Department of Economics
Working Paper Series

2022/001

The Great Recession vs. the Great Inflation: A Markov-switching Approach to Understanding the Determinants of Fed Policy

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September 2022
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September 5, 2022

ABSTRACT

We analyze the determinants of the Federal Reserve’s monetary policy decisions since the 1960s justified by potentially evolving beliefs—through a real-time learning process—about the structure of the economy and Markov-switching shifts in policymakers’ preferences between dove and hawk regimes. We argue that although central bank learning played an important role in the determination of Fed policy there were several shifts in policy makers’ preferences in the post-war period. We find a dovish kind of monetary policy regime present in the 1970s and early 2000s, and before the onset of the Great Recession.

Keywords: Great Inflation; Policy Preferences; Policymakers’ Beliefs; Constant Gain Learning; Markov-switching DSGE Models

JEL Classifications: C11; D83; E31; E50; E52; E58; E32; E44

*We would like to thank seminar participants at the 2022 NBER-NSF SBIES Conference, the 2022 WEAI Annual Conference, the Korea Macroeconomics Research Group, Korea University, Sogang University, Sungkyunkwan University and Siddhartha Chib, Sylverie Herbert, Jinill Kim, and Wade Martin for helpful comments.

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1 INTRODUCTION

The Federal Reserve (Fed) has conducted monetary policy in an attempt to achieve its dual mandate of fostering economic conditions to achieve stable prices and maximum sustainable employment. Even though this mandate has not changed, there is evidence that monetary policy responses to prices and output, as well as policy objectives have. The most widely used approach is to model Fed’s behavior in a reduced form setting using Taylor Rules as the expression of the evolution of monetary policy. In fact, Ang et al. (2011), Boivin (2006) and Kim and Nelson (2006) have encountered time-variation in the reaction function of the Fed. One potential drawback of previous studies focusing on Taylor rules is that it is not possible to distinguish between changes in policymakers preferences, and other factors affecting policymaker behavior such as changes in understanding of the central bank model. Those studies attributed to “good policy” something that may or may not be related to central bank’s preferences.

One strategy followed in the literature that permits to focus only on the objectives of the Fed’s policy is to structurally model its preferences by using a simple model of optimizing central bank behavior. Typically, in this setting, authors have recorded one shift in monetary policy objectives with the appointment of Paul Volcker as chairman of the Federal Reserve [Dennis (2006), Favero and Rovelli (2003), Ozlale (2003), Salemi (2006), Ilbas (2012), Givens (2012), and Best (2016)]. However, it is entirely possible that this preferences parameters observe parameter instability during more than one date. In fact, Meltzer (2006) and Romer and Romer (1989) have documented several shifts in policy objectives in the period of study.

As a response to this concern, Lakdawala (2016) using a backward looking model of the economy estimates a series of time-varying preference parameters for the Fed, and concludes that there have been numerous preference changes in the post-war period. In a complementary approach, Debortoli and Nunes (2014) analyze regime switches in policy preferences between dovish and hawkish regimes. They find that the possibility of a dovish regime appearing in the future increases inflation expectations and intensifies the response to inflation during the hawkish regime. Moreover, a potential drawback of this entire literature is that the structural parameters of the economy’s model are fixed, potentially biasing the estimates of the central bank preference. This literature assigns too much weight to the evolving central bank objectives neglecting the role played by the policymakers’ understanding about the structure of the economy on monetary policy behavior.\footnote{Owyang and Ramey (2004) modeled Fed preferences using a Markov-switching process.}

On the other side of the spectrum, monetary policy evolution has been attributed entirely to policymakers learning about the behavior of the economy in real time. In that light, stabilization policy is set optimally, conditional on current beliefs as in Primiceri (2006) and Lubik and Matthes (2016) among others. This literature attributes the Great inflation to misperceptions about the standard features of the U.S. economy [Romer and Romer (2002), Hartnett et al. (2006), and
Carboni and Ellison (2009)]), and typically assumes stable policymaker’s preferences in the post-war period— with the exception of Best and Hur (2019) that allowed for a break at the date of the appointment of Chairman Volcker. As a result, the time-variation of policy coefficients during the whole sample, or in the pre- and post-Volcker period, is explained exclusively by the central bank’s learning process. One alternative would be to allow for time variation in both: central bank preferences and understanding of the model of the economy, thus showing to what extent are changes in central bank behavior due to each. More generally, the present specification is consistent with the currently well-established finding that the Federal Reserve experienced several regime switches in the past decades, both before and after 1980s [see e.g. Bianchi (2013)]. A specification that ignores those recurrent monetary switches may attribute too much importance to the learning mechanism.

The purpose of this paper to fill the gap in the extant literature and disentangle the role that Fed’s learning about the structure of the economy vs. shifts in policymakers’ preferences played in the evolution of U.S. policy in the post-war period. In that sense we are interested in uncovering the time-varying sources of variation in monetary policy. We estimate a model that includes central bank learning á la Primiceri (2006) and a Markov-switching process between dove and hawk regimes for the preference parameter in the optimal policy function.

It has been hypothesized that monetary policy conducted by the Fed, played a key role in the Great Inflation (1965–1982) and the Great Recession (2007–2009). This has been well documented for the Great Inflation episode [Primiceri (2006), Lubik and Matthes (2016)], while the research on the latter episode is in an incipient stage. In particular, it has been found that the Fed kept interest rates unreasonably low for a prolonged period, called in the literature “bad policy.” It is possible that bad policy fueled both, the rise in inflation during the 1960s and 1970s, and the speculative lending bubble that led to the expansion in U.S. housing construction, home prices, and house credit in the 2000s—see Taylor (2014)—that ultimately caused the Great Recession. In this project, we plan to study the parallels that led to both important economic events in U.S. economic history, specifically, unraveling the role played by monetary policy in the eventual debacle of the economy.

An important reason why these periods are controversial and at the same time difficult to study is that “bad policy” caused by unreasonably low interest rates, leads to an economy subject to indeterminacy or a multiplicity of shocks hitting economic activity concurrently that could amplify recessions [see Bullard and Mitra (2002)]. Good monetary policy has the potential of stabilizing the economy during a crisis, by contrast, bad monetary policy induces multiple equilibria. The private sector may be incapable of coordinating on a specific equilibrium; even when capable of such coordination, it may be undesirable causing a depressed economy. Although this result has been continuously found in the literature, and certain features of the conduction of monetary policy could cause it, estimations of models with “bad policy” are technically challenging. Papers like
Lubik and Schorfheide (2004) and Farmer et al. (2015) have proposed methods that accommodate indeterminacy, however, those are complicated and not implementable with standard packages. We apply the new methodology proposed in Bianchi and Nicolò (2021) to estimate a model that accounts for a possibly “bad policy” and potential for indeterminacy.

In addition, the model embeds a broad spectrum of causes of the Great Inflation such as instability in financial markets, slowdown of productivity, and fiscal policy mistakes, to the conditions that led to the Great Recession. We are able to capture these changes because we incorporate the possibility of heteroskedastic non-policy shock hitting the U.S. economy that follow a Markov switching process. We specifically try to disentangle the sources that led to the latter by making a thorough examination in a medium-scale dynamic stochastic general equilibrium (DSGE) model.

We find that indeed, learning about the structure of the economy, a permanent dovish regime presents during the 1970s and higher volatility of the shocks contributed to the Great Inflation. Consequently, the switch to a hawkish regime with the appointment of chairman Volcker to the Federal Reserve, led to a period of economic and financial stability that made the financial system the main contributor to the business cycle. However, in 1987, and the early and late 2000s we observe further switches to dovish regimes. In the two latter episodes, the Fed appeared timid, not willing to offset adverse shocks that hit the economy, and left the economy vulnerable to monetary, fiscal and technology shocks. The timid behavior of the Fed during the early 2000s [Romer (2022)], fueled the speculative lending maelstrom that caused the Great Recession.

2 The Private Sector

In order to draw a parallel between previous models that consider potential regime switches in monetary policy and shocks evolving over time according to a Markov-switching (MS) process, we estimated a model closer to Bianchi (2013). Moreover, it includes two types of investment shocks akin to Justiniano et al. (2011, JPT hereafter) as in Best and Hur (2019). It is essential to keep this two investment shock structure because one of the shocks, the marginal efficiency of investment (MEI) shock, has been found to be a key driver of business cycle fluctuations and the functioning of the financial sector. It explains how savings are transformed into future capital input, specifically how installed capital is produced from investment goods. In the present regime switching structure, we investigate how its contribution to the variables fluctuates overtime and through monetary regimes. The second investment shock considered, is an investment-specific technology shock that explains how consumption goods are transformed into investment goods.

The additional consideration of the present paper is that the central bank has time-varying beliefs about the structure of the economy as well as monetary policy preferences subject to potential MS switches between dove and hawk regimes. This is a medium scale DSGE model that has been proven to fit the data well and has been reproduced here for convenience.\textsuperscript{2}

\textsuperscript{2}As in Bianchi (2013) we abstract from the household’s labor supply decisions, which are similar to those of Erceg...
Consumption, investment and capital goods are decentralized into separate sectors. A chain of intermediate and final good producers makes the final consumption good using the following technology

\[ Y_t = \left[ \int_0^1 Y_t(i)^{1+\lambda_{p,t}} di \right]^{1+\lambda_{p,t}} \]  

(1)

where \( \lambda_{p,t} \) is the desired markup of price over marginal cost for intermediate goods firms.

The final good is purchased at a unit price \( P_t \) and is used for consumption by households and as an input in production for the investment good by firms. Profit maximization and the zero profit condition leads to the following demand function for intermediate good \( i \):

\[ Y_t(i) = \left( \frac{P_t(i)}{P_t} \right)^{-\frac{1+\lambda_{p,t}}{\lambda_{p,t}}} Y_t. \]  

(2)

The price \( P_t \) is a CES aggregate of the prices of the intermediate goods \( P_t(i) \).

Each intermediate good \( Y_t(i) \) is produced by a monopolist using the following production function:

\[ Y_t(i) = \max \{ A_t^{1-\alpha} K_t(i)^{\alpha} L_t(i)^{1-\alpha} - A_t \gamma_t^{1-\alpha} F; 0 \} \]

(3)

where \( F \) is a fixed cost, \( K_t(i) \) and \( L_t(i) \) are the services of capital and labor employed by firm \( i \), while \( A_t \) is an exogenous labor-augmenting technological process or a neutral technology factor with a growth rate \( z_t \equiv \Delta \log A_t \) which follows a stationary AR(1) process:

\[ z_t = z_{t-1}/\bar{z} + \sigma_z \xi_Q^t \epsilon_{z,t}, \quad \epsilon_{z,t} \sim N(0,1), \]

where \( \xi_Q^t \) is an unobservable state variable which governs the volatility regime at time \( t \), and \( \bar{z} \) is the steady-state technology growth. The variable \( \gamma_t \) is the investment-specific technological progress with properties that would be outlined below.

Every period a fraction \( 1 - \xi_p \) of intermediate firms can optimize their price à la Calvo (1983). The remaining firms reset their prices according to the indexation rule as follows:

\[ P_t(i) = P_{t-1}(i) \pi_{t-1}^{\tau_p} \pi^{1-\tau_p}, \]

where \( \pi_t \) is gross inflation and \( \pi \) is its steady state. \( \tau_p \) denotes the degree of price indexation. The fraction of firms that choose their price \( \hat{P}_t(i) \) optimize the present discounted value of future profits subject to the demand function (2) and production function (3).

et al. (2000). They are monopolistic suppliers of specialized labor with wage setting behavior that evolves à la Calvo (1983). For details on the derivation of the model and the system of log-linearized equations refer to Bianchi (2013) and Justiniano et al. (2011) technical appendix. This model private sector model presented here is the same as in Best and Hur (2019).
2.1 Investment Good Producing Sector  As previously noted, perfectly competitive firms purchase $Y'_t$ of the final good to transform it into the investment good in $I_t$ units which are sold at a unit price $P_I t$ to the producers of capital. They maximize the profit function: $P_I t I_t - P_Y Y'_t$, subject to the following production technology given by $I_t = \gamma_t Y'_t$. The investment-specific technological (IST) progress $\gamma_t$, the slope of the production technology, increases with the quantity and quality of investment goods that can be produced with given inputs. The growth rate of the IST progress, defined by $\nu_t = \Delta \log \gamma_t$, evolves according to the following process

$$
\nu_t = \nu_t(\nu_{t-1}/\nu) \exp \left[ \sigma_{\nu}(\xi^Q_t) e_{\nu,t} \right], \quad e_{\nu,t} \sim N(0, 1),
$$

where $\nu$ is the steady-state level of the IST progress growth.

2.2 Capital Good Producing Sector  Perfectly competitive firms buy investment goods and convert them to installed capital which is then sold to households. The installed capital, $I_I t$ is produced using the following technology: $I_I t = \mu_t \left(1 - S(I_I t / I_I t-1)\right)I_I t$, where the function $S$ represents adjustment costs to investment and $\mu_t$ is the shock to the MEI or the disturbance to the process that transform investment goods into installed capital. The shock $\mu_t$ evolves according to the following process

$$
\mu_t = \mu_t(\mu_{t-1}/\mu) \exp \left[ \sigma_{\mu}(\xi^Q_t) e_{\mu,t} \right], \quad e_{\mu,t} \sim N(0, 1),
$$

where $\mu$ is the steady-state level of the $\mu_t$ shock process. Producers of installed capital maximize the expected discounted value of future profits given by $E_t \sum_{s=0}^{\infty} \beta^s L_t \lambda_{t+s} \left( P_{kt+s} I_I t+s - P_{I_I t} + P_{I_I t+s} I_I t+s \right)$, where $P_{kt}$ is the price of installed capital per efficiency unit.

2.3 Households  The representative household maximizes the following utility function:

$$
E_t \sum_{s=0}^{\infty} \beta^s b_{t+s} \left[ \log(C_{t+s} - h C_{t+s-1}) - \frac{L_{t+s}}{1 + \nu} \right],
$$

where $C_t$ denotes consumption, $h$ is the external habit parameter, $L_t$ denotes the household’s labor supply and $b_t$ is a shock to the discount factor that follows

$$
b_t = b_t(\beta_{t-1}/\beta) \exp \left[ \sigma_b(\xi^Q_t) e_{b,t} \right], \quad e_{b,t} \sim N(0, 1),
$$
where \( \bar{b} \) is the steady-state level of the discount factor shock process.\(^3\) The budget constraint of the household is

\[
P_tC_t + P_{kt} \bar{I}_t + T_t + B_t \leq R_{t-1} B_{t-1} + W_t L_t + r^k_t u_t \bar{K}_{t-1} - P_t \frac{a(u_t)}{\gamma_t} \bar{K}_{t-1},
\]

where \( T_t \) equal to net lump-sum taxes, \( B_t \) are government bond holdings, \( R_t \) is the gross nominal interest rate, and \( W_t \) is the wage rate.

Capital is owned by households that select the capital utilization rate \( u_t \) which transforms physical capital into effective capital following \( K_t = u_t \bar{K}_{t-1} \). Firms rent effective capital at a rate \( r^k_t \). The dollar cost of capital utilization per unit of physical capital is \( P_t \frac{a(u_t)}{\gamma_t} \). The capital accumulation law of motion is given by \( \bar{K}_t = (1 - \delta) \bar{K}_{t-1} + \bar{I}_t \) with the depreciation rate \( \delta \).

As previously mentioned, the model separates final consumption goods, investment goods and newly installed capital, however it can be re-expressed as a one-sector model which proposes the following physical capital accumulation equation

\[
\bar{K}_t = (1 - \delta) \bar{K}_{t-1} + \mu_t \gamma_t (1 - S_t) \bar{I}_t,
\]

where \( S_t \) is the investment adjustment cost paid at time \( t \) and \( \bar{I}_t \) is real investment in consumption units.\(^4\) As in Justiniano et al. (2011) physical capital accumulation is impacted by two shocks: the IST shock \( \gamma_t \), that affects how consumption goods are transformed into investment goods, and the MEI shock \( \mu_t \) that represents how investment goods are transformed into installed capital. These two shocks had been combined into one shock in previous estimations[see Smets and Wouters (2007) and Schmitt-Groh´ e and Uribe (2012)]; however, the distinction between these two shocks is important because it is the MEI shock—not the IST shock—that has been found to be the main driver of the business cycle.

### 2.4 Government

The government issues short-term bonds to finance its budget deficit. Government expenditures are determined as a time-varying factor of GDP as in \( G_t = (1 - \frac{1}{g_t}) Y_t \), where \( g_t \) follows the stochastic process given by

\[
g_t = \bar{g} \left( g_{t-1} / \bar{g} \right)^{g_t} \exp \left[ \sigma_g \xi_t^g \epsilon_{g,t} \right], \quad \epsilon_{g,t} \sim N(0, 1),
\]

where \( \bar{g} \) is the steady-state level of government spending.

Finally, monetary policy is time-varying and is determined through a central bank loss function which is maximized subject to constraints that vary over time following an adaptive learning

\(^3\)The existence of state contingent securities ensures that in equilibrium consumption and asset holdings are the same across households.

\(^4\)For details on the procedure to obtain the one sector model see Justiniano et al. (2011).
process. The details will be outlined in the next section.

2.5 Model Solution  The levels of neutral and investment specific technology have a unit root therefore consumption, investment, capital, real wages, and output fluctuate around a stochastic balance growth path with the composite trend $A_t\gamma_{t+\alpha}$. Its steady state growth rate is $\gamma^* = \gamma_z + \gamma_{t+\alpha}$. The estimation involves writing the private sector model in detrended stationary variables, estimate its steady state, and log-linearize the model around its steady state.

3 The Central Bank

In the present paper there are two potential sources of monetary policy time variation. On one hand, we attempt to capture the evolution of policymaker’s understanding about the economy’s structure using a vector autoregressive of order two (VAR(2)) model of the economy. Its parameter values are obtained recursively using a least-squares learning algorithm. On the other hand, monetary policy preferences that change between dove and hawk regimes are represented by weights in the central bank loss function. The VAR model parameters will be used in the optimal control problem to minimize the central bank’s welfare loss function.

3.1 The Policy Objective Function under Imperfect Information  The central bank’s objective is to minimize the following quadratic welfare loss function that aims at stabilizing the output gap ($x_t$), and deviations of the nominal interest rate from its lagged value relative to inflation stabilization [see Dennis (2006) and Lubik and Matthes (2016)]:

$$E_t \left\{ \sum_{j=0}^{\infty} \beta^j \left[ (\pi_{t+j})^2 + \lambda_{x,t}(x_{t+j})^2 + \lambda_{i,t}(i_{t+j} - i_{t+j-1})^2 \right] \right\}. \quad (4)$$

The focus of the present paper is on estimating the policy preference parameters that are the weights assigned to the different stabilizing objectives represented by $\lambda_t = [\lambda_{x,t}, \lambda_{i,t}]$. As is customary in this type of literature, the weight assigned to inflation stabilization has been normalized to one. Therefore, we estimate the weights that the FOMC gave to output gap stabilization relative to inflation; consistent with the Fed dual mandate and the interest rate smoothing parameter. The later term provides the appropriate set-up to obtain an optimal monetary policy instrument $(i_t)$ that embeds both, policymakers’ beliefs and switches in policy preferences. The preference parameters $\lambda_t$ experience Markov switches between dove and hawk regimes. In the dove regime, the central bank gives more weight to output gap stabilization, while the hawk regime is primarily concerned with inflation stabilization.

other papers suggest the existence of additional breaks in the late 1960s, early 1970s and a potential shift in the 2000s that led to the Great Recession. An example of these regime switches using narrative evidence have been outlined in RR, denominated the Romer dates (September 1955, December 1968, April 1974, August 1978, October 1979, and December 1988). The latter are dates, identified by RR, at which the Fed declared an intent “to exert a contractionary influence on the economy in order to reduce inflation” (1989, p. 134). The present setup captures the possibility of multiple possible regime changes in the post-war period.

The central bank solves its optimal control problem (4) subject to a set of constraints. These constraints are expressed as a VAR(2) model of the economy that contain information on inflation, the output gap, and past interest rates. Although the Fed’s model could contain other variables as well, we decide to keep it simple and consistent with the Federal Reserve mandate. The VAR(2) model has been studied in the literature yielding reasonable estimated of the time-varying Fed beliefs about the structure of the economy [Primiceri (2006), Slobodyan and Wouters (2014)].

We estimate the following central bank VAR learning model

\[
y_t = \hat{\mu}_s + \hat{\Gamma}_s(L)y_{t-1} + \hat{\Xi}_s(L)i_{t-1}^f + \epsilon_t, \tag{5}
\]

for \( t \geq s + 1 \) where \( y_t = [x_t, \pi_t]' \) and \( i_t^f \) is the short-term interest rate. The following matrices contain the coefficients that are time-varying and capture the policymakers evolving beliefs about the structure of the economy \( \hat{\mu}_s = [\hat{c}_{g,s}, \hat{c}_{\pi,s}]' \), \( \hat{\Gamma}_s = [\hat{b}_{1,s}, \hat{b}_{2,s}, \hat{b}_{4,s}, \hat{b}_{5,s}; \hat{c}_{1,s}, \hat{c}_{2,s}, \hat{c}_{4,s}, \hat{c}_{5,s}] \), and \( \hat{\Xi}_s = [\hat{b}_{3,s}, \hat{c}_{3,s}, \hat{b}_{6,s}, \hat{c}_{6,s}]' \).

3.2 LEARNING For the recursive estimation of the central bank VAR model we use a constant gain learning algorithm. The algorithm updates the model parameters using real time vintages of the output gap, inflation, and the lagged short term interest rates as more data becomes available. The crucial assumption of having access only to initial releases (no revisions) allows us to pin the down the time-varying policymakers’ beliefs parameters and differentiate them from the central bank preferences. The updating rule for the central bank’s beliefs is represented by (6), while (7) describes the updating formula for the precision matrix of the stacked regressors \( R_{j,t} \) presented below:

\[
\hat{\phi}_t = \hat{\phi}_{t-1} + gR_{j,t-1}^{-1}\chi_t(\zeta_t'\hat{\phi}_{t-1}^j - \chi_t'), \tag{6}
\]

\[
R_{j,t} = R_{j,t-1} + g(\chi_t\chi_t' - R_{j,t-1}), \tag{7}
\]

\footnote{On a previous estimation we have included wage inflation, however the information seem redundant and the estimates with a parsimonious model are intuitive.}

\footnote{Slobodyan and Wouters (2014) estimates and evaluated a VAR learning model to form agent’s expectations and they found that it outperforming the rational expectations (RE) model.}

\footnote{The estimation uses the lagged federal funds rate as a proxy for the previous short-term interest rate.}
where \( j = \{x, \pi\} \), \( \zeta_t \equiv [x_t, \pi_t]' \) is a vector of endogenous variables and \( \chi_t \equiv [1, \zeta_{t-1}, \zeta_{t-2}, i_{t-1}, i_{t-2}] \) is a matrix of regressors. \( \hat{\phi}_t \) collects the reduce-form parameters of the central bank model and \( g \) is the gain parameter that governs how strongly past data are discounted.

### 3.3 Optimal Policy

Every period, policymakers minimize their welfare loss function (4) subject to their constraints represented by the VAR model of the central bank, gathered in (5). The following is the solution to the optimal regulator problem [see Sargent (1987)],

\[
i_t = F(\hat{\phi}_t, \lambda_t)z_t,
\]

that results in the optimal monetary policy variable \( i_t \) which is a function of the time-varying beliefs \( \hat{\phi}_t \), regime dependent policy preference parameters \( \lambda_t \), and state variables \( z_t \). The policy variable \( i_t \) will be later used in the estimation of the private center model.

Specifically, the policy rule (8) can be rewritten as

\[
i_t = F_{x1}x_t + F_{x2}x_{t-1} + F_{x11}x_t + F_{x21}x_{t-1} + F_{i\Pi}i_{t-1} + \sigma_i \epsilon_{i,t},
\]

where \( \sigma_i \) denotes the regime independent standard deviation of the monetary policy disturbance with \( \epsilon_{i,t} \sim N(0, 1) \).\(^8\) One technical difficulty of this model is that both beliefs and preferences vary over time, and so does \( F(\hat{\phi}_t, \lambda_t) \); therefore the model must be solved every period to find the time-varying data generating process.

We follow the convention on the adaptive learning literature, where policymakers are “anticipated utility” decision makers [see Kreps (1998), Primiceri (2006), and Sargent (1999)] who estimate the parameter in their model and treat them as true values, neglecting the possibility of future updates.

### 4 Solution and Estimation of the MS-DSGE Model

We estimate three sets of the parameters in the model: (1) the structural parameters in the private sector of the model; (2) the monetary policy preference parameters, which are allowed to vary across the regimes; and (3) the regime-dependent standard deviations of the shock processes. We allow for two regimes for monetary policy preference as well as for the volatility of the shocks. The two monetary policy preference regimes are designed to capture potential switches between the hawkish and dovish policy stances [Dennis (2006) and Lakdawala (2016)], while the two shock volatility regimes reflect changes in the size of the shocks hitting the U.S. economy [Sims and Zha (2006)].

\(^8\)The monetary policy disturbance was added to aid with estimation of the model but is not part of the central bank’s optimization problem.
4.1 Estimation Procedure: Overview  The estimation of the model has two phases. In the first stage, the parameters in the central bank model that evolve according to a learning process are obtained by using real time data on the output gap and inflation.

The estimation was performed using two data sets. The first data set was used for the estimation of the central bank learning model to solve the policy problem. It included real time vintages of the output gap and inflation, available to the FOMC for policy decisions from 1960:Q2 to 2007:Q4. The output gap data, has the feature of including the Fed’s real time estimates of potential output used in Orphanides (2003). The main implication is that we are able to account for real time Fed economic understanding by including the overestimation of potential output during the Great Inflation.9 The real time inflation series come from two sources; from 1960:Q2 to 1966:Q1 we use Orphanides (2003), and for the remaining period we use the Real Time Data Set for Macroeconomists available from the Federal Reserve Bank of Philadelphia. Lastly, we use ordinary least-squares estimates as initial beliefs for the central bank learning model using data from Orphanides (2003) for the pre-sample period (1954:Q2 and 1960:Q1).10

Then, given the central bank’s policy preference parameters and its optimal policy variable, the second stage of the estimation procedure identifies the parameters appeared in the private sector of the DSGE model. For this purpose, we use ex-post macroeconomic data ranged from 1960:Q1 to 2007:Q4. The estimation utilizes six series: the growth rates of real per capita output, consumption and investment, and of the relative price of investment, together with inflation and the optimal policy variable emerged from the first stage of the estimation. Notice that these variables—except for the optimal policy rate—are identical to one that used for the estimation of the model by Justiniano et al. (2011).

4.2 Solution of the MS-DSGE Model  After log-linearizing the private sector DSGE model depicted in Section 2, the system of equations in the model associated with the Markov-switching structure can be written as follows:

\[ \Gamma_{0,t}(\xi_t^P, \Theta^P)S_t = \Gamma_{1,t}(\xi_t^P, \Theta^P)S_{t-1} + M(\xi_t^Q, \Theta^Q)\epsilon_t + \Pi \eta_t, \]  

where \( S_t \) denotes the vector of the model’s variables. \( \xi_t^P \) and \( \xi_t^Q \) are the latent factors governing the monetary policy preference and non-policy shock volatility regimes, respectively. \( \Theta^P \) and \( \Theta^Q \) denote the vectors of the model’s structural parameters and stochastic volatilities, respectively. Lastly, \( \epsilon_t \) is the vector containing all the exogenous shocks of unit variance and the vector \( \eta_t \) includes the expectation errors. Notice that the matrices \( \Gamma_{0,t} \) and \( \Gamma_{1,t} \) are time-varying because the central bank keeps updating the Taylor rule coefficients to inflation and output by solving the

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9We are greatly indebted to Athanasios Orphanides for kindly providing us with the real-time data on inflation and the output gap used in Orphanides (2003).

10Slobodyan and Wouters (2014) conclude that the data from the said pre-sample period provides a superior fit for the learning model.
optimal problem described in Section 3.

The state variables $\xi^P_t$ and $\xi^Q_t$ follow a first-order Markov chain with the following transition probability matrices:

$$H^P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} \quad \text{and} \quad H^Q = \begin{bmatrix} Q_{11} & Q_{12} \\ Q_{21} & Q_{22} \end{bmatrix},$$

where $P_{ij} = \text{Prob}(\xi^P_t = j | \xi^P_{t-1} = i)$ and $Q_{ij} = \text{Prob}(\xi^Q_t = j | \xi^Q_{t-1} = i)$. Following the previous studies on this topic, changes in $\xi^P_t$ and $\xi^Q_t$ are assumed to be independent [Bianchi (2013), Davig and Doh (2014)].

As made explicit in Bianchi (2013), the model expressed in (10) becomes linear once conditioning on a specific realization of $\xi^P_t$ and $\xi^Q_t$. We solve the linear rational expectations model by using the solution algorithm proposed by Bianchi and Nicolò (2021). It is well established in the existing literature that the post-World War II U.S. macroeconomic dynamics are associated with periods of violating the Taylor principle—a central bank implements a stabilizing monetary policy when it raises the nominal policy rate by more than an increase in inflation. Since the principle is a necessary and sufficient condition for the existence of a determinate rational expectations equilibrium in conventional monetary models, the possibility of equilibrium indeterminacy makes standard solutions to rational expectation models, such as Blanchard and Kahn (1980) and Sims (2002), inapplicable for our study. In contrast, Bianchi and Nicolò’s (2021) algorithm is unlikely to be plagued by the issue since it solves linear rational expectations models both for determinacy and indeterminacy.\footnote{It is worth noting that the implementation of Bianchi and Nicolò’s (2021) solution algorithm requires the maximum degree of indeterminacy—the number of auxiliary expectational variables needed for the solution of an indeterminate model to be uniquely determined—set by the practitioner. Based on the model as in Smets and Wouters (2007), Bianchi and Nicolò (2021) demonstrate that the maximum degree of indeterminacy to be one and add an auxiliary process to the expectation error of inflation. We also confirm the identical degree of indeterminacy in the model employed in this article and augment it with an auxiliary process onto the expectation error of inflation.}

If there exists a solution to (10), the output of the solution algorithm can be expressed in a regime-switching vector autoregressive form:

$$S_t = T_t(\xi^P_t, \Theta^P)S_{t-1} + M(\xi^Q_t, \Theta^Q)\epsilon_t. \quad (11)$$

Notice again that the solution matrix $T_t$ varies over time due to the time-varying monetary policy stance toward inflation and the output gap.

4.3 Bayesian Estimation Procedure \hfill Let $X_t$ denote the observable data used for the second stage of the estimation procedure delineated in Section 4.1. Then the measurement equation is given by

$$X_t = ZS_t \quad (12)$$
where $Z$ is a matrix that maps the DSGE model’s law of motion in (11) into the observable variables.

Once having the solution of the model, the next step of estimation is to maximize the log posterior function, which combines the priors and the likelihood of the data, by using the Sims’s optimization routine *csminwel*. Evaluating the likelihood for the Markov-switching model employs the Kalman filter developed by Kim and Nelson (1999). Unlike the standard Kalman filter utilizing information only at the current period, inferences associated with Kim and Nelson (1999)’s algorithm are conditional both on current and past states $\xi_P^t$ and $\xi_Q^t$’s. Finally, the random walk Metropolis-Hastings algorithm simulates 300,000 draws with the first 100,000 used as a burn-in period and every 20th thinned, leaving a final sample size of 10,000.

### 4.4 Bayesian Estimation: Priors

Following Justiniano et al. (2011), some of the parameters that are difficult to identify from the data are calibrated. The quarterly depreciation rate for capital, $\delta$, is set to 0.025, implying that the annual depreciation rate is 10 percent. The steady state government spending to GDP ratio $(1 - 1/g)$ is computed from the sample mean, which is 0.22. We also fix the gain parameter for the learning algorithm, $g$, which is drawn from the estimates of Best and Hur (2019). They allow for a potential break in the speed of policymakers’ learning in 1979:Q3 and obtain the median gain coefficients for the pre- and post-79 samples of 0.01 and 0.003, respectively. Following Best and Hur (2019), we set $g_{pre-79} = 0.01$ and $g_{post-79} = 0.003$, postulating that policymakers assign a relatively larger weight to new information for the pre-79 period, compared to the post-79 one [Marcet and Nicolini (2003), and Milani (2014)].

We estimate the rest of the model’s parameters. The third and fourth columns of Table 1 present prior distributions along with their means and standard deviations for the estimated parameters. The prior distributions for the structural parameters of the private sector model are largely drawn from Justiniano et al. (2011) and Bianchi (2013). In addition, the priors for the regime switching probability are similar to those in Bianchi (2013), and they are assumed to follow Dirichlet distributions—refer to Bianchi (2013) and Hur (2017) for details.

The priors for the weights on the policymakers’ loss function follow a beta distribution. Meanwhile, they are chosen to be asymmetric across the policy preference regimes, centered at the values consistent with the microfounded estimates in Giannoni and Woodford (2003) as well as with the DSGE estimates reported in Best and Hur (2019). The priors for the monetary policy weight on the output gap have their mean values of 0.005 for the hawkish regime with a standard deviation of 0.005, and a value of 0.45 for the mean of the dovish regime with a larger standard deviation of 0.18. The prior for the interest rate-smoothing parameter assumes *a priori* that monetary policy decisions tend to be more persistent for the dovish regime than the hawkish one. Best and Hur (2019) finds that the interest-rate-smoothing parameter for the 1970s, when a dovish policy regime was in place, is estimated to be consistently higher than for the pre- and post-70s decade samples.
<table>
<thead>
<tr>
<th>Description</th>
<th>Parameter</th>
<th>Density</th>
<th>Mean (Std.)</th>
<th>Median [5%, 95%]</th>
<th>Median [5%, 95%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>$\alpha$</td>
<td>Normal</td>
<td>0.30 (0.05)</td>
<td>0.19 [0.18, 0.20]</td>
<td>0.16 [0.15, 0.18]</td>
</tr>
<tr>
<td>Price indexation</td>
<td>$\nu_p$</td>
<td>Beta</td>
<td>0.50 (0.15)</td>
<td>0.19 [0.07, 0.38]</td>
<td>0.15 [0.05, 0.30]</td>
</tr>
<tr>
<td>SS composite tech. growth rate</td>
<td>$\gamma_s$</td>
<td>Normal</td>
<td>0.40 (0.01)</td>
<td>0.40 [0.38, 0.41]</td>
<td>0.40 [0.38, 0.42]</td>
</tr>
<tr>
<td>SS IST growth rate</td>
<td>$\gamma_v$</td>
<td>Normal</td>
<td>0.29 (0.01)</td>
<td>0.29 [0.27, 0.30]</td>
<td>0.29 [0.27, 0.30]</td>
</tr>
<tr>
<td>Consumption habit</td>
<td>$h$</td>
<td>Beta</td>
<td>0.50 (0.10)</td>
<td>0.84 [0.80, 0.87]</td>
<td>0.89 [0.86, 0.91]</td>
</tr>
<tr>
<td>SS mark-up goods prices</td>
<td>$\lambda_p$</td>
<td>Normal</td>
<td>0.15 (0.05)</td>
<td>0.17 [0.08, 0.25]</td>
<td>0.17 [0.08, 0.25]</td>
</tr>
<tr>
<td>SS hours</td>
<td>$\log L^{\delta}$</td>
<td>Normal</td>
<td>0.00 (0.50)</td>
<td>0.04 [-0.79, 0.86]</td>
<td>0.01 [-0.76, 0.79]</td>
</tr>
<tr>
<td>SS quarterly inflation</td>
<td>$100(\tau - 1)$</td>
<td>Normal</td>
<td>0.50 (0.05)</td>
<td>0.50 [0.44, 0.57]</td>
<td>0.51 [0.44, 0.57]</td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\nu$</td>
<td>Gamma</td>
<td>2.00 (0.75)</td>
<td>2.02 [1.52, 2.71]</td>
<td>1.05 [0.79, 1.41]</td>
</tr>
<tr>
<td>Calvo prices</td>
<td>$\xi$</td>
<td>Beta</td>
<td>0.50 (0.10)</td>
<td>0.64 [0.58, 0.70]</td>
<td>0.57 [0.55, 0.63]</td>
</tr>
<tr>
<td>Capital utilization costs</td>
<td>$\lambda$</td>
<td>Gamma</td>
<td>5.00 (1.00)</td>
<td>5.39 [3.93, 7.18]</td>
<td>5.27 [3.74, 7.14]</td>
</tr>
<tr>
<td>Investment adjustment costs</td>
<td>$S''$</td>
<td>Gamma</td>
<td>4.00 (1.00)</td>
<td>0.76 [0.59, 0.95]</td>
<td>1.01 [0.75, 1.26]</td>
</tr>
<tr>
<td>Neutral tech. AR(1)</td>
<td>$\rho_z$</td>
<td>Beta</td>
<td>0.40 (0.20)</td>
<td>0.08 [0.02, 0.17]</td>
<td>0.04 [0.01, 0.09]</td>
</tr>
<tr>
<td>Gov’t spending AR(1)</td>
<td>$\rho_g$</td>
<td>Beta</td>
<td>0.60 (0.20)</td>
<td>0.97 [0.96, 0.98]</td>
<td>0.99 [0.98, 0.99]</td>
</tr>
<tr>
<td>Invest. tech. AR(1)</td>
<td>$\rho_v$</td>
<td>Beta</td>
<td>0.60 (0.20)</td>
<td>0.46 [0.36, 0.56]</td>
<td>0.46 [0.38, 0.56]</td>
</tr>
<tr>
<td>Preference AR(1)</td>
<td>$\rho_b$</td>
<td>Beta</td>
<td>0.60 (0.20)</td>
<td>0.27 [0.12, 0.46]</td>
<td>0.52 [0.41, 0.63]</td>
</tr>
<tr>
<td>MEI AR(1)</td>
<td>$\rho_{\mu}$</td>
<td>Beta</td>
<td>0.60 (0.20)</td>
<td>0.28 [0.16, 0.39]</td>
<td>0.25 [0.16, 0.35]</td>
</tr>
<tr>
<td>Monetary policy std.</td>
<td>$\sigma_{\xi}$</td>
<td>Inv. Gamma</td>
<td>0.20 (0.20)</td>
<td>0.07 [0.05, 0.08]</td>
<td></td>
</tr>
<tr>
<td>Monetary policy std., regime 1</td>
<td>$\sigma_{\xi}(R1)$</td>
<td>Inv. Gamma</td>
<td>0.20 (0.20)</td>
<td>0.04 [0.03, 0.05]</td>
<td></td>
</tr>
<tr>
<td>Monetary policy std., regime 2</td>
<td>$\sigma_{\xi}(R2)$</td>
<td>Inv. Gamma</td>
<td>0.20 (0.20)</td>
<td>0.22 [0.14, 0.40]</td>
<td></td>
</tr>
<tr>
<td>Neutral tech. std., regime 1</td>
<td>$\sigma_z(R1)$</td>
<td>Inv. Gamma</td>
<td>2.00 (2.00)</td>
<td>0.83 [0.60, 1.15]</td>
<td>1.57 [1.18, 2.08]</td>
</tr>
<tr>
<td>Neutral tech. std., regime 2</td>
<td>$\sigma_z(R2)$</td>
<td>Inv. Gamma</td>
<td>2.00 (2.00)</td>
<td>2.35 [1.55, 3.49]</td>
<td>5.24 [3.37, 8.36]</td>
</tr>
<tr>
<td>Gov’t spending std., regime 1</td>
<td>$\sigma_g(R1)$</td>
<td>Inv. Gamma</td>
<td>1.00 (2.00)</td>
<td>0.09 [0.07, 0.12]</td>
<td>0.21 [0.18, 0.24]</td>
</tr>
<tr>
<td>Gov’t spending std., regime 2</td>
<td>$\sigma_g(R2)$</td>
<td>Inv. Gamma</td>
<td>1.00 (2.00)</td>
<td>0.21 [0.15, 0.28]</td>
<td>0.44 [0.33, 0.64]</td>
</tr>
<tr>
<td>Invest. tech. std., regime 1</td>
<td>$\sigma_v(R1)$</td>
<td>Inv. Gamma</td>
<td>0.50 (0.50)</td>
<td>0.93 [0.61, 1.43]</td>
<td>2.80 [1.72, 4.33]</td>
</tr>
<tr>
<td>Invest. tech. std., regime 2</td>
<td>$\sigma_v(R2)$</td>
<td>Inv. Gamma</td>
<td>0.50 (0.50)</td>
<td>13.71 [10.32, 14.89]</td>
<td>12.60 [8.13, 14.74]</td>
</tr>
<tr>
<td>Preference std., regime 1</td>
<td>$\sigma_b(R1)$</td>
<td>Inv. Gamma</td>
<td>1.00 (1.00)</td>
<td>2.52 [1.58, 4.12]</td>
<td>9.95 [6.23, 13.97]</td>
</tr>
<tr>
<td>Preference std., regime 2</td>
<td>$\sigma_b(R2)$</td>
<td>Inv. Gamma</td>
<td>1.00 (1.00)</td>
<td>4.95 [2.52, 10.24]</td>
<td>13.18 [9.47, 14.81]</td>
</tr>
<tr>
<td>MEI std., regime 1</td>
<td>$\sigma_{\mu}(R1)$</td>
<td>Inv. Gamma</td>
<td>2.00 (2.00)</td>
<td>0.17 [0.13, 0.21]</td>
<td>0.20 [0.16, 0.24]</td>
</tr>
<tr>
<td>MEI std., regime 2</td>
<td>$\sigma_{\mu}(R2)$</td>
<td>Inv. Gamma</td>
<td>2.00 (2.00)</td>
<td>0.47 [0.36, 0.64]</td>
<td>0.70 [0.48, 1.14]</td>
</tr>
<tr>
<td>Prob. of MP regime 1</td>
<td>$F_{11}(R1)$</td>
<td>Dirichlet</td>
<td>0.948 (0.063)</td>
<td>0.97 [0.95, 0.98]</td>
<td>0.99 [0.97, 1.00]</td>
</tr>
<tr>
<td>Prob. of MP regime 2</td>
<td>$F_{22}(R2)$</td>
<td>Dirichlet</td>
<td>0.948 (0.063)</td>
<td>0.86 [0.80, 0.92]</td>
<td>0.98 [0.96, 0.99]</td>
</tr>
<tr>
<td>Prob. of volatility regime 1</td>
<td>$Q_{11}(R1)$</td>
<td>Dirichlet</td>
<td>0.948 (0.063)</td>
<td>0.97 [0.93, 0.99]</td>
<td>0.97 [0.94, 0.99]</td>
</tr>
<tr>
<td>Prob. of volatility regime 2</td>
<td>$Q_{22}(R2)$</td>
<td>Dirichlet</td>
<td>0.948 (0.063)</td>
<td>0.95 [0.88, 0.98]</td>
<td>0.90 [0.80, 0.96]</td>
</tr>
<tr>
<td>MP weight on output gap, regime 1</td>
<td>$\lambda_x(R1)$</td>
<td>Beta</td>
<td>0.005 (0.005)</td>
<td>0.00 [0.00, 0.00]</td>
<td></td>
</tr>
<tr>
<td>MP weight on output gap, regime 2</td>
<td>$\lambda_x(R2)$</td>
<td>Beta</td>
<td>0.45 (0.18)</td>
<td>0.11 [0.10, 0.15]</td>
<td></td>
</tr>
<tr>
<td>MP weight on smoothing, regime 1</td>
<td>$\lambda_1(R1)$</td>
<td>Beta</td>
<td>0.35 (0.15)</td>
<td>0.22 [0.20, 0.26]</td>
<td></td>
</tr>
<tr>
<td>MP weight on smoothing, regime 2</td>
<td>$\lambda_1(R2)$</td>
<td>Beta</td>
<td>0.75 (0.15)</td>
<td>0.94 [0.84, 0.99]</td>
<td></td>
</tr>
<tr>
<td>MP resp. to inflation, regime 1</td>
<td>$f_\pi(R1)$</td>
<td>Gamma</td>
<td>1.8 (0.4)</td>
<td>1.71 [1.47, 2.01]</td>
<td></td>
</tr>
<tr>
<td>MP resp. to inflation, regime 2</td>
<td>$f_\pi(R2)$</td>
<td>Gamma</td>
<td>1 (0.4)</td>
<td>0.98 [0.93, 1.03]</td>
<td></td>
</tr>
<tr>
<td>MP resp. to output growth, regime 1</td>
<td>$f_y(R1)$</td>
<td>Gamma</td>
<td>0.25 (0.15)</td>
<td>0.16 [0.06, 0.32]</td>
<td></td>
</tr>
<tr>
<td>MP resp. to output growth, regime 2</td>
<td>$f_y(R2)$</td>
<td>Gamma</td>
<td>0.25 (0.15)</td>
<td>0.20 [0.07, 0.41]</td>
<td></td>
</tr>
<tr>
<td>MP rule AR(1), regime 1</td>
<td>$f_{AR}(R1)$</td>
<td>Beta</td>
<td>0.6 (0.2)</td>
<td>0.73 [0.69, 0.78]</td>
<td></td>
</tr>
<tr>
<td>MP rule AR(1), regime 2</td>
<td>$f_{AR}(R2)$</td>
<td>Beta</td>
<td>0.6 (0.2)</td>
<td>0.51 [0.42, 0.62]</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Prior and posterior distributions for the estimated parameters.
4.5 Estimation of the Model with MS in the Taylor Rule Coefficients

For comparison, we additionally estimate a model with the Markov-switching structure in the Taylor rule coefficients analogous to Bianchi (2013) and Davig and Doh (2014). We follow Bianchi (2013)’s specification—including the prior distributions selection, the solution algorithm by Farmer et al. (2011), and the Markov-switching structure both in monetary policy and shock volatility.

5 Results

5.1 Parameter Estimates

The fifth and sixth columns of Table 1 report the posterior median and 90% interval estimates for the structural parameters in the benchmark specification. Overall, the data seem to be informative in identifying the parameters, as the 90% posterior intervals for most of the parameters are different from those implied by the prior distributions. Moreover, the regime-independent parameter estimates tend to be in line with those in the existing literature—including Smets and Wouters (2007), JPT and Bianchi (2013).

Focusing on the regime-dependent monetary policy preference parameters, regime 1 is associated with almost no weight on output gap stabilization as the parameter $\lambda_x$ (R1) is quite tightly estimated around zero. In contrast, a relatively more weight is given to stabilizing output gap under regime 2 with $\lambda_x$’s (R2) posterior median and [5%, 95%] estimates of 0.11 and [0.10, 0.15], respectively. Due to these characteristics, we shall refer to regime 1 as the hawk regime, while regime 2 will be the dove regime. Regarding the weight on interest rate smoothing, our estimates suggest that regime 1 is associated with a lower interest rate smoothing objective of the Fed than regime 2, as the median estimates for $\lambda_i$ (R1) and $\lambda_i$ (R2) are 0.22 and 0.94, respectively.

The data characterize that median probabilities of the current policy preference regime taking place in the next period are 0.97 and 0.86 for regimes 1 and 2, respectively with no overlap of their 90% posterior intervals. This finding indicates that the hawk regime is substantially more persistent than the dove regime.

Turning to the volatility of the non-policy shocks, the estimated standard deviations of the exogenous shocks are consistently higher under the volatility regime 2 than the first one. For this obvious reason, we refer to the first and second volatility regimes as the low and high volatility regimes, respectively. Finally, the persistence parameter estimates for each volatility regime, $Q_{11}$ and $Q_{22}$, reveal that the low volatility regime is slightly more persistent than the high volatility one. This finding is consistent with Bianchi (2013).

5.2 Model-Implied Optimal Policy Variable

Figure 1 plots the actual federal funds rate and model-implied optimal monetary policy variable associated with the benchmark specification. We find that the policy variable resulting from the benchmark model estimation matches well the dynamic behavior of the Fed instrument during the period of study. In particular, it matches the upper bound of the magnitude of the policy variable during Volcker disinflation and follows closely.
the instrument during the 1990s and the pre-Great Recession period. In addition, the volatility of the policy instrument matches the federal funds rate’s. Using a similar framework with central bank’s learning, Best and Hur (2019) obtain the optimal federal funds rate in a model with deterministic shifts in policymakers’ preferences in 1970 and 1979. The model-implied optimal policy variable in this paper outperforms theirs as it improves the fit in the mid-1970s, early 1980s, mid 1990s and in the pre-Great Recession period. This finding underscores the possibility of stochastic regime changes in monetary policy preference for applications as in this paper.

The following section describes the dynamics that explain the optimal monetary policy instrument. We split the explanation between the beliefs part, that is motivated by our central bank learning structure, and the Markov-switching monetary policy preference estimation in which the central bank experiences shifts between a dove and hawk regime.

5.3 Smoothed Regime Switching Probability Figure 2, top panel, plots the probabilities of the monetary policy preference regime 1, or hawk regime with the vertical lines indicating Fed chairmanship. It is important to highlight that these are regime switches in preference parameters in the central bank loss function. Thus, they represent policy shifts, with the characteristic that a change in preferences should produce an increase in the volatility of one variable—i.e. the output gap—, but a decrease in the volatility of the other [see Debertoli and Nunes (2014)]. So a direct comparison with Bianchi (2013) and Davig and Doh (2014) may be misleading because in simple policy rules is possible to drive the volatility of the output gap and inflation in the same direction. The probabilities in the top panel of Figure 2 follow a similar pattern than in Bianchi (2013) and Davig and Doh (2014); that is a dovish episode with great preference for output gap stabilization in the 1970s under Burns’ chairmanship. We also estimate a non-zero probability of switching to a dove regime on the late 1970s-to-early 1980s, 1987, early 2000s and in the onset of the Great Recession.
Istrefi (2019) measures perceived policy preferences of the FOMC based on newspaper and financial media coverage. The author designates the chairman as a hawk or a dove, based upon their perceived preference for fighting inflation or promoting pro-growth policies which could yield price pressures. The perception is based on the policy leaning with respect to the dual mandate of the Fed and the preferred direction of the monetary policy instrument. Istrefi (2019) finds variation between dove and hawk in the composition of the FOMC. The composition varies due to the annual rotation of the four Reserve Bank presidents and switching preferences of other FOMC members. She sees a larger variation in perceived preferences from the Board members than from the Reserve Bank Presidents. Moreover, she acknowledges that a direct mapping to policy preferences as discussed in theory is not straightforward, and a formal mapping on policy preferences with theoretical counterparts in a loss function is left for future research. This is where our paper fills a gap in the existent literature. We can disentangle switches between dove and hawk regimes considering the Feds understanding of the economy in real time.

In the 1960s and the 1970 William McChesney Martin was the chairman of the Federal Reserve. He served from 1951 to 1970 and consistent with our estimates Istrefi regards him as a perceived hawk, a symbol at home and abroad of noninflationary monetary policy. The smoothed regime probability shows a hawkish monetary policy regime during most of the 1960s up to 1966 when there is a non-zero probability of having a dovish regime. This hawkish behavior coincides with the press’ perception that Chairman Martin followed a hard monetary policy with a concern
for inflation through his whole tenure. One possible reason why we estimate a slight regime change in 1966 is because, according to Istrefi, a large portion of FOMC members changed their positions and started leaning toward a dovish regime around 1966. Meltzer (2006) further comments that Martin would delay taking anti-inflationary action until a majority was formed during times where dovish members were ubiquitous.

In 1969, Arthur Burns was nominated by President Nixon as the Chairman of the Federal Reserve. Istrefi (2019) re-iterates on the perception present in the narrative of the press that during the 1970s the FOMC was perceived as hawkish, even when politically pressured to follow expansionary policy [Abrams (2006)]. Istrefi regards Burns as “overly concerned with inflation rather than fighting the recession” aiming for a moderately restrictive monetary policy until the existing inflation had been eliminated. However, what was different during Burn’s term were the policies to control inflation as well as the prevalence of perception mistakes on the functioning of the economy. In this paper, we explicitly model Fed perceptions (described below) and confirm that beliefs about the functioning of the economy, in particular, about the inflation output gap trade-off influenced monetary policy decision.

In the top panel of Figure 2 the smoothed regime probability shows that, contrary to Istrefis findings, there is a strong probability of a dove regime during the 1970s, up to 1978; in particular, between 1973 up to 1978. In the present paper we found evidence that the earlier stages of the Great Inflation can be justified by erroneous beliefs about the functioning of the economy and potential output. However, the reason why high inflation persisted was because of the prolonged dovish state of the FOMC.

Romer and Romer (2002) recognized that the Fed was not willing to make “discernible output sacrifices” to reduce inflation. The Federal Reserve has previously been aiming at above trend growth rates of output (1978 Annual Report (in August), p. 176), and they expressed their desire to achieve a lower growth rate of output—sustainable for a long term—in the second half of the year. In fact, and consistent with Romer and Romer (2002) we observe a shift to a hawkish regime in the late 1970s, this has been extensively described as the two major anti-inflationary shocks to monetary policy that occurred in August of 1978, and October of 1979. In the subsequent period, the regime prevalent was hawkish in nature.

In 1978, G. William Miller was appointed as Chairman of the Federal Reserve by President Carter. Istrefi regards Miller as a dove because he was not expected to fight inflation as hard as Burns was perceived to. The press narrative disseminated that the Miller majority believed that a recession would be starting before the end of the year, and that dovish monetary policy would follow. Our estimates of the smoothed probability provide mixed evidence of a dovish/hawkish regime. This finding supports Istrefi’s notion that the public did not know much about Millers policy preferences or beliefs—a businessman. While he was not known as an inflation fighter, the FOMC was still perceived as hawkish.
In 1979, President Carter appointed Paul Volcker as the replacement of Miller to the chairmanship of the Federal Reserve. Volcker was a well-known hawk since 1975 during his role as president of the New York Fed [see Istrefi (2019)]. The press cites Volcker saying that there had been a tendency of the Fed to downplay inflation risks while overemphasizing the dangers of recession. This tendency supports our findings of a dovish Fed during the 1970s. However, at Volcker’s appointment and thereafter there was a radical policy regime shift toward a hawkish Fed captured by our estimates in the top panel of Figure 2. Chronicled in Istrefi (2019), the press emphasized that he engineered the fastest increase in the short-term interest rate since the Fed was created, making drastic inflation fighting revisions in monetary policy. This large swing to a hawkish regime lasted until the early 2000s. The FOMC real time preference analysis captures a switch to a larger share of dovish compared to hawkish members toward the end of Volcker’s mandate. This dovish bias, is also visible in our estimates of the smoothed probability, resurfacing around 1987 toward the end of Volcker’s mandate, which coincided with the stock market crash.

The smoothed probability shows that a hawkish regime prevailed after Greenspan’s 1987 appointment as Federal Reserve chair. He was initially regarded as an inflation fighter like Volcker, but Istrefi narrates that the perception of Greenspan’s policies changed in the second part of 1997. In fact, the press regarded him as a “dove in hawk’s clothing.” The smoothed probability captures Greenspan’s policy switch toward a dovish regime in 1999—although a little bit delayed. Blinder and Reis (2019) describe Greenspan as a dove, relative to the center of gravity of the FOMC, who was committed to the idea that productivity trend had increased the potential for non-inflationary growth. Sometime around 2002, the smoothed probability catches a short-lived switch to a dovish regime that lasts for a few years, returning to a hawkish regime around the mid-2000s. Regarding the board members, President George W. Bush nominated Ben Bernanke in 2002 as a board member of the Federal Reserve; consequently he was appointed as the chairman in 2006. Istrefi (2019) recounts that as a board member, he leaned toward the hawkish side of the policy spectrum. However, as the Federal Reserve chair and an advocate of inflation targeting his biggest concern was preventing deflation. In fact, the press regarded him as dovish, more so than Greenspan.

Istrefi (2019), not only focuses on the perceived preferences of the Fed chairman but he also counts the preferences of the FOMC members during the 1960-2015 period. She perceives a hawkish FOMC during most of Burn’s, Miller’s, Volcker’s and Greenspan’s chairmanships. Although there is a tendency to switch to a dovish bias during the last years of Martin’s, Volcker’s, Greenspan’s, and Bernanke’s chairmanships. Within the FOMC, Board members are more prone to favoring expansionary policies than Reserve Bank Presidents. For example, there was a larger share of doves among the Board Members during the late 1960s, mid 1970s, mid-to-late 1980s, and a large majority (100 percent at times) after the 2001 recession. While Reserve Bank Presidents were only dovish for a brief period during the 2000s, and during the Great Recession. Therefore, the FOMC in general turned dovish during the 2001 recession until the mid-2000s and after the
Great Recession. Istrefi (2019) shows the composition of the FOMC at meeting frequency in real time ‘since 1960. She finds swings toward a larger share of doves in the late 1960s, 1974, around 1987, and in the late 1990s until 2005, and during the Great Recession. She claims that the 1990s swings were due to price stability and inflation targeting discussion, while the early 2000s, were related to Greenspans optimism on productivity; most reported swings are in line with our policy switches to a dove regime.

5.4 Smoothed Probability of Shock Volatility

Turning to the timing of the shock volatility regimes, the top panel of Figure 3 reports the smoothed probability of the high volatility regime for the non-policy shocks. Our estimates indicate that most of the 1970s and the first half of the 1980s were associated with high volatility of the non-policy shock, which is consistent with the finding in Bianchi (2013) and Davig and Doh (2014). In addition, we identify periods of high volatility of the non-policy shock in the early 1960s, the second half of the 1960s, and the early 1990s. Therefore, we find strong evidence of high volatility of the shocks from the earlier stages of the Great Inflation until the beginning of the Great Moderation and after the Black Monday of 1987. It is undeniable the contribution of “bad luck” or sizable adverse shocks to the Great Inflation as in Sims and Zha (2006), among others. However, we do not detect high volatility of the shocks before the Great Recession, therefore we don’t consider this as a main source of instability that is why we look at monetary policy as the culprit.

Figure 3: Probabilities of the shock volatility regime 2 associated with the monetary policy preference model (upper panel) and associated with the Taylor rule coefficient model (lower panel). Posterior median and [5%, 95%] band estimates are reported.
5.5 Policy Makers’ Beliefs  

Figure 4 plots the real time estimates of the persistence of inflation, parameters $\hat{c}_1$ and $\hat{c}_2$ as well as the total estimates of the slope of the Phillips curve or parameters $\hat{c}_3$ and $\hat{c}_5$. These parameters are crucial in the interpretation of the evolution of the monetary policy instrument in the period of study see Orphanides and Williams (2005), Milani (2007), and Primiceri (2006). In sum, the strong persistence of inflation is very prevalent through the whole sample except for the second half of the 1970s. The dove regime coincides with the volatile period in the persistence of inflation in the mid-1970s. A notable difference between this paper and the extant literature is that we do not observe a low persistence at the beginning of the period.

In the bottom panel of Figure 4 we present the perceived slope of the Phillips curve. In the beginning of the sample the slope was higher, then we observe a persistent decline on the output gap-inflation trade-off consistent with the recent perception of a flatter Phillips curve. The main implication is that since the mid-1960s the perceived effectiveness of monetary policy decreased, and the cost of bringing inflation down, in terms of the output gap, increased. Policy makers reviewed their perceived output gap-inflation trade-off toward zero, finding it very unfavorable. In the latter part of the sample, with anchored inflation expectations, the perceived worsening of the trade-off hasn’t been an issue, but it was problematic when attempting to bring inflation down during the Great Inflation. This belief leads to non-traditional responses of the variables to shocks in the 1960s and 1970s. It also partially explains why policymakers kept a dovish regime in place during the Great Inflation, even when the inflation rate had been on the rise since 1965 [see Primiceri (2006), Lubik and Matthes (2016)].

\footnote{Recently mentioned by Christina Romer on her keynote speech to the WEAI 2022 meeting entitled “The Timid Fed: Evidence and Explanations.”}
5.6 MODE-IMPLIED TAYLOR RULE COEFFICIENTS  Figure 5 presents the model-implied Taylor rule (TR) coefficients for inflation and output gap associated with the benchmark specification. These can replicate remarkably, the time-varying TR coefficients present in papers such as Boivin (2006), Kim and Nelson (2006), and Ang et al. (2011). We emphasize that early in the sample, before the mid-1970s, we find policy preferences consistent with a “hawkish” central banker, however, the TR coefficients presented here correspond to a low response to inflation—less than one for one—and a higher response to the output gap. We can conclude that TR coefficients cannot be interpreted entirely as central bank stabilizing objectives, because they also mask beliefs about the structure of the economy.

During the mid-1970s, and up to the early 1980s the Taylor rule response to the output gap increases considerably, consistent with a dovish central banker, while the response to inflation decreases. We observe a spike in the inflation coefficient in the mid-1970s in response to the oil price shock and the increased inflation persistence. Of note is that while the change in preference to a hawkish regime started in the late 1970s the response to inflation did not increase until the early 1980s, so the regime change for a Fed concerned with inflation was put in place in the late 1970s as in Romer and Romer (2002).

In the early 1980s, the response to inflation increased, with dips right before the mid-1990s and the mid-2000s. As shown before, in Figure 2, there was a shift in policy preferences around 2001–2002 to a dovish regime which may have affected the response to inflation from the reaction function with a lag. In the episode leading to the Great Recession, we observe a lower response to inflation than in the late 1990s, comparable to the behavior of monetary policy during the Great
5.7 **Comparison to the Model with MS in the Taylor Rule Coefficients**  
The last two columns of Table 1 provide the posterior estimates emerged from the model with Markov-switching Taylor-rule coefficients. Regarding the parameters of the Taylor rule, regime 1 reacts more actively to inflation, but does less strongly to output, when compared to regime 2. The degree of interest rate smoothing turns out to be higher under regime 1. Meanwhile, the standard deviations of the shocks are invariably higher under the volatility regime 2. All these properties are consistent with those observed in the existing MS literature using a similar framework [e.g., Bianchi (2013) and Davig and Doh (2014)].

The timing of the Taylor-rule regime 1 is plotted in the bottom panel of Figure 2. Based on the MS in the Taylor rule coefficients, we observe a regime switch in the late 1960s and early 1980s, earlier than under the benchmark model for the former, and later for the later. Therefore, the estimation of a regime switching Taylor rule for monetary policy may be misleading in the sense that it would appear like monetary policy preferences are shifting while the change may come the Fed’s understanding about the functioning of the economy. Romer (2022)’s speech on the timid Fed, explains that timid policy changes are due to wrong economic ideas, such as the worsening of the output-gap inflation trade-off (1970−1971) or the belief that the Fed’s role is to mitigate bad economic conditions, not offset them (2000−2001 and 2007−2008). The Taylor rule estimation also shows a consistent hawk regime until the end of the sample while in the top panel of Figure 2 we observe switches to dove regimes in 1987, but most importantly in the early 2000s. Bianchi (2013), in a similar setup, records a switch to dovish policy in the onset of the Great Recession only. We believe that this early 2000s switch to a dovish policy fueled the speculative investment boom that later led to the Great Recession and it is captured by our model.

In the bottom panel of Figure 3, we plot the smoothed probability of non-policy shock volatility in a model with the Taylor Rule as the expression of evolution of monetary policy. We find a high volatility shock regime present since the early-to-mid 1970s up to the onset of the Great Moderation. We observe a similar graph to our benchmark model, however we do not detect high volatility in the earlier stages of the Great Inflation and after the Black Monday. Also, as in the benchmark model we high volatility shock regime does not bear any weight on the creation of the Great Recession.

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13We checked determinacy properties of the benchmark model and we conclude that there exists a determinate equilibrium during the entire sample which is consistent with the use of the Bianchi and Nicolò algorithm.
14Fed timidity is defined as having monetary policymakers that see undesirable shocks to the variables they care about, but choose not to respond or to respond only partially.
6 Time-varying Variance Decomposition

In the following section we present the results of a time varying decomposition for the benchmark and counterfactual scenarios of an all dove, and all hawk regimes during the period of study. The purpose is twofold, first, we study the time-varying contribution of each individual shock to the forecast error variance of each variable. It has been established that the MEI shock, that proxies for the functioning of the financial system, is a key player in the business cycle, however our estimation detects that the contribution varies over time and through monetary policy regimes. We are also very interested in drawing a parallel between the Great Inflation and the period leading to the Great Recession given that they are both consistent with dovish regimes, in particular what shocks matter to the unraveling of both economic periods.

6.1 Time-varying Variance Decomposition: Definition

In order to examine the role of each exogenous shock in accounting for the variability of a macro variable at a specific period, we calculate time-varying variance decomposition defined as

\[
\text{Time-varying variance decomposition } (X^s_t) = \frac{(X^s_t)^2}{\sum_{s \in S} (X^s_t)^2}
\]

where \( X = \{Y, C, I, \pi, R\} \) is the set of the aggregate variable of interest and \( S = \{i, z, g, v, b, \mu\} \) is the set of exogenous shocks in the model. Accordingly, \( X^s_t \) denotes the value of the variable \( X \) at time \( t \) generated by a specific shock \( s \in S \).

6.2 Time-varying Variance Decomposition

Technology, government spending, and MEI shocks are the most important determinants of output. The tendency is similar to the model without regime switching [Best and Hur (2019)], the main differences occur during the 2000s leading to the Great Recession. In the models without regime switching or time varying monetary policy, the 2000s are usually regarded as a hawkish regime. In this paper, we detect switches between a dove and a hawk policy regime back to a dovish regime during the 2000s which yields differences in the dynamics of the variables. We observe switches between government spending as the main contributor to output during the dovish regime to the MEI shock as main driver during the hawkish regime.

This is also consistent with our counterfactual experiments without regime switching. Figure 7 depicts an economy with an all hawk regime in place where the MEI shock drives output entirely and Figure 8, during an all dovish regime, where output fluctuations are due to government spending during the 2000s.

Consumption is mainly determined by government spending; in the current model, the role of government spending decreases in the 2000s while the IST shock increases its contribution. We also observe that technology shocks are more important during the Great Moderation in the regime...
switching model. In our all hawkish regime model, as in Figure 7, government spending would have driven output almost entirely in the 2000s (no IST contribution). While for a dovish regime, in Figure 8, mainly technology, but also MEI and discount shocks’ contribution during the Great Moderation would have been disproportionately large, taking the role of government spending.

Investment is driven by technology shocks during the 1960s and second half of the 1980s, and the MEI shocks drives investment during the rest of the period. The counterfactual experiment of an all dove regime, in Figure 8, would have exacerbated the role of technology shocks during the 1980s, and decreased the role of the MEI shock on investment from 1990 on; the discount factor shock would have taken its place.

Under a regime switching model, a monetary policy shock did not appear to have a strong contribution to inflation in the 1960s and 1970s, MEI shock prevailed during these decades, however, its contribution increases in the 1980s through the 2000s. Had monetary policy been dovish, and
Figure 7: Share of forecasting error variances accounted for by each shock, associated with the counterfactual scenario. The counterfactual series are obtained under the assumption that the hawkish policy preference regime is maintained for the entire sample. In each figure, median (solid line) and 90% interval (dashed lines) estimates are reported.

not shifted to a hawkish regime with the appointment of Chairman Volcker to the Federal Reserve, the monetary policy shock would have had a strong effect on inflation as we can observe in Figure 8. However, during the 2000s, the role of monetary policy would have decreased while the contribution of the MEI shock increased. Therefore the behavior of inflation is asymmetric, and it is also regime and decade dependent. A dovish regime during the Great Moderation, while a hawkish regime in the 2000s, would have left monetary policy as the main determinant of inflation.

Regarding the interest rate, monetary policy contributes to interest rates in the 1970s, late 1980s, and in the 2000s (during the dove regimes); however, the MEI shock is the main determinant in the earlier part of the sample. In particular, the contribution of the MEI shock increases during the hawk regimes, while government spending and the discount shock explain the rest.

In a counterfactual experiment of a consistent dovish regime, Figure 8, monetary policy would
have been the main determinant of the interest rate during most of the sample, especially after the 1980s. Lastly, under the hawkish counterfactual (Figure 7) monetary policy would have had no role on the interest rate while the MEI shock would have been the main contributor.

In sum, during the hawkish regimes of the mid 2000s for inflation, and the dovish regime present in the early and late 2000s for the interest rate monetary policy is a key contributor. However, in general, a hawkish regime all along would have diminished the contribution of monetary policy to inflation and the interest rate, while a dovish regime would have exacerbated it.

The MEI shock increases its contribution to output and investment since the 1970s. It is also essential for inflation, and the interest rate up to the 1980’s dovish episode with brief dips during the 1970s dovish monetary policy regime. During the mid-2000s hawk regime the MEI shock determined output and investment and decreases its contribution during the dove interventions.
Therefore, the MEI shock’s overall contribution increases in the regime-switching model; mostly during the hawkish episodes.

6.3 Time-Varying Variance Decomposition: Historical Periods  Our counterfactual experiment shows that during the Great Inflation, the MEI shock would have increased its contribution to investment, inflation, and the interest rate under a hawkish regime but only very slightly. Therefore, we conclude that beliefs and other macroeconomic shocks played an essential role on the rise and fall of inflation in the 1970s.

If a dovish regime would have prevailed, and monetary policy had not changed with the appointment of Paul Volcker to the Fed, Figure 8 and in the onset of the Great Moderation. The role of financial markets through the MEI shock would have decreased for output, investment, and the interest rate. While the role of technology shocks on consumption and investment, and monetary policy on inflation and the interest rate would have been exaggerated; decreasing even further the role of the MEI shock right after the 1980s. In the regime switching, benchmark model we only see technology shock spikes on consumption and investment in the early 1980s, and the late 1980s dovish regimes (possibly during the stock market crash of 1987).

The dovish regime, Figure 8, decreases considerably the contribution of government spending on output, consumption, inflation and the interest rate mainly during the Great Moderation. However, if a hawkish regime would’ve been in place all along, it would have decreased the contribution of government spending on output, consumption, investment, and inflation in the late 2000s, when a dovish regime was in place as we approached the Great Recession.

In contrast with the Great Inflation, we observe considerable differences during the 2000s dovish regimes leading to the Great Recession under the counterfactual scenario of a hawkish regime. In the regime switching model we observe that in the early-mid 2000s, the MEI shock drove output. However, as the policy turned dovish, the contribution of the MEI shock falls and government spending becomes very important. In the counterfactual case of the all hawk regime, in the early 2000s, government spending would have been unimportant and the MEI shock would have driven output.

For consumption, government spending drops in the dovish episode of the 2000s, and IST takes its place, however in the end, government spending becomes important again. Under an all hawkish regime, government spending would have been important until the very end of the period.

For investment, in the regime switching model, the MEI shock’s contribution is strong during the mid-2000s, but in the early and late 2000s, the discount shock increases; a hawk in place would have slightly decreased the contribution of the discount shock in favor of the MEI shock.

The monetary policy shock determines inflation during the mid-2000s hawkish phase, and the interest rate during the dovish regimes in the early 2000s, and before the Great Recession. Inflation is affected by government spending and the MEI shock at the end of the sample, and the MEI shock determines the interest rate in the mid-2000s.
Therefore, the MEI shock would have accounted for most of the variation of output, investment, and the interest rate if the hawkish regime would have prevailed in the 2000s before the Great Recession. In the inflation case, we observe that the monetary policy shock would have driven it.

7 IMPULSE RESPONSES

As in Figure 9, the effect of a contractionary monetary policy shock varies between dove and hawk regimes, and the reaction depends on what decade it was produced. The hawk regimes of the 1963 and the dove regime of 1975, 2001, and 2006 affect output in a similar way. Output, consumption and investment fell in a humped shaped pattern turning slightly positive for a few periods. The inflation rate increased as a result of the monetary policy shock leading to the price puzzle.

During the hawk regimes of 1983, 1992, and 2004, output, investment, consumption and the inflation rate fell as expected. And the effect on these variables is much more pronounced that under the dove and hawk-pre-1970s regime. There is no price puzzle present in this graph. Therefore, the Bianchi-Nicolò algorithm shows that the dynamics present during the 1970s and the dove regimes are not a product of indeterminacy.

A government spending shock increases output, but decreases consumption and crowds out investment almost at the same magnitude, as plotted in Figure 10. Davig and Leeper (2011) found that a government spending shock increases output during all regimes, and decreases consumption under an active monetary/passive fiscal regime. The government spending shock has a positive effect on the interest rate during the hawkish regimes of 1983, 1992, and 2004, an effect that is not statistically significant during the dove regimes of 2001 and 2006, and a negative effect during the Great Inflation. Davig and Leeper (2011) found that the nominal interest rate increases after a government spending shock under all regimes. The government spending shock increases the inflation rate during the hawkish regimes, and decreases inflation during the dovinish regimes. The
nominal interest rate increases during all regimes in Davig and Leeper (2011), consistent with our findings under a hawkish monetary policy regime.

Figure 11 reports how the responses of the macro aggregates to discount factor shocks vary over time. The discount factor shock increases output, consumption, and decreases investment for all regimes. It increases the nominal interest rate and the inflation rate during the hawkish regimes but it has a negligible to negative effect on inflation and the interest rate during the dovish regimes, with a pronounced negative effect during the Great Inflation. The discount shock dynamics for output, inflation, and the interest rate are comparable to the impulse responses presented in Smets and Wouters (2005).

Lastly, as depicted in Figure 12, the MEI shock increases output, and investment with a slightly more pronounced effect during the hawk regimes. It causes a negative effect on consumption that
turns positive after approximately 8 periods, causing a stronger initial negative effect during the dovish regimes. The effect of the MEI shock is asymmetric with a positive effect on the interest rate and the inflation rate during the hawkish regimes, but a negative effect during both dovish regimes. The effect is stronger during the Great Inflation. The MEI shock dynamics under the hawkish regime correspond to the dynamics present under Justiniano et al. (2011).

We conclude that impulse responses under a hawkish regime are standard and have been previously described in the literature. However, the shocks present under our documented dovish regimes yield atypical responses. We have one exception, during the 1960s, a hawkish regime was in place however the responses are consistent with what we see during dovish regimes. These atypical responses are the product of the Fed’s erroneous beliefs about the structure of the economy described in Section 5.5.

8 THE GREAT INFLATION AND THE GREAT RECESSION

In our benchmark model we observe that the combination of Fed beliefs about the structure and performance of the economy, “bad luck” due to the sequence of adverse shocks that hit the economy, as well as a prolonged dovish monetary policy regime during the 1960s and 1970s were the determinants of the Great Inflation. We conclude that having a hawkish regime during the Great Inflation would have not changed the contribution of the shocks to the model variables. Therefore, a change in monetary regime alone would have been insufficient (in the presence of adverse shocks and erroneous beliefs) to avert the Great Inflation.

However, the appointment of chairman Volcker to the Federal Reserve in 1979 and the reported shift to a hawkish regime improved financial and economic stability, and decreased volatility of the shocks, making the MEI (financial sector) the main driver of the business cycle. Otherwise, as shown in the counterfactual under a dovish regime in Figure 8, the economy would have still been
vulnerable to technology and monetary policy shocks. Therefore, the switch to a hawkish regime as a fire extinguisher, citing Christopher Sim’s kitchen fire analogy [Sims (2012)], is capable of limiting the adverse impact of even a major shock.

We observe two switches to a dovish regime in the early 2000s and after 2006; in the prelude to the Great Recession. These were identified in Romer (2022) as episodes were the Fed was behaving timidly, observing undesirable shocks hitting the economy but choosing to respond partially or not at all and determining the behavior of interest rates. This timidity is in line with recent changes (2000) in the Fed’s monetary policy framework, where they would not respond to unemployment below potential if the inflation rate had not risen Romer (2022). The prevailing economic dynamics changed decreasing the contribution of the MEI shock, and leaving the economy susceptible to other shocks such as government spending and monetary policy. In particular, the monetary policy shock drove the interest rate.

We believe that the 2000s were different from the 1970s in the sense that we do not detect an increased volatility of the shocks, or erroneous beliefs about the structure of the economy driving monetary policy. We argue that the recorded prolonged dovish episode presents in the earlier part of the decade during the Fed’s timid phase, fueled the speculative investment that led to the housing crisis and eventually the Great Recession. Meltzer (2012) argues that the Fed propitiated the economy’s longest period of low inflation and relatively stable growth between 1985 and 2003 when it followed a Taylor rule. He also concludes that discretionary judgments, as we have observed in the current set-up through deviations to a dovish regime, brought about the Great Inflation, but in particular the current crisis by keeping interest rates too low for too long.

9 Conclusion

We conclude that it is important to discern between the causes of monetary policy evolution in the post war period. We find that a Taylor rule that switches between dove and hawk regimes is not able to identify the exact dates in which monetary policy objectives switched, because it is capturing also beliefs in the central bank model. However, when we allow for the possibility of regime switches in monetary policy explained by changes in policy preferences regarding inflation and output gap stabilization, we find that a “dove” regime was in place during the 1970s. Therefore, before the 1970s, a hawkish regime governed the conduction of monetary policy making it clear that erroneous beliefs about the structure of the economy led to the beginnings of the soaring inflation episode. We also find that the inflation stabilization efforts started with a switch to a hawkish regime in the late 1970s; when a hawkish monetary policy regime is put in place, the contribution of MEI shock that acts as a proxy for the functioning of the financial markets increases almost across the board.

We observe three additional switches to a dove regime; one in the late 1980s, one in the early 2000s, and one before the Great Recession. In these episodes we observe a decrease in the con-
tribution of the MEI shock leaving the economy vulnerable to the effects of other shocks such as government spending, monetary policy, and technology. Some of these observe switches to dovish regimes coincide with periods were the Fed was timidly acting to offset adverse economic shocks (2000−01 and 2007−08) and we believe that in the former case, it fueled the speculative investment that led to the Great Recession.
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