formulation of the Phillips curves below in terms of the productivity-adjusted real wage. For *DW-DP-BP(DA)* the magnitude of these responses fluctuates from -0.4 in the extended period 1960-Q1–2022-Q2 to -2.42 over the time interval 1967-Q3–1970-Q4. These later estimates are quite comparable to those of the other MTCs. Therefore, the propagation wage effects of variations in the unemployment rate are especially noticeable over our selected MTCs.

Table 12: Sensitivity of Wage Growth to the Unemployment Rate

| Dependent Variable | Forecasting Horizons | | | | |
	s=0	s=2	s=4	s=6	s=8
1960-Q1–2022-Q2					
DW-DP	-0.25	-0.27	-0.40	-0.38	-0.39
	(-3.93)	(-4.25)	(-6.43)	(-6.07)	(-6.32)
	[0.06]	[0.07]	[0.14]	[0.13]	[0.14]
DW-DP-BP(DA)	0.03	-0.41	-0.64	-0.45	-0.29
	(0.27)	(-3.66)	(-5.96)	(-3.99)	(-2.51)
	[0.00]	[0.05]	[0.13]	[0.06]	[0.02]
BP(DW-DP-DA)	0.09	-0.18	-0.31	-0.14	0.04
	(1.37)	(-2.70)	(-4.92)	(-2.11)	(0.54)
	[0.08]	[0.03]	[0.09]	[0.02]	[0.00]
1967-Q3–1970-Q4					
DW-DP	-0.81	-0.68	0.10	0.95	1.26
	(-2.56)	(-1.81)	(0.26)	(3.83)	(4.87)
	[0.35]	[0.21]	[0.00]	[0.55]	[0.66]
DW-DP-BP(DA)	0.19	-1.81	-2.42	-1.83	-1.61
	(0.29)	(-3.23)	(-4.72)	(-2.41)	(-1.72)
	[0.00]	[0.46]	[0.65]	[0.33]	[0.19]
BP(DW-DP-DA)	-0.24	-1.91	-1.56	-0.62	-0.49
	(-0.50)	(-5.04)	(-2.88)	(-0.91)	(-0.66)
	[0.02]	[0.68]	[0.41]	[0.06]	[0.04]
1972-Q1–1975-Q4					
DW-DP	-0.63	-0.34	-0.08	0.12	0.16
	(-3.07)	(-1.29)	(-0.34)	(0.57)	(1.85)
	[0.40]	[0.11]	[0.00]	[0.02]	[0.19]
DW-DP-BP(DA)	1.10	-1.14	-1.95	-1.58	-0.99
	(1.36)	(-1.44)	(-3.40)	(-2.77)	(-1.45)
	[0.11]	[0.13]	[0.45]	[0.35]	[0.13]
BP(DW-DP-DA)	-0.28	-1.32	-1.37	-0.69	-0.04
	(-0.65)	(-4.11)	(-4.78)	(-1.66)	(-0.09)
	[0.03]	[0.55]	[0.62]	[0.16]	[0.00]
1977-Q1–1982-Q4					
DW-DP	-0.12	0.24	0.29	0.14	0.17
	(-0.62)	(1.31)	(1.76)	(0.89)	(1.19)
	[0.02]	[0.07]	[0.12]	[0.03]	[0.06]
DW-DP-BP(DA)	0.23	-0.86	-1.99	-2.33	-1.96
	(0.73)	(-2.73)	(-8.71)	(-7.91)	(-4.44)
	[0.02]	[0.25]	[0.77]	[0.74]	[0.47]
BP(DW-DP-DA)	0.61	0.39	-0.33	-0.69	-0.51
	(2.91)	(1.61)	(-1.18)	(-2.34)	(-1.54)
	[0.28]	[0.11]	[0.06]	[0.19]	[0.09]
2004-Q2–2009-Q4					
DW-DP	-0.38	-0.21	-0.12	0.04	-0.11
	(-3.13)	(-1.65)	(-0.99)	(0.33)	(-0.81)
	[0.31]	[0.11]	[0.04]	[0.00]	[0.03]
DW-DP-BP(DA)	-0.40	-1.03	-1.25	-0.63	-0.26
	(-2.54)	(-7.41)	(-9.73)	(-2.36)	(-0.85)
	[0.23]	[0.72]	[0.82]	[0.21]	[0.03]
BP(DW-DP-DA)	-0.15	-0.77	-0.79	-0.21	0.00
	(-1.19)	(-6.31)	(-5.87)	(-0.93)	(0.01)
	[0.06]	[0.65]	[0.62]	[0.04]	[0.00]

Notes: We estimate the following regressions $DX_{t+s} = \beta_0 + \beta_1^s U_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where DX_{t+s} denotes annual growth rates from $t + s - 4$ to $t + s$. We report *OLS* estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **DW-DP**: Growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS) less *CPI*-core (excluding food and energy) inflation. **DW-DP-BP(DA)**: Growth rate of *HCOMPBS* less *CPI*-core inflation and filtered *TFP* growth. **BP(DW-DP-DA)**: Filtered *DW-DP-DA*. **U**: Unemployment rate. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Table 13 completes our exploration of the effects of nominal price changes upon increases in the *FFR*. We observe a significant positive and prompt reaction of inflation to nominal wage growth. The main response occurs within two quarters of the increase in nominal wage growth *DW* (from *s=0* to *s=2*). Although the magnitude of the impact varies substantially across sub-periods, both headline and core inflation move *in tandem* for the first three MTCs. The higher estimated coefficients over the two middle MTCs attests for the considerable reduction in inflation in these two episodes.

Table 13: Sensitivity of Inflation to Nominal Wage Growth

Dependent Variable	Forecasting Horizons				
	s=0	s=2	s=4	s=6	s=8
1958-Q1−2022-Q3					
DCPI-HL	0.80	0.80	0.76	0.73	0.67
	(16.52)	(16.33)	(14.85)	(13.78)	(11.90)
	[0.51]	[0.51]	[0.46]	[0.43]	[0.36]
DPCE-HL	0.71	0.71	0.68	0.66	0.63
	(17.28)	(17.21)	(16.02)	(14.85)	(13.51)
	[0.53]	[0.53]	[0.50]	[0.46]	[0.42]
DCPI-C	0.73	0.75	0.74	0.72	0.68
	(17.40)	(17.96)	(17.46)	(16.62)	(14.39)
	[0.54]	[0.56]	[0.55]	[0.52]	[0.45]
DPCE-C	0.63	0.65	0.65	0.64	0.62
	(17.80)	(18.96)	(18.93)	(18.23)	(16.67)
	[0.56]	[0.59]	[0.58]	[0.57]	[0.52]
1967-Q3−1970-Q4					
DCPI-HL	0.61	0.44	0.22	0.04	-0.21
	(2.44)	(2.68)	(1.07)	(1.65)	(-0.69)
	[0.33]	[0.37]	[0.08]	[0.00]	[0.04]
DPCE-HL	0.49	0.18	0.11	0.13	-0.08
	(3.15)	(1.88)	(1.49)	(1.11)	(-0.55)
	[0.45]	[0.22]	[0.15]	[0.09]	[0.02]
DCPI-C	0.45	0.448	0.324	0.00	-0.20
	(1.86)	(3.17)	(1.59)	(0.00)	(-0.54)
	[0.22]	[0.46]	[0.17]	[0.00]	[0.02]
DPCE-C	0.36	0.11	0.11	0.11	-0.09
	(2.93)	(1.47)	(1.93)	(0.79)	(-0.48)
	[0.41]	[0.15]	[0.23]	[0.05]	[0.02]
1972-Q1−1975-Q4					
DCPI-HL	1.367	0.698	-0.156	-0.771	-0.915
	(5.54)	(2.02)	(-0.46)	(-3.38)	(-4.68)
	[0.69]	[0.27]	[0.01]	[0.45]	[0.61]
DPCE-HL	1.24	0.63	-0.09	-0.65	-0.80
	(5.32)	(1.91)	(-0.26)	(-2.80)	(-4.26)
	[0.67]	[0.21]	[0.00]	[0.36]	[0.56]
DCPI-C	1.54	1.04	0.44	0.043	-0.45
	(9.57)	(3.39)	(1.27)	(0.14)	(-1.93)
	[0.87]	[0.45]	[0.10]	[0.00]	[0.21]
DPCE-C	1.25	0.87	0.33	-0.06	-0.37
	(8.90)	(3.55)	(1.18)	(-0.27)	(-2.22)
	[0.85]	[0.47]	[0.09]	[0.00]	[0.26]
1977-Q1−1982-Q4					
DCPI-HL	2.13	2.13	1.63	0.48	-0.501
	(12.19)	(6.91)	(3.19)	(0.75)	(-7.51)
	[0.87]	[0.68]	[0.31]	[0.02]	[0.02]
DPCE-HL	1.44	1.43	1.05	0.40	-0.13
	(14.61)	(7.76)	(3.15)	(0.95)	(-0.28)
	[0.90]	[0.73]	[0.31]	[0.04]	[0.00]
DCPI-C	1.61	1.84	1.66	0.81	-0.11
	(8.18)	(8.70)	(4.74)	(1.67)	(-0.20)
	[0.75]	[0.77]	[0.50]	[0.11]	[0.00]
DPCE-C	0.82	0.99	0.93	0.66	0.32
	(7.69)	(14.83)	(5.89)	(2.63)	(0.99)
	[0.72]	[0.91]	[0.61]	[0.24]	[0.04]
2004-Q2−2009-Q4					
DCPI-HL	0.65	0.726	0.658	0.322	-0.28
	(2.60)	(2.99)	(2.55)	(1.13)	(-0.98)
	[0.24]	[0.30]	[0.24]	[0.06]	[0.04]
DPCE-HL	0.61	0.57	0.44	0.20	-0.21
	(3.13)	(2.89)	(2.08)	(0.88)	(-0.95)
	[0.32]	[0.28]	[0.17]	[0.03]	[0.04]
DCPI-C	0.094	0.229	0.30	0.31	0.22
	(1.76)	(4.07)	(4.06)	(3.76)	(2.36)
	[0.13]	[0.44]	[0.44]	[0.40]	[0.21]
DPCE-C	0.28	0.26	0.22	0.18	0.09
	(3.96)	(3.52)	(2.47)	(1.97)	(0.93)
	[0.42]	[0.37]	[0.22]	[0.15]	[0.04]

Notes: We estimate the following regressions $DX_{t+s} = \beta_0 + \beta_1^s DW_t + \epsilon_t$, $s = 0, 2, 4, 6, 8$, where DX_{t+s} denotes annual growth rates from $t + s - 4$ to $t + s$. We report OLS estimates of β_1^s, t-statistics in parenthesis, and R^2 in square brackets. **DCPI-HL**: Headline inflation from the *CPI*. **DPCE-HL**: Headline inflation from the *PCE* deflator. **DCPI-C**: Core inflation (excluding food and energy) from the *CPI*. **DPCE-C**: Core inflation from the *PCE* deflator. **DW**: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 2 graphs the response of unemployment, wage growth, and inflation upon cumulative *FFR* hikes over our MTCs. These graphs help us visualize the nature and extent of nominal price and wage rigidities lagging the unemployment rate and output growth.

## Figure 2: Response of Unemployment, Wages, and Inflation. Growth Rates
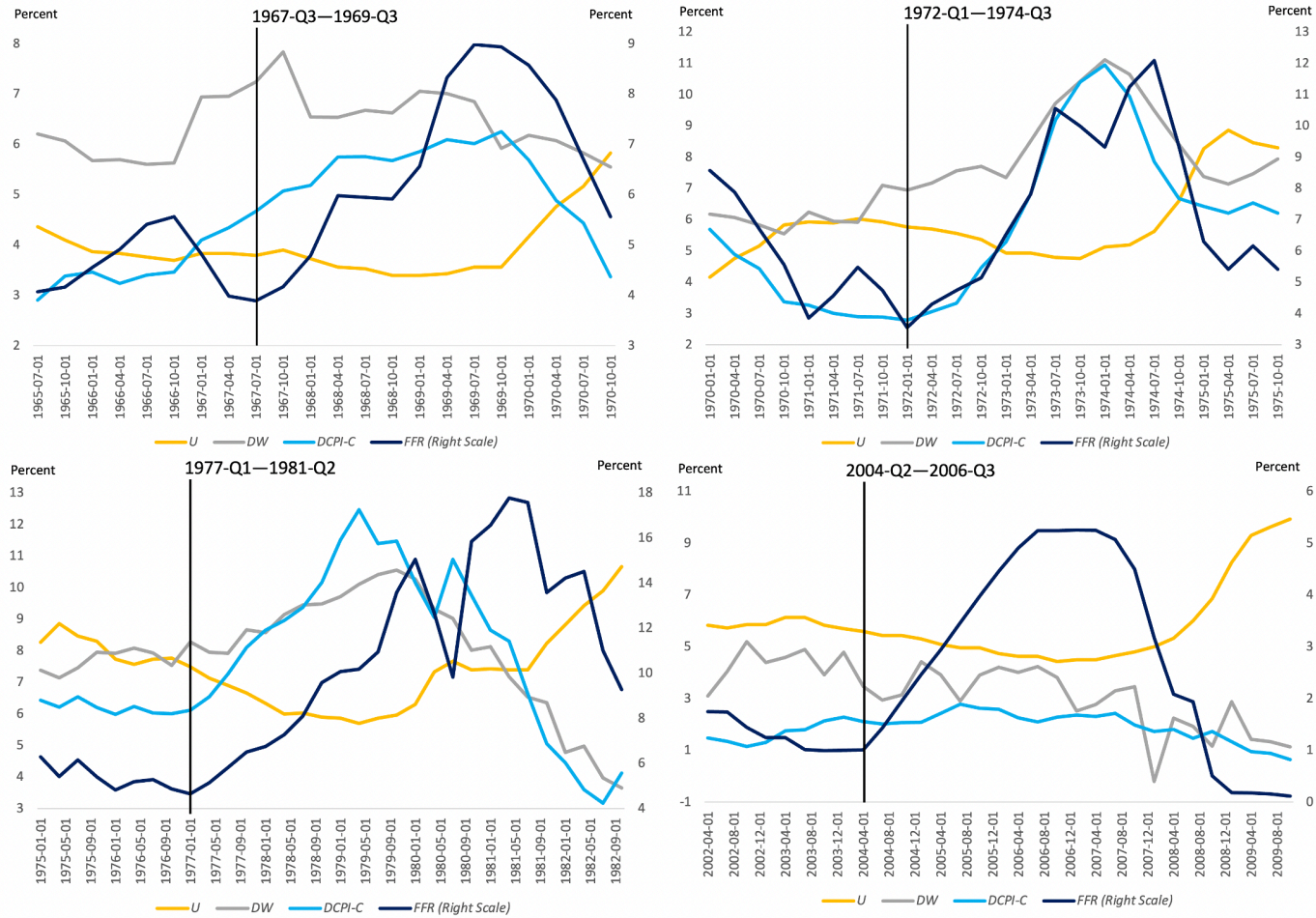
Notes: The figure depicts the evolution of U, DW, $DCPI$-C and FFR, where U is the unemployment rate, $\boldsymbol{DW}$ is the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), $\boldsymbol{DCPI\text{-}C}$ is annual CPI-core (excluding food and energy) inflation, and $\boldsymbol{FFR}$ is the federal funds effective rate. Growth rates are reported from t to $t+4$. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figures 3–5 below plot the evolution of the unemployment rate against deviations of nominal wage growth adjusted for productivity gains over various specifications of inflation:

$$DP_{t+s} - DW_t + DA_t, \text{ for } s = 0, 2, 3,$$

where DP_{t+s} denotes annual *CPI*-core inflation at time $t + s$, DW_t is the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS) at time t, and DA_t is the annual *TFP* growth rate at time t. Observe that Figure 3 in the paper displays the evolution of these estimates for *s=1*. Hence, Figures 3–5 generalize our discussion of Figure 3 in the paper over lags *s=0,2,3*. As pointed out above, at all peaks of the unemployment rate there is a lagging drop of our productivity-adjusted measure of real wage (i.e., $DP_{t+s} - DW_t + DA_t > 0$) . Because of the *non-linear response* observed in these lead-lag patterns among the unemployment rate, nominal wage growth, and the inflation rate, we can see that changes in s do not substantially flatten out these peaks on $DP_{t+s} - DW_t + DA_t$.

Figure 3: Dynamics of Unemployment, and Inflation minus Growth of Labor Costs, *s=0*
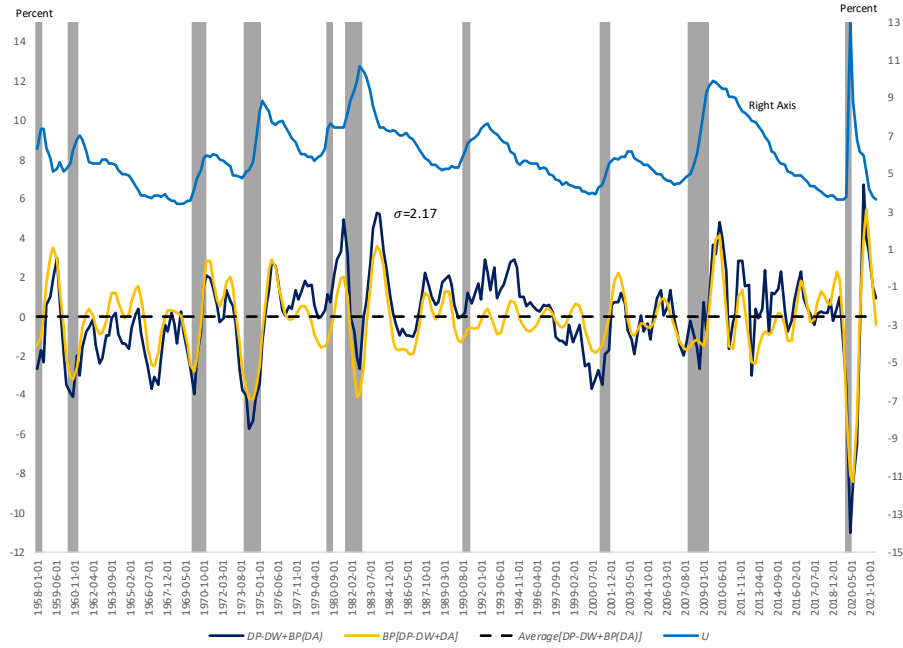
Notes: The figure depicts the evolution of *U*, *DP-DW+BP(DA)* and its average, and filtered *DP-DW+DA*, where **U** is the unemployment rate, **DP** is *CPI*-core inflation, **DW** is the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), **DA** is *TFP* growth, **BP(DA)** is filtered *DA*, and **BP[DP-DW+DA]** is filtered *DP-DW+DA*. Filtering procedure: Band-pass filter isolating frequencies between 6 and 32 quarters. Shaded areas represent periods of *NBER*-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 4: Dynamics of Unemployment, and Inflation minus Growth of Labor Costs, $s=2$
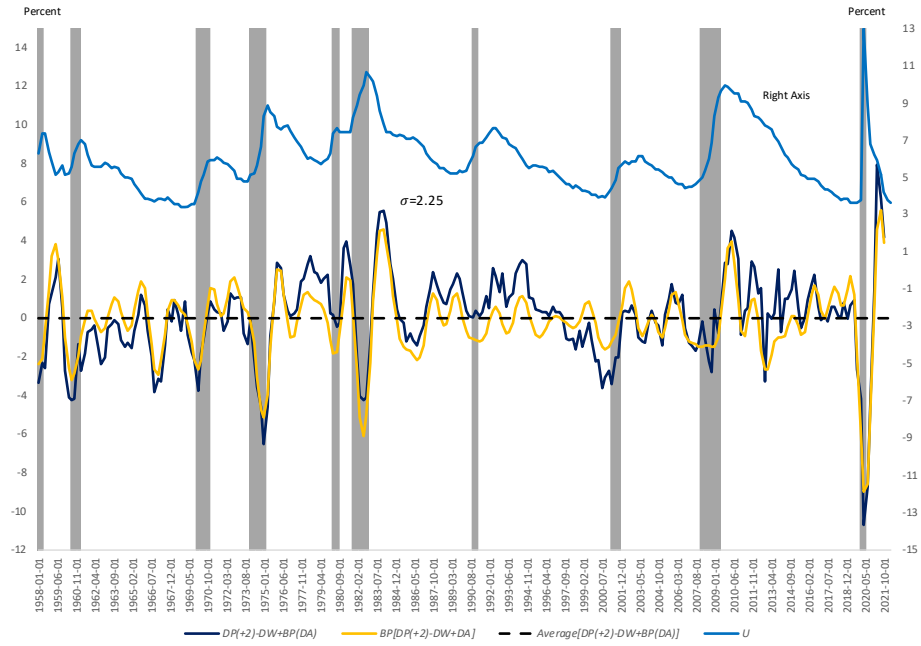
Notes: The figure depicts the evolution of U, $DP(+2)\text{-}DW+BP(DA)$ and its average, and filtered $DP(+2)\text{-}DW+DA$, where **U** is the unemployment rate, **$DP(+2)$** is CPI-core inflation two periods in the future, **DW** is the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), **DA** is TFP growth, **$BP(DA)$** is filtered DA, and **$BP[DP(+2)\text{-}DW+DA]$** is filtered $DP(+2)\text{-}DW+DA$. Filtering procedure: Band-pass filter isolating frequencies between 6 and 32 quarters. Shaded areas represent periods of $NBER$-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 5: Dynamics of Unemployment, and Inflation minus Growth of Labor Costs, $s=3$
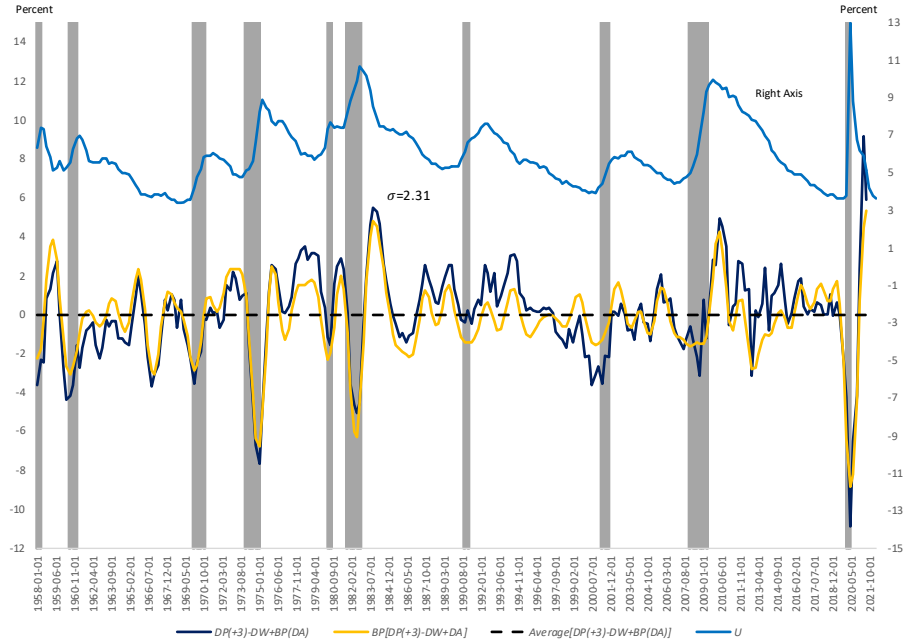
Notes: The figure depicts the evolution of U, $DP(+3)$-DW+$BP(DA)$ and its average, and filtered $DP(+3)$-DW+DA, where U is the unemployment rate, $DP(+3)$ is CPI-core inflation three periods in the future, DW is the annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), DA is TFP growth, $BP(DA)$ is filtered DA, and $BP[DP(+3)$-DW+$DA]$ is filtered $DP(+3)$-DW+DA. Filtering procedure: Band-pass filter isolating frequencies between 6 and 32 quarters. Shaded areas represent periods of $NBER$-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figures 6–10 below display the evolution of the estimated coefficient b^s in the following versions of the Phillips curve:

$$b_t^s = \frac{DW_{t+s} - DP_{t+s} - BP(DA_t)}{U_t - NU_t}, \ \ s = 0, 2, 3,$$

where b_t^s is the slope coefficient (expected to be negative), U_t is the unemployment rate, NU_t is the natural unemployment rate, DP_{t+s} is *CPI*-core inflation s periods in the future, DW_{t+s} is nominal wage growth s periods in the future, DA_t is *TFP* growth, and $BP(DA)_t$ is filtered DA_t. Figure 4 in the paper depicts the evolution of b_t^s for *s=1*. Hence, Figures 6–10 below generalize Figure 4 in the paper by changing the lagging structure over *s=0,2,3*. Again, these lags in the real wage do not completely remove the volatility of coefficient b^s. The computation of coefficient b_t^s becomes highly sensitive to numerical and measurement errors as $(U_t - NU_t)$ approaches zero. Hence, for $|U_t - NU_t| < 0.5$, we let

$$b_t^s = \frac{DW_{t+s} - DP_{t+s} - BP(DA_t) + b_t^{itp} NU_t}{U_t},$$

where b_t^{itp} is interpolated over t from fixed values b_r such that $|U_r - NU_r| \geq 0.5$. In particular, $b_t^{itp} \equiv b_{t_p} + \frac{b_{t_f} - b_{t_p}}{t_f - t_p}(t - t_p)$, where $t_p < t$ is defined as the last period before t in which $|U_{t_p} - NU_{t_p}| \geq 0.5$, and $t_f > t$ is defined as the first period after t in which $|U_{t_f} - NU_{t_f}| \geq 0.5$.

Coefficient b_t^s is highly volatile. The mean values are between -0.45 and -0.62 with standard deviations over these estimates between 1.58 and 2.26. As discussed in the paper, the slope of the Phillips curve peaks in our monetary tightening cycles and may even become positive.

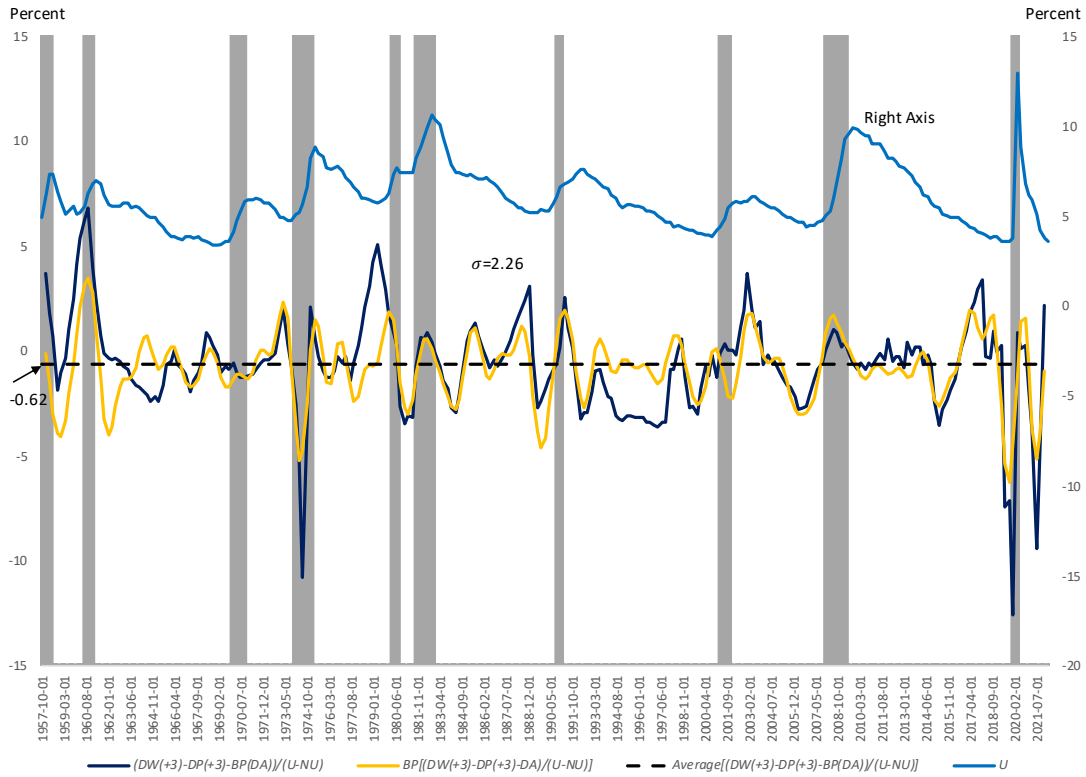# Figure 6: Dynamics of Unemployment and the Slope of The Phillips Curve, *s=0*
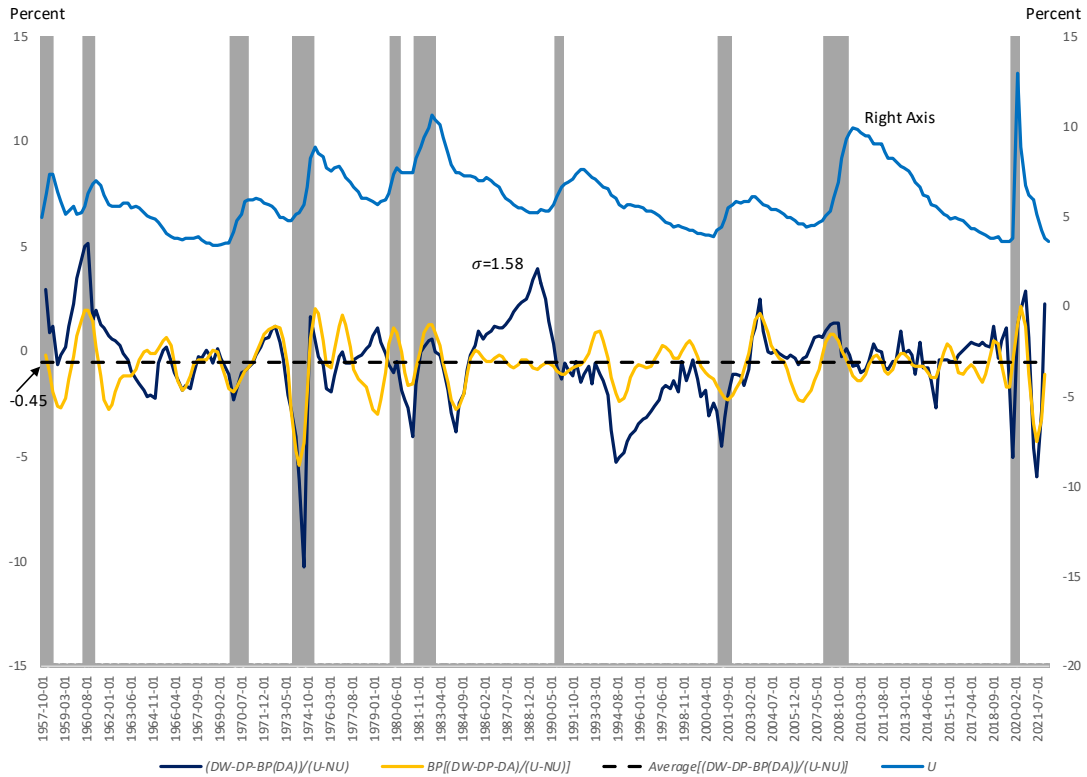
Notes: The figure depicts the evolution of *U*, the ratio *(DW-DP-BP(DA))/(U-NU)* and its average, and the filtered ratio *(DW-DP-DA)/(U-NU)*, where **U** is the unemployment rate, **NU** is the noncyclical rate of unemployment, **DP** is *CPI*-core inflation, **DW** is the growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), **DA** is *TFP* growth, **BP(DA)** is filtered *DA*, and **BP[(DW-DP-DA)/(U-NU)]** is the filtered ratio *(DW-DP-DA)/(U-NU)*. An interpolation method explained in the paper is used for periods in which the unemployment gap *(U-NU)* is close to zero. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. Shaded areas represent periods of *NBER*-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 7: Dynamics of Unemployment and the Slope of The Phillips Curve, $s=2$
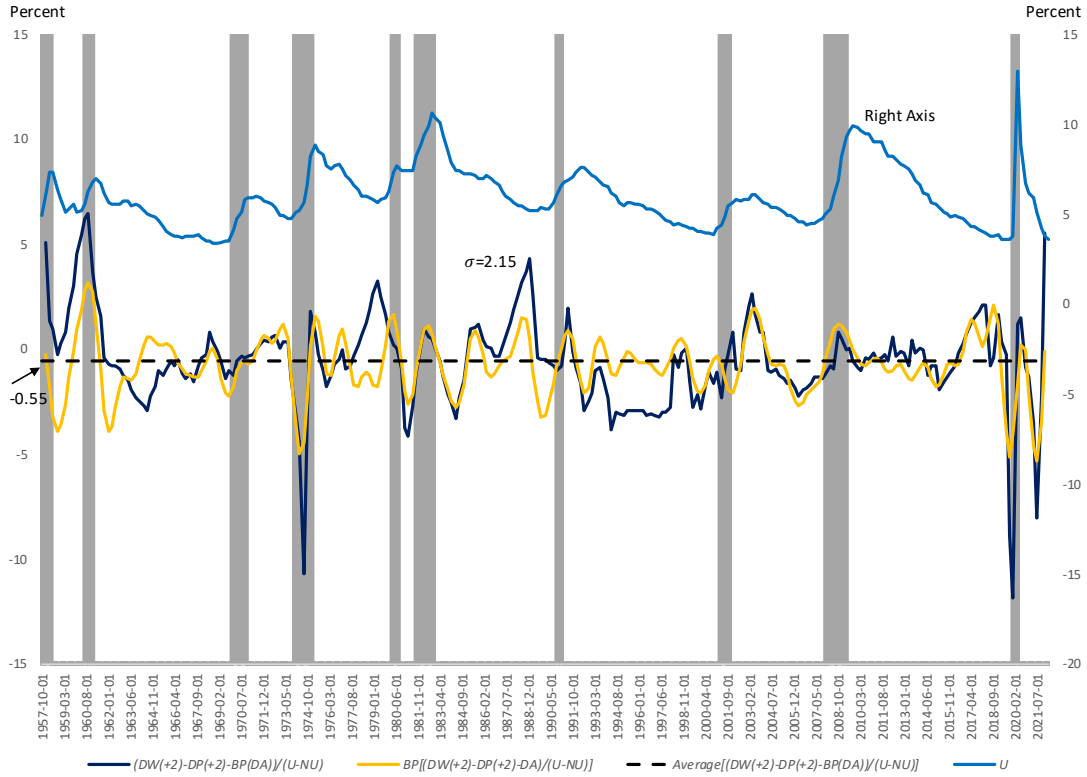
Notes: The figure depicts the evolution of *U*, the ratio *(DW(+2)-DP(+2)-BP(DA))/(U-NU)* and its average, and the filtered ratio *(DW(+2)-DP(+2)-DA)/(U-NU)*, where $\boldsymbol{U}$ is the unemployment rate, $\boldsymbol{NU}$ is the noncyclical rate of unemployment, $\boldsymbol{DP(+2)}$ is *CPI*-core inflation two periods in the future, $\boldsymbol{DW(+2)}$ is the growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS) two periods in the future, $\boldsymbol{DA}$ is *TFP* growth, $\boldsymbol{BP(DA)}$ is filtered *DA*, and $\boldsymbol{BP[(DW(+2)-DP(+2)-DA)/(U-NU)]}$ is the filtered ratio *(DW(+2)-DP(+2)-DA)/(U-NU)*. An interpolation method explained in the paper is used for periods in which the unemployment gap *(U-NU)* is close to zero. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. Shaded areas represent periods of *NBER*-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 8: Dynamics of Unemployment and the Slope of The Phillips Curve, $s=3$

Notes: The figure depicts the evolution of U, the ratio *(DW(+3)-DP(+3)-BP(DA))/(U-NU)* and its average, and the filtered ratio *(DW(+3)-DP(+3)-DA)/(U-NU)*, where U is the unemployment rate, **NU** is the noncyclical rate of unemployment, **DP(+3)** is *CPI*-core inflation three periods in the future, **DW(+3)** is the growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS) three periods in the future, **DA** is *TFP* growth, **BP(DA)** is filtered *DA*, and **BP[(DW(+3)-DP(+3)-DA)/(U-NU)]** is the filtered ratio *(DW(+3)-DP(+3)-DA)/(U-NU)*. An interpolation method explained in the paper is used for periods in which the unemployment gap *(U-NU)* is close to zero. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. Shaded areas represent periods of *NBER*-dated recessions. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

E   Analysis of Current Economic Conditions

Table 14 reports peak/trough levels for several variables in the post-COVID-19 recovery period. These values will be our starting point or initial conditions for assessing the evolution of economic activity and inflation upon the cumulative increase in the *FFR*.

Table 14: Post-COVID-19 Peak (or Trough) Values

	Expenditures Over *GDP*
I/Y	18.88
I_{res}/Y	4.80
I_{nres}/Y	13.23
C_{dur}/Y	9.17
$(C_{ndur} + C_{srv})/Y$	60.00
$(C_{dur} + I)/Y$	27.70
	Inflation Measures
DPCE-HL	6.64
DCPI-HL	8.56
DPCE-C	5.30
DCPI-C	6.30
	Labor Market
U	3.40
DW	7.00
DW-DP	-2.00
DW-DP-BP(DA)	-2.80

Notes: Peak (or trough) levels in the post-COVID-19 recovery period. I/Y: Nominal gross private domestic investment over gross domestic product. I_{res}/Y: Nominal private residential fixed investment over gross domestic product. I_{nres}/Y: Nominal gross private nonresidential fixed investment over gross domestic product. C_{dur}/Y: Nominal personal consumption expenditures of durable goods over gross domestic product. $(C_{ndur}+C_{srv})/Y$: Nominal personal consumption expenditures of nondurable goods and services over gross domestic product. $(C_{dur}+I)/Y$: Nominal personal consumption expenditures of durable goods and nominal gross private domestic investment over gross domestic product. **DPCE-HL**: Headline inflation from the *PCE* deflator. **DCPI-HL**: Headline inflation from the *CPI*. **DPCE-C**: Core inflation from the *PCE* deflator. **DCPI-C**: Core inflation from the *CPI*. **U**: Unemployment rate. **DW**: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). **DW-DP**: Annual growth rate of *HCOMPBS* less *CPI*-core (excluding food and energy) inflation. **DW-DP-BP(DA)**: Annual growth rate of *HCOMPBS* less *CPI*-core inflation and filtered *TFP* growth. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Table 15 reports the average estimated percentage change of our economic variables to an increment of one percentage point in the *FFR*, *BP(GDP)*, *U*, and *DW*, respectively. These are estimated as averages over our MTCs. In the first panel we report *FFR* semi-elasticities for real investment, consumption, and *GDP*. Also, this panel reports the reduction in the ratio $(C_{dur} + I)/Y$, in the unemployment rate, inflation, and wage growth, after an increase of one percentage point in the *FFR*. As we work with filtered *GDP* data, the second panel tracks down similar changes for a one-percentage-point increase in *BP(GDP)*. While the third panel tracks down the effects of one-percentage-point increase in the unemployment rate on nominal wage growth and inflation, the last panel reports the effects of one percentage point increase in nominal wage growth on inflation. These estimates vary when considering all MTCs, the first three MTCs, or just the last MTC extending over the time period 2004-2009 so as to isolate the effects of the financial crisis of 2007-2009.

Table 15: Sensitivity of Key Economic Variables to the *FFR*, Filtered *GDP*, the Unemployment Rate, and Nominal Wage Growth

Time Sample	All MTCs	All MTCs Excluding 2004-2009	2004-2009
Panel I: Sensitivity to Changes in *FFR*			
$BP(I^r)$	-3.68	-2.78	-6.36
$BP(I^r_{res})$	-4.36	-4.39	-4.27
$BP(I^r_{nres})$	-2.60	-1.77	-5.11
$BP(C^r_{dur})$	-2.23	-1.91	-3.17
$BP(C^r_{dur} + I^r)$	-3.24	-2.57	-5.24
$BP(C^r_{ndur} + C^r_{srv})$	-0.35	-0.31	-0.47
$BP(GDP)$	-0.80	-0.70	-1.11
$(C_{dur} + I)/Y$	-0.92	-0.55	-2.01
U	0.67	0.46	1.30
DPCE-HL	-0.71	-0.55	-1.21
DCPI-HL	-0.99	-0.78	-1.62
DPCE-C	-0.48	-0.48	-0.45
DCPI-C	-0.66	-0.70	-0.51
DW	-0.78	-0.61	-1.28
DW-DP	-0.65	-0.52	-1.03
DW-DP-BP(DA)	-1.08	-0.86	-1.75
Panel II: Sensitivity to Changes in *BP(GDP)*			
U	-0.80	-0.68	-1.17
DPCE-HL	0.87	0.80	1.09
DCPI-HL	1.26	1.19	1.46
DPCE-C	0.65	0.73	0.41
DCPI-C	0.92	1.08	0.46
Panel III: Sensitivity to Changes in *U*			
DW	-1.25	-1.34	-0.98
DPCE-HL	-1.15	-1.23	-0.93
DCPI-HL	-1.63	-1.76	-1.24
DPCE-C	-0.89	-1.07	-0.35
DCPI-C	-1.28	-1.57	-0.39
Panel IV: Sensitivity to Changes in *DW*			
DPCE-HL	0.93	0.92	0.95
DCPI-HL	1.30	1.31	1.27
DPCE-C	0.69	0.80	0.36
DCPI-C	0.98	1.17	0.40

Notes: This table reports the response of our economic variables to one-percentage-point increase in *FFR*, *BP(GDP)*, *U*, and *DW*. **FFR**: Federal funds effective rate. **BP(GDP)**: Filtered real *GDP*. **U**: Unemployment rate. **DW**: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). $\boldsymbol{BP(I^r)}$: Filtered real gross private domestic investment. $\boldsymbol{BP(I^r_{res})}$: Filtered real private residential fixed investment. $\boldsymbol{BP(I^r_{nres})}$: Filtered real private nonresidential fixed investment. $\boldsymbol{BP(C^r_{dur})}$: Filtered real personal consumption expenditures of durable goods. $\boldsymbol{BP(C^r_{dur} + I^r)}$: Filtered sum of real personal consumption expenditures of durable goods and real gross private domestic investment. $\boldsymbol{BP(C^r_{ndur} + C^r_{srv})}$: Filtered sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. **U**: Unemployment rate. **DPCE-HL**: Headline inflation from the *PCE* deflator. **DCPI-HL**: Headline inflation from the *CPI*. **DPCE-C**: Core inflation from the *PCE* deflator. **DCPI-C**: Core inflation from the *CPI*. Filtering procedure: Band-pass filter isolating frequencies from 6 to 32 quarters. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Based upon these estimated coefficients for our economic variables over the propagation channels, Tables 16-18 report several scenarios for *FFR* hikes between 500 and 700 basis points. In Table 16 the reported figures are based on the average estimated coefficients over all MTCs, whereas in Table 17 the reported figures are based on the average estimated coefficients over the first three MTCs excluding the time period 2004-2009, and in Table 18 the reported figures are based on the estimated coefficients for the last MTC extending over the time period 2004-2009 so as to highlight the stronger negative effects during the financial crisis of 2007-2009.

Panel A in Tables 16-18 presents two estimates for $\Delta BP(GDP)$: an upper bound obtained from the direct response of *BP(GDP)* to the *FFR* hike as reported in Panel I in Table 15, and an indirect lower bound approximating *BP(GDP)* from changes in $BP(I_{res}^r)$, $BP(I_{nres}^r)$, $BP(C_{dur}^r)$, and $BP(C_{ndur}^r + C_{srv}^r)$. **Panel B in Tables 16-18** presents final values for all these variables over various scenarios for the *FFR* hike. In the case of $(C_{dur}^r + I^r)/GDP$, we report two values corresponding to the two estimated responses of *BP(GDP)* from Panel A, for a given direct response of $BP(C_{dur}^r)$ and $BP(I^r)$.

Finally, **Panel C in Tables 16-18** again considers the two upper and lower estimated changes for *BP(GDP)*, and reports estimated final values computed from the sensitivity of each variable as indicated in Panel II of Table 15.

Table 16: Percent Change of Key Economic Variables under Various *FFR* Scenarios. Estimated Changes Based upon All MTCs

Scenario	$\Delta FFR = 5.00$	$\Delta FFR = 5.50$	$\Delta FFR = 6.00$	$\Delta FFR = 6.50$	$\Delta FFR = 7.00$
Panel A: Change from Peak Values, Responses to *FFR* Changes					
$\Delta BP(I^r_{res})$	-21.80	-23.99	-26.17	-28.35	-30.53
$\Delta BP(I^r_{nres})$	-13.02	-14.32	-15.63	-14.32	-18.23
$\Delta BP(C^r_{dur})$	-11.14	-12.26	-13.37	-16.93	-15.60
$\Delta BP(C^r_{ndur} + C^r_{srv})$	-1.77	-1.94	-2.12	-2.30	-2.47
$\Delta BP(GDP)$	(-4.85,-4.00)	(-5.34,-4.40)	(-5.82,-4.80)	(-6.31,-5.20)	(-6.79,-5.60)
Panel B: Final Values, Responses to *FFR* Changes					
$(C^r_{dur} + I^r)/GDP$	(24.19, 24.40)	(23.82, 24.05)	(23.45, 23.70)	(23.07, 23.35)	(22.70, 22.99)
$(C_{dur} + I)/Y$	23.10	22.64	22.18	21.72	21.26
U	6.74	7.08	7.41	7.74	8.08
DW	3.12	2.74	2.35	1.96	1.57
$DPCE$-HL	3.08	2.72	2.36	2.01	1.65
$DCPI$-HL	3.61	3.12	2.62	2.13	1.64
$DPCE$-C	2.92	2.69	2.45	2.21	1.97
$DCPI$-C	3.02	2.69	2.36	2.04	1.71
Panel C: Final Values, Responses to *BP(GDP)* Changes					
U	(6.60, 7.28)	(6.92, 7.67)	(7.24, 8.06)	(7.56, 8.44)	(7.88, 8.83)
DW	(2.30, 3.12)	(1.83, 2.74)	(1.36, 2.35)	(0.89, 1.96)	(0.42, 1.57)
$DPCE$-HL	(2.40, 3.15)	(1.98, 2.80)	(1.56, 2.45)	(1.13, 2.10)	(0.71, 1.75)
$DCPI$-HL	(2.46, 3.53)	(1.85, 3.03)	(1.24, 2.53)	(0.63, 2.02)	(0.02, 1.52)
$DPCE$-C	(2.15, 2.70)	(1.83, 2.44)	(1.51, 2.18)	(1.20, 1.92)	(0.88, 1.66)
$DCPI$-C	(1.82, 2.61)	(1.37, 2.24)	(0.92, 1.87)	(0.48, 1.50)	(0.03, 1.13)

Notes: In **Panel A** we report estimated percentage changes from peak to trough (or trough to peak). In **Panels B and C** we report estimated percentage final values. $\Delta BP(I^r_{res})$: Change in filtered real private residential fixed investment. $\Delta BP(I^r_{nres})$: Change in filtered real private nonresidential fixed investment. $\Delta BP(C^r_{dur})$: Change in filtered real personal consumption expenditures of durable goods. $\Delta BP(C^r_{ndur} + C^r_{srv})$: Change in the filtered sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. $\Delta BP(GDP)$: Change in filtered real GDP. $(C^r_{dur} + I^r)/GDP$: Sum of real personal consumption expenditures of durable goods and gross private domestic investment as percentage of real gross domestic product. $(C^r_{dur} + I^r)/GDP$: Sum of nominal personal consumption expenditures of durable goods and gross private domestic investment as percentage of nominal gross domestic product. U: Unemployment rate. DW: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). $DPCE$-HL: Headline inflation from the *PCE* deflator. $DCPI$-HL: Headline inflation from the *CPI*. $DPCE$-C: Core inflation from the *PCE* deflator. $DCPI$-C: Core inflation from the *CPI*. FFR: Federal funds effective rate. For further definitions and data sources see Section F below.

Table 17: Percent Change of Key Economic Variables under Various *FFR* Scenarios. Estimated Changes Based upon All MTCs Excluding the Sample Period 2004-2009

Scenario	$\Delta FFR = 5.00$	$\Delta FFR = 5.50$	$\Delta FFR = 6.00$	$\Delta FFR = 6.50$	$\Delta FFR = 7.00$
Panel A: Change from Peak Values, Responses to *FFR* Changes					
$\Delta BP(I_{res}^r)$	-21.96	-24.15	-26.35	-28.55	-30.74
$\Delta BP(I_{nres}^r)$	-8.84	-9.72	-10.61	-11.49	-12.38
$\Delta BP(C_{dur}^r)$	-9.57	-10.53	-11.49	-12.44	-13.40
$\Delta BP(C_{ndur}^r + C_{srv}^r)$	-1.57	-1.72	-1.88	-2.04	-2.19
$\Delta BP(GDP)$	(-4.04,-3.49)	(-4.44,-3.85)	(-4.85,-4.19)	(-5.25,-4.54)	(-5.66,-4.89)
Panel B: Final Values, Responses to *FFR* Changes					
$(C_{dur}^r + I^r)/GDP$	(25.08, 25.22)	(24.81, 24.96)	(24.53, 24.70)	(24.26,44)	(23.98, 24.17)
$(C_{dur} + I)/Y$	24.92	24.65	24.37	24.09	23.81
U	5.69	5.92	6.15	6.38	6.61
DW	3.96	3.65	3.35	3.04	2.74
$DPCE$-HL	3.90	3.63	3.35	3.08	2.81
$DCPI$-HL	4.66	4.27	3.88	3.49	3.10
$DPCE$-C	2.89	2.65	2.41	2.17	1.93
$DCPI$-C	2.78	2.43	2.07	1.72	1.37
Panel C: Final Values, Responses to *BP(GDP)* Changes					
U	(5.76, 6.13)	(5.99, 6.40)	(6.23, 6.68)	(6.47, 6.95)	(6.70, 7.22)
DW	(3.33, 3.83)	(2.97, 3.52)	(2.60, 3.20)	(2.23, 2.88)	(1.87, 2.57)
$DPCE$-HL	(3.40, 3.85)	(3.08, 3.57)	(2.76, 3.29)	(2.43, 3.01)	(2.11, 2.73)
$DCPI$-HL	(3.76, 4.41)	(3.28, 4.00)	(2.80, 3.58)	(2.32, 3.17)	(1.84, 2.75)
$DPCE$-C	(2.35, 2.76)	(2.06, 2.50)	(1.76, 2.25)	(1.47, 1.99)	(1.18, 1.74)
$DCPI$-C	(1.95, 2.54)	(1.51, 2.17)	(1.08, 1.79)	(0.64, 1.41)	(0.21, 1.04)

Notes: In **Panel A** we report estimated percentage changes from peak to trough (or trough to peak). In **Panels B and C** we report estimated percentage final values. $\Delta BP(I_{res}^r)$: Change in filtered real private residential fixed investment. $\Delta BP(I_{nres}^r)$: Change in filtered real private nonresidential fixed investment. $\Delta BP(C_{dur}^r)$: Change in filtered real personal consumption expenditures of durable goods. $\Delta BP(C_{ndur}^r + C_{srv}^r)$: Change in the filtered sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. $\Delta BP(GDP)$: Change in filtered real GDP. $(C_{dur}^r + I^r)/GDP$: Sum of real personal consumption expenditures of durable goods and gross private domestic investment as percentage of real gross domestic product. $(C_{dur}^r + I^r)/GDP$: Sum of nominal personal consumption expenditures of durable goods and gross private domestic investment as percentage of nominal gross domestic product. U: Unemployment rate. DW: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). **DPCE-HL**: Headline inflation from the *PCE* deflator. **DCPI-HL**: Headline inflation from the *CPI*. **DPCE-C**: Core inflation from the *PCE* deflator. **DCPI-C**: Core inflation from the *CPI*. **FFR**: Federal funds effective rate. For further definitions and data sources see Section F below.

Table 18: Percent Change of Key Economic Variables under Various FFR Scenarios. Estimated Changes Based upon the Sample Period 2004-2009

Variable	$\Delta FFR = 5.00$	$\Delta FFR = 5.50$	$\Delta FFR = 6.00$	$\Delta FFR = 6.50$	$\Delta FFR = 7.00$
Panel A: Change from Peak Values, Responses to FFR Changes					
$\Delta BP(I_{res}^r)$	-21.34	-23.48	-25.61	-27.75	-29.88
$\Delta BP(I_{nres}^r)$	-25.57	-28.12	-30.68	-33.24	-35.79
$\Delta BP(C_{dur}^r)$	-15.85	-17.43	-19.02	-20.60	-22.19
$\Delta BP(C_{ndur}^r + C_{srv}^r)$	-2.37	-2.61	-2.84	-1.85	-3.32
$\Delta BP(GDP)$	(-7.28,-5.53)	(-8.01,-6.08)	(-8.74,-6.64)	(-9.47,-7.19)	(-10.20,-7.74)
Panel B: Final Values, Responses to FFR Changes					
$(C_{dur}^r + I^r)/GDP$	(21.45, 21.85)	(20.78, 21.22)	(20.11, 20.57)	(19.43, 19.92)	(18.74, 19.25)
$(C_{dur} + I)/Y$	17.63	16.62	15.62	14.61	13.60
U	9.89	10.53	11.18	11.83	12.48
DW	0.62	-0.02	-0.66	-1.29	-1.93
PCE-HL	0.60	0.00	-0.61	-1.21	-1.81
CPI-HL	0.47	-0.34	-1.15	-1.96	-2.77
PCE-C	3.01	2.78	2.55	2.33	2.10
CPI-C	3.74	3.49	3.23	2.97	2.72
Panel C: Final Values, Responses to $BP(GDP)$ Changes					
U	(9.89, 11.94)	(10.53, 12.79)	(11.18, 13.65)	(11.83, 14.50)	(12.48, 15.36)
DW	(-1.40, 0.62)	(-2.24, -0.02)	(-3.08, -0.66)	(-3.92, -1.29)	(-4.76, -1.93)
PCE-HL	(-1.31, 0.60)	(-2.11, 0.00)	(-2.90, -0.61)	(-3.70, -1.21)	(-4.49, -1.81)
CPI-HL	(-2.09, 0.47)	(-3.16, -0.34)	(-4.22, -1.15)	(-5.29, -1.96)	(-6.35, -2.77)
PCE-C	(2.29, 3.01)	(1.99, 2.78)	(1.69, 2.55)	(1.38, 2.33)	(1.08, 2.10)
CPI-C	(2.93, 3.74)	(2.59, 3.49)	(2.26, 3.23)	(1.92, 2.97)	(1.58, 2.72)

Notes: In **Panel A** we report estimated percentage changes from peak to trough (or trough to peak). In **Panels B and C** we report estimated percentage final values. $\boldsymbol{\Delta BP(I_{res}^r)}$: Change in filtered real private residential fixed investment. $\boldsymbol{\Delta BP(I_{nres}^r)}$: Change in filtered real private nonresidential fixed investment. $\boldsymbol{\Delta BP(C_{dur}^r)}$: Change in filtered real personal consumption expenditures of durable goods. $\boldsymbol{\Delta BP(C_{ndur}^r + C_{srv}^r)}$: Change in the filtered sum of real personal consumption expenditures of non-durable goods and real personal consumption expenditures of services. $\boldsymbol{\Delta BP(GDP)}$: Change in filtered real GDP. $\boldsymbol{(C_{dur}^r + I^r)/GDP}$: Sum of real personal consumption expenditures of durable goods and gross private domestic investment as percentage of real gross domestic product. $\boldsymbol{(C_{dur}^r + I^r)/GDP}$: Sum of nominal personal consumption expenditures of durable goods and gross private domestic investment as percentage of nominal gross domestic product. $\boldsymbol{U}$: Unemployment rate. $\boldsymbol{DW}$: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS). $\boldsymbol{DPCE}$-$\boldsymbol{HL}$: Headline inflation from the PCE deflator. $\boldsymbol{DCPI}$-$\boldsymbol{HL}$: Headline inflation from the CPI. $\boldsymbol{DPCE}$-$\boldsymbol{C}$: Core inflation from the PCE deflator. $\boldsymbol{DCPI}$-$\boldsymbol{C}$: Core inflation from the CPI. $\boldsymbol{FFR}$: Federal funds effective rate. For further definitions and data sources see Section F below.

Bounds for Systematic Increases in the FFR. The *lower bound* refers to the necessary cumulative increase of *FFR* to bring down the various inflation measures close to the two-percent inflation target. The *upper bound* is based on acceptable investment levels to preserve low financial risk, and avoid sharper contractions in output and employment derived from a possible financial meltdown.

(i) *Lower bound:* From Table 16, we get that a cumulative hike of *at least* 700 basis points for the *FFR* is necessary to bring down headline inflation indexes closer to the two-percent mark (see the values highlighted in yellow). As we leave out the financial crisis of 2007-2009 from our estimations, Table 17 shows, however, that even 700 basis points may be a conservative move to get these headline inflation targets close to the 2-percent mark (see the values highlighted in yellow). Finally, Table 18 shows that in a financial meltdown as experienced in 2007-2009, the contraction of our filtered measure of real *GDP* may be over 10 percentage points while the unemployment rate may jump over 12 percent (see the values highlighted in yellow).

(ii) *Upper bound:* From our study of the four selected MTCs, it seems reasonable to let the ratio $(C_{dur} + I)/Y$ stay above 0.23 so as to avert a financial crisis. As highlighted in green in Table 16, a cumulative *FFR* increase around 500-550 basis points would bring the ratio $(C_{dur} + I)/Y$ close to 0.23. Then, total contraction for our filtered measure of output would be about 5 percentage points, while unemployment may jump to 7 percent. Inflation would near 3 percent while nominal wage growth would be approaching 2.7 percent. Leaving out the financial crisis of 2007-2009, Table 17 shows that the ratio $(C_{dur} + I)/Y$ would remain over 0.24, our filtered measure of output would contract about 4 percentage points, unemployment may jump to 6 percent, and inflation would be over 3 percent (see the values highlighted in green).

Dynamic Response. Figures 9–10 illustrate the dynamic response of inflation, unemployment, and real *GDP* to a *FFR* hike of 550 basis points. These projections are based on the data available up until the first quarter of 2023, *FFR* semi-elasticities from Table 9, and the projected values of 5.25 and 5.5 for the *FFR* in the second and third quarters of 2023 respectively. For each variable x, projections in Figure 9 are computed from

$$x_{t_0+r} = x_{t_0} + \rho_x FFR_{t_0-s_x+r}, \tag{1}$$

where t_0=2023-Q1 is the last available observation, r denotes the forecasting horizon, s_x is the lag in the response of variable x to a monetary shock, and ρ_x is the *FFR* semi-elasticity

of variable x. Both s_x and ρ_x are based on our first three MTCs. The values for s_x are taken from Panel C in Table 8, and the ones for ρ_x are taken from Table 15.

Figure 9 shows a projected path for the unemployment rate that is expected to start rising in 2023-Q4, and *DPCE-C* projected inflation rates over 3 percent until 2025-Q3. Note that projected final values for *DPCE-C* diverge from the ones reported in Table 17 because projections in Figure 9 start from the last available observation, 2023-Q1, instead of the peak (or trough) values considered in Tables 16-18.

Figure 10 exhibits projections for the level of real *GDP* normalized to be 100 in 2023-Q1, and the deterministic exponential trend of *GDP* starting in 2023-Q1. Assuming a lagged response of *BP(GDP)* to *FFR* hikes of 5 quarters, the current MTC is expected to start impacting *BP(GDP)* by 2023-Q3. Projections are obtained by first forecasting filtered deviations of *GDP* from its deterministic exponential trend, and then incorporating the trend. Hence, we first forecast future values for *BP(GDP)* following the procedure described in Equation 1, and then projections for $t > t_0$ are obtained from

$$GDP_t = exp\left\{BP(GDP)_t - BP(GDP)_{t-1}\right\} GDP_{t-1}(1 + g_T)^{1/4},$$

where $g_T = 3$ percent is the annual trend growth rate for *GDP*. We observe that the expected average annualized growth rate of *GDP* is 0.83 percent from 2023-Q1 to 2024-Q4. This low average growth rate is compatible with negative *GDP* growth rates of -0.94 and -1.06 percent in 2023-Q4 and 2024-Q1 respectively. We also get a cumulative log deviation from trend of -3.85 percent. Again, this latter figure is different from our measure of output contraction $\Delta BP(GDP)$ reported in Table 17 because Figure 10 considers a different starting date for computing the cumulative deviation from trend.

Figure 9: Expected Evolution of Inflation and Unemployment for a *FFR* Hike of 550 Basis Points
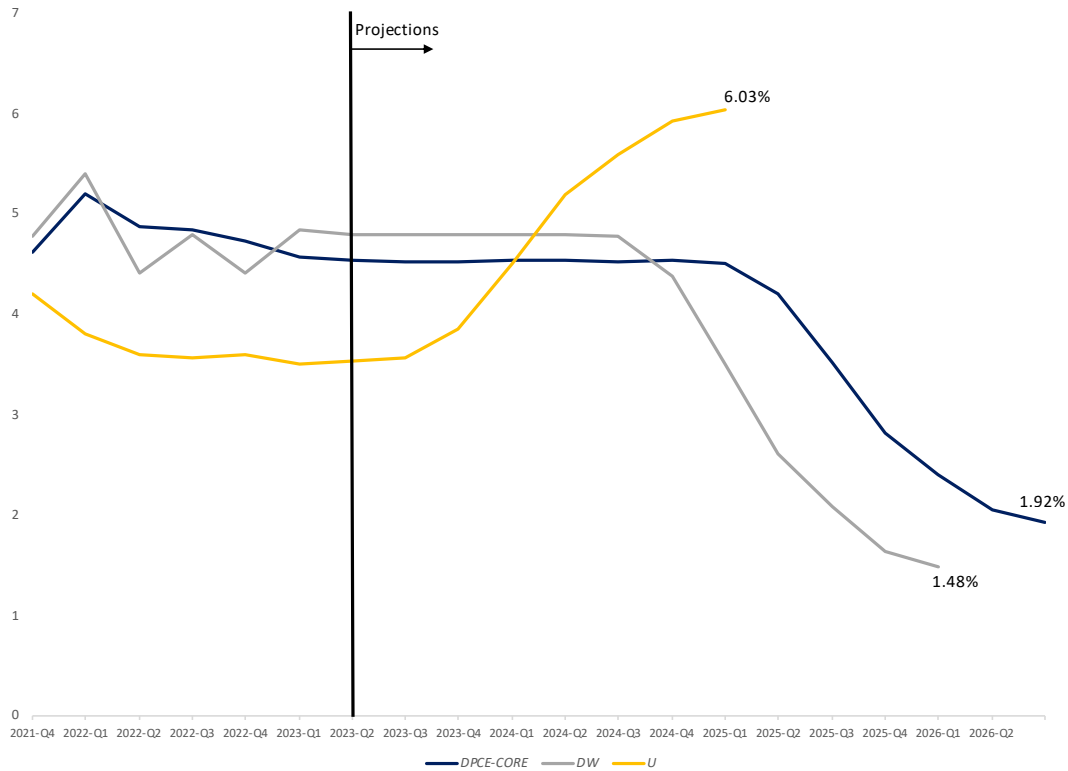
Notes: This figure depicts the observed evolution of *DPCE-C*, *DW*, and *U*, until 2023-Q1, and projections afterwards. **DPCE-C** is annual core inflation from the *PCE* deflator, **DW** is annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS), and **U** is the unemployment rate. Projections are based on responses shown in Table 15 for our first three MTCs. All variables are measured in percentage points. All variables are measured in percentage points. Quarterly data. For further definitions and data sources see Section F below.

Figure 10: Expected Evolution of Real *GDP* for a *FFR* Hike of 550 Basis Points
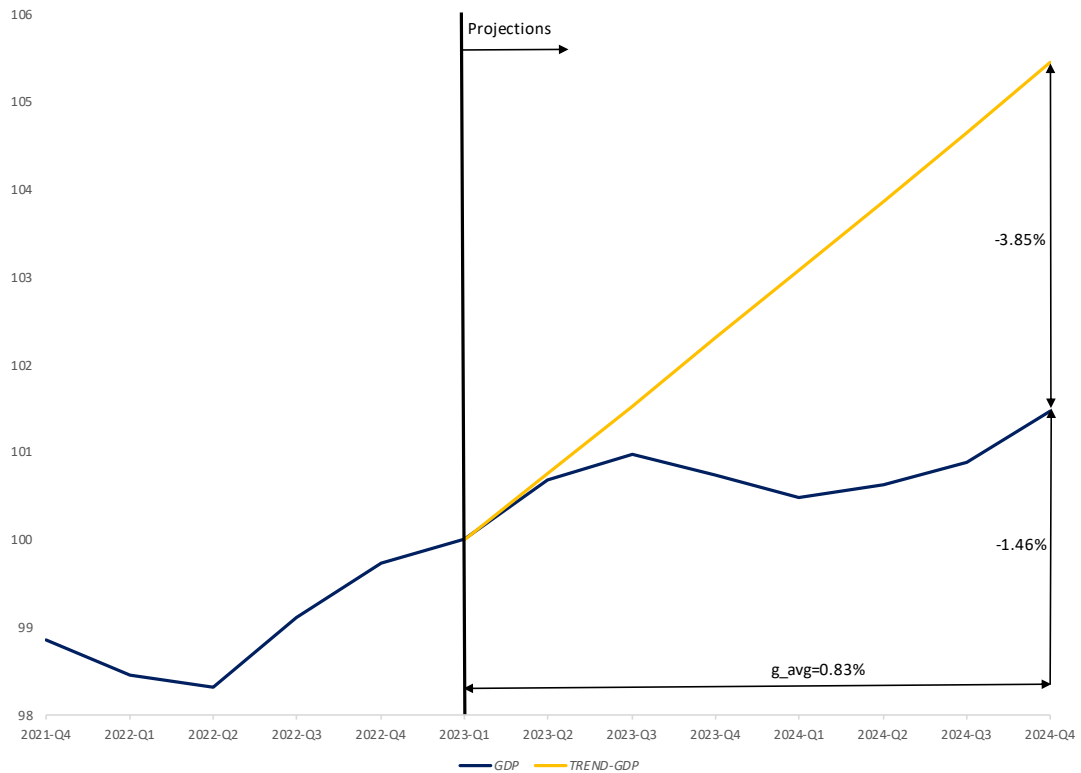
Notes: This figure depicts the observed evolution of the real gross domestic product until 2023-Q1, and projections afterwards. Projections are based on responses shown in Table 15 for our first three MTCs. The trend line starts in 2023-Q1. All variables are measured in percentage points. Index values normalized to 100 in 2023-Q1. Quarterly data. For further definitions and data sources see Section F below.

F   Data Sources

With the exception of Figure 2 in the paper, we consider quarterly data. Our filtered variables [except for *HP(GDP)*] are computed with a band-pass filter isolating frequencies from 6 to 32 quarters. Filtered components of *GDP* and productivity measures are computed by applying the filter to the linearly detrended natural log of each variable. The cyclical component is then multiplied by 100. Hence, these filtered variables represent percentage deviations from their deterministic exponential trends. Also, the change of these filtered variables over a given period of time represent cumulative percentage deviations from trend since the initial date.

F.1   Components of GDP

From the U.S. Bureau of Economic Analysis:

Y: Nominal gross domestic product.

GDP: Real gross domestic product.

I: Nominal gross private domestic investment.

I^r: Real gross private domestic investment.

I^r_{res}: Real private residential fixed investment.

I^r_{nres} Real gross private nonresidential fixed investment.

C_{dur}: Nominal personal consumption expenditures of durable goods.

C_{ndur}: Nominal personal consumption expenditures of nondurable goods.

C_{srv}: Nominal personal consumption expenditures of services.

C^r_{dur}: Real personal consumption expenditures of durable goods.

C^r_{ndur}: Real personal consumption expenditures of nondurable goods.

C^r_{srv}: Real personal consumption expenditures of services.

G: Nominal government consumption and investment expenditures.

NX: Nominal net exports of goods and services.

F.2   Productivity

From John Fernald's web page:

A: Total Factor Productivity (*TFP*).

$A\text{-}UT$: Utilization-adjusted total factor productivity.

F.3   Prices

From the U.S. Bureau of Labor Statistics:

DCPI-HL: Annual *CPI*-headline inflation.

DCPI-C and DP: Annual *CPI*-core inflation (excluding food and energy).

DCPI-ENERGY: Energy inflation from the *CPI*.

DCPI-FOOD: Food inflation from the *CPI*.

DCPI-SHELTER: Shelter inflation from the *CPI*.

DCPI-SERVICES: Services inflation from the *CPI*.

DCPI-SER-LS: Services less rent of shelter inflation from the *CPI*.

DCPI-SER-LEN: Services less energy services inflation from the *CPI*.

DCPI-DURCOM: Durable commodities inflation from the *CPI*.

DCPI-COM-LFE: Commodities less food and energy commodities inflation from the *CPI*.

From the U.S. Bureau of Economic Analysis:

DPCE-HL: Annual headline inflation from the *PCE* deflator.

DPCE-C: Annual core inflation from the *PCE* deflator.

F.4   Labor Market

NU: Noncyclical rate of unemployment. *Source*: U.S. Congressional Budget Office, retrieved from FRED.

DATL: Annual growth rate of the Atlanta Fed's wage growth tracker, unweighted overall. *Source*: Federal Reserve Bank of Atlanta.

From the U.S. Bureau of Labor Statistics:

U: Unemployment rate.

DAHE-PNS: Annual growth rate of average hourly earnings of production and nonsupervisory employees.

DECI: Annual growth rate of the total compensation for private industry workers in all industries and occupations, employment cost index.

DW: Annual growth rate of hourly compensation for all employed persons in the business sector (HCOMPBS).

DULC: Annual growth rate of the unit labor costs for all workers, business sector.

F.5 Financial Variables

FFR: Federal funds effective rate. *Source*: Board of Governors of the Federal Reserve System, retrieved from FRED.

DEF: Federal fiscal deficit. *Source*: U.S. Bureau of Economic Analysis.

CS: Moody's seasoned *Baa* corporate bond yield relative to yield on 10-Year Treasury constant maturity. *Source*: Federal Reserve Bank of St. Louis.

NFCI: Chicago Fed's national financial conditions index. *Source*: Federal Reserve Bank of Chicago.

TS: 10-year Treasury constant maturity minus *FFR*. *Source*: Federal Reserve Bank of St. Louis.

GB10: Market yield on U.S. Treasury securities at 10-year constant maturity. *Source*: Board of Governors of the Federal Reserve System.

BCR: Bank credit for all commercial banks. *Source*: Board of Governors of the Federal Reserve System.

M2: Money stock *M2*. *Source*: Board of Governors of the Federal Reserve System.

DCASE-SHILLER: Growth rate of the S&P/Case-Shiller U.S. National Home Price Index. *Source*: *S&P* Dow Jones Indices LLC, retrieved from FRED.

DS&P500: Growth rate of the *S&P500* stock price index. *Source*: *S&P* Dow Jones Indices LLC, retrieved from FRED.

DNASDAQ: Growth rate of the *NASDAQ* composite stock price index. *Source*: NASDAQ OMX Group, retrieved from FRED.

DPROFITS: Growth rate of corporate profits before taxes. *Source*: U.S. Bureau of Economic Analysis.

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