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U.S. TREND INFLATION REINTERPRETED: THE ROLE OF FISCAL POLICIES AND TIME-VARYING NOMINAL RIGIDITIES

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This paper offers a reinterpretation of the Fed's time-varying implicit inflation target, based on two considerations. The first is that the need to alleviate the burden of distortionary taxation may justify the choice of a positive inflation rate. The second is based on compelling evidence that the degree of price and wage indexation falls with trend inflation. In fact, we find that a proper characterization of the joint evolution of fiscal variables and nominal rigidities has a strong impact on the Ramsey optimal policies, implying optimal inflation dynamics that are consistent with the observed evolution of U.S. trend inflation. By contrast, tax policies have been too lax, especially at the time of the controversial Bush tax cuts.

Keywords: Trend Inflation, Monetary and Fiscal Policy, Ramsey Plan

1. INTRODUCTION

Recent years have witnessed increasing interest in the dynamics of U.S. inflation and output volatility, characterized by a post-1981 "Great Moderation" following the "Great Inflation" episode of the 1970s. Several explanations have been put forward for the observed gradual reduction in inflation and in macroeconomic volatility that characterized the U.S. economy up to the 2008 financial crisis. Some researchers pointed at a change in the stochastic processes driving structural supply and demand shocks [Stock and Watson (2003); Primiceri (2005); Sims and Zha (2006); Gambetti et al. (2008); Justiniano and Primiceri (2008)]. Others

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emphasized the Fed's shift to a rule-based approach, including more aggressive interest rate feedback on inflation [Carlstrom et al. (2009); Taylor (2012)].

A complementary view pinpoints changes in U.S. trend inflation as a key factor behind the end of the Great Inflation and the outset of the Great Moderation [Coibion and Gorodnichenko (2011)]. Cogley and Sbordone (2008) document a gradual reduction in the underlying core or trend inflation rate. Few macroeconomists would disagree with the statement that trend inflation is determined by the long-run target in the central bank's policy rule, and the drift in trend inflation is usually attributed to shifts in that target. Ireland (2007) estimates a New Keynesian model accounting for an exogenous, time-varying Fed's implicit inflation target. His results suggest that the target gradually rose from slightly above 1% at the end of the 1950s to over 8% in the second part of the 1970s; then it gradually fell to about 2% in 2004. Interpreting this result has proved difficult. A number of contributions suggest that the Fed opportunistically transformed supply shocks into persistent inflation changes in order to limit output losses in the 1970s, when shocks were mainly adverse; by contrast, the Fed acted in order to bring down inflation expectations, in the 1980s and 1990s, when shocks were mainly favorable [see Ireland (2007) and references cited therein]. Another interpretation sees changes in U.S. trend inflation as a consequence of policy makers' misperceptions and learning about the true structure of the economy.[1] According to evidence provided in Milani (2009), learning accounts for the bulk of observed volatility in U.S. trend inflation, and the implicit Fed's inflation target has remained in the –3% range throughout the whole postwar sample.

Leading macroeconomic models fit uncomfortably with empirical evidence and with these interpretations. According to Schmitt-Grohé and Uribe (2011), theories of monetary non-neutrality (accounting for monetary transaction costs, nominal rigidities, distortionary taxation, the zero lower bound, foreign holdings of domestic currency, and the untaxed informal economy) imply that the optimal rate of inflation ranges between the Friedman rule and a number insignificantly above zero.[2] Similarly, the implied optimal policy responses to shocks require minimal inflation volatility and permanent debt adjustment in order to obtain tax-smoothing over the business cycle. In this framework it is clearly impossible to rationalize the "opportunistic view" of the Fed's responses to shocks, which should have allowed large and persistent variations in inflation. Even interpretations based on policy makers' misperceptions and learning imply a relatively large inflation target.

This paper offers a reinterpretation of the Fed's time-varying implicit inflation target, based on two key factors. The first is a recent theoretical finding that the need to alleviate the burden of distortionary taxation may justify the choice of a positive inflation rate (and a substantially larger inflation volatility) when total fiscal outlays include a substantial amount of transfers in addition to the public consumption expenditures typically considered in macroeconomic models [Di Bartolomeo et al. (2013)]. The underlying intuition is relatively simple. Ceteris paribus, a permanent change in public consumption causes a fall in private consumption and in real money balances, eroding the inflation tax base. In contrast, an equivalent increase in public transfers has no effect on public consumption or real money balances. As a result, the optimal financing mix gradually tilts toward stronger reliance on inflation when transfers become relatively large. The second factor behind our interpretation is compelling evidence of a time-varying pattern in the parameters characterizing the pricing behavior of firms and wage setters, where the degree of indexation typically falls together with trend inflation [Benati (2008, 2009); Fernández-Villaverde and Rubio-Ramírez (2008)]. In fact, we find that a proper characterization of the joint evolution of fiscal variables and nominal rigidities has a strong impact on the Ramsey optimal policies, implying optimal inflation dynamics that are consistent with the observed evolution of U.S. trend inflation.

In a nutshell, our results are summarized as follows. We see a complementarity between our results and previous interpretations of U.S. inflation that emphasized the role of shocks and learning about the true structure of the economy. Up until the mid-1960s, the optimal inflation rate was virtually nil. Then the contemporaneous increase in public transfers and in the degree of inflation indexation caused a strong increase in the optimal inflation target, 6% by the mid-1970s. Finally, in the last part of the sample, the reduction in inflation indexation and the stabilization in the level of public transfers caused a fall in the optimal inflation rate.

We also determine the pattern of optimal tax policies. Our predicted fiscal revenues track the increase in observed revenues fairly closely up to the end of the 1970s, but they are systematically higher during the rest of the sample. This result is consistent with observed debt dynamics, characterized by a reduction until 1980 and a large increase thereafter. This is puzzling in the light of received interpretations of the observed patterns of inflation and output volatility. In fact, debt dynamics should have been consistent with the changes in the stochastic processes driving structural shocks. This implies that a debt increase should have been observed in the adverse economic environment of the 1970s, and a contraction should have occurred during the Great Moderation.

Our results also contribute to the ongoing debate about the "Great Deviation" of U.S. monetary policy in the years preceding the 2007 financial crisis [Taylor (2010, 2012)]. In fact our predicted optimal inflation rate is very close to observed inflation. By contrast, tax policies appear considerably lax, exactly at the time when the controversial Bush tax cuts occurred. During the Bush Administration, the 2001 and 2003 Tax Reform Acts significantly lowered the marginal tax rates, which lowered the relative tax burden on the rich and contributed to raising income inequality. This policy has generated a considerable controversy over who benefited from the tax cuts and whether or not they have been effective in spurring sufficient growth. Many critics have stated that the cuts increased the budget deficit.[3] We suggest that the role played by fiscal policy in causing the Great Deviation may have been underestimated.

The rest of the paper is structured as follows. The next section introduces our theoretical model. We consider a remarkably simple model, which abstracts from capital accumulation but takes into account monetary transactions costs, monopolistic competition in goods and labor markets, price and wage stickiness and inflation indexation. Section 3 presents the results. The final section concludes.

2. THE MODEL

We set up a simple DSGE model characterized by standard nominal and real frictions. The nominal frictions include sluggish price and wage adjustments with indexation to past inflation. The real rigidities originate from monopolistic competition in both goods and labor markets. In addition, a transaction technology where money facilitates transactions makes it possible to motivate a money demand function. Exogenous government expenditures (public consumption, transfers, and interest payments on debt) are financed by a distortionary labor-income tax, money creation (inflation tax), and issuance of one-period, nominally risk-free bonds.

2.1. Households

The economy is populated by a continuum of households of measure 1. Household i's preferences are

$$U_i = E_{t=0} \sum_{t=0}^{\infty} \beta^t u(C_{t,i}, l_{t,i}), \tag{1}$$

where $\beta \in (0, 1)$ is the discount factor, $C_{t,i} = (\int_0^1 c_{t,i}(j)^\rho dj)^{1/\rho}$ is a consumption bundle, and $l_{t,i}$ is a differentiated labor type that is supplied to all firms.

The household's flow budget constraint is

$$C_{t,i}\left(1 + S_{t,i}\right) + \frac{M_{t,i}}{P_t} + \frac{B_{t,i}}{P_t} = \frac{(1-\tau_t)\, W_{t,i} l_{t,i}}{P_t} + \frac{M_{t-1,i}}{P_t} + \theta_t + T_t$$
$$+ \frac{R_{t-1} B_{t-1,i}}{P_t} - \frac{\xi_w}{2}\left(\frac{W_t(i)/W_{t-1,}(i)}{\pi_{t-1}^{\delta_w}} - 1\right)^2, \tag{2}$$

where $W_{t,i}$ is the nominal wage; τ_t is the labor income tax rate; T_t denotes real fiscal transfers; θ_t are firms' profits; R_t is the gross nominal interest rate; and $B_{t,i}$ is a nominally riskless bond that pays one unit of currency in period $t+1$. $M_{t,i}$ defines nominal money holdings to be used in period $t+1$ to facilitate consumption purchases. Consumption purchases are subject to a transaction cost, $S_{t,i} = s(v_{t,i})$, where $v_{t,i} = P_{t,i} C_{t,i}/M_{t,i}$ is the household's consumption-based money velocity. The features of $s(v_{t,i})$ are such that a satiation level of money velocity ($v^* > 0$) exists where the transaction cost vanishes and, simultaneously, a finite demand for money is associated with a zero nominal interest rate. We assume that $s(v_{t,i})$ is twice continuously differentiable and $(v_{t,i} - v^*)s'(v_{t,i}) > 0$.[4] Households also set wages facing a quadratic adjustment cost à la Rotemberg (1982). $\xi_w > 0$ is a measure of wage stickiness and $\delta_w \in [0, 1]$ is the degree of wage indexation to past inflation; i.e., $\pi_t = P_t/P_{t-1}$. Each household maximizes the expected value of (1) subject to the labor demand (described in the next section).

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2.2. Firms

Each firm (j) produces a differentiated good in a monopolistically competitive environment using labor services. The production technology is given by

$$y_t(j) = z_t l_{t,j}, \tag{3}$$

where z_t denotes a productivity shock[5] and $l_{t,j} = [\int_0^1 l_{t,j}(i)^{(\sigma-1)/\sigma} di]^{\sigma/(\sigma-1)}$ is a standard labor bundle. Firm (j)'s demand for labor type (i) is

$$l_{t,j}(i) = \left(\frac{w_{t,i}}{W_t}\right)^{-\sigma} l_{t,j}, \tag{4}$$

where $W_t = [\int_0^1 w_{t,i}^{1-\sigma} di]^{1/(1-\sigma)}$ is the wage index. We assume a sticky price specification based on Rotemberg (1982)'s quadratic cost of nominal price adjustment: $\frac{\xi_p}{2}(\frac{P_t(j)/P_{t-1}(j)}{\pi_{t-1}^{\delta_p}} - 1)^2$, where $\xi_p > 0$ is a measure of price stickiness and $\delta_p \in [0, 1]$ is the degree of price indexation to past inflation.

2.3. Fiscal Sector

The consolidated government supplies an exogenous, stochastic, and unproductive amount of public good G_t and implements exogenous transfers T_t.[6] Government financing is obtained through a labor-income tax, money creation, and issuance of one-period, nominally risk-free bonds. Its period-by-period budget constraint is

$$R_{t-1}\frac{B_{t-1}}{P_t} + G_t + T_t = \tau_t \frac{W_t}{P_t} l_t + \frac{M_t - M_{t-1}}{P_t} + \frac{B_t}{P_t}. \tag{5}$$

As in Schmitt-Grohé and Uribe (2004a), $\ln g_t$, where $g_t = \frac{G_t}{Y_t}$, is subject to shocks following an independent $AR(1)$ process.

2.4. Competitive Equilibrium

The competitive equilibrium is obtained by solving the representative household's and firm's problems.[7]

The household's first-order conditions are

$$\lambda_t = \frac{u_c(C_t, l_t)}{1 + s(v_t) + v_t s'(v_t)}, \tag{6}$$

$$\frac{\lambda_t}{\lambda_{t+1}} = \beta \frac{R_t}{\pi_t}, \tag{7}$$

$$\frac{R_t - 1}{R_t} = s'(v_t) v_t^2, \tag{8}$$

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$$c_{t,i}(j) = C_{t,i}\left(\frac{p_t(j)}{P_t}\right)^{\frac{1}{\rho-1}}, \tag{9}$$

$$\left[\frac{W_t}{P_t} + \mu^w \Omega_t \frac{u_l(C_t, l_t)}{u_c(C_t, l_t)}\right]\frac{l_t(1-\tau_t)}{\mu^w - 1} + \xi_w \omega_t \pi_{t-1}^{-\delta_w}\left(\omega_t \pi_{t-1}^{-\delta_w} - 1\right) \tag{10}$$
$$= E_t \beta \frac{\lambda_{t+1}}{\lambda_t}\xi_w \omega_t \pi_t^{-\delta_w}\left(\omega_{t+1}\pi_t^{-\delta_w} - 1\right).$$

Condition (6) states that the transaction cost introduces a wedge between the marginal utility of consumption and the marginal utility of wealth that vanishes only if $v = v^*$. Equation (7) is a standard Euler condition. Equation (8) implicitly defines the household's money demand function. Equation (9) defines consumer demand for product j. Correspondingly, the consumption price index is $P_t = (\int_0^1 p_t(i)^{\rho/(\rho-1)} di)^{(\rho-1)/\rho}$. Equation (11) defines the wage adjustment rule, where $\omega_t = W_t / W_{t-1}$ is the gross wage inflation rate; $\mu^w = \frac{\sigma}{\sigma-1}$ defines the markup generated by monopolistic competition under flexible nominal wages; $\Omega_t = \frac{1+s(v_t)+v_t s'(v_t)}{1-\tau_t}$ defines the policy wedge, which depends on both tax and inflation distortions.

The representative firm maximizes profits, $\theta_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-1/(\rho-1)} y_t(j) - W_t l_{t,j} - \frac{\xi_p}{2}\left(\frac{P_t(j)/P_{t-1}(j)}{\pi_{t-1}^{\delta_p}} - 1\right)^2$. In the symmetric equilibrium, the resulting firm's price adjustment rule is

$$\frac{\mu^p l_t}{\mu^p - 1}\left(\frac{1}{\mu^p} - \frac{W_t}{P_t}\right) + \frac{\xi_p \pi_t}{\pi_{t-1}^{\delta_p}}\left(\frac{\pi_t}{\pi_{t-1}^{\delta_p}} - 1\right) = E_t \frac{\beta \lambda_{t+1}}{\lambda_t}\frac{\xi_p \pi_{t+1}}{\pi_t^{\delta_p}}\left(\frac{\pi_{t+1}}{\pi_t^{\delta_p}} - 1\right), \tag{11}$$

where $\mu^p = \frac{1}{\rho}$ defines the flex-price markup. Equation (11) is a conventional New Keynesian Phillips curve, which simply states that the presence of price-adjustment costs prevents firms in the short run from setting their prices to equate marginal revenue to marginal cost.

Finally, the aggregate resource constraint is

$$Y_t = C_t(1 + S_t) + G_t + \frac{\xi_p}{2}\left(\frac{\pi_t}{\pi_{t-1}^{\delta_p}} - 1\right)^2 + \frac{\xi_w}{2}\left(\frac{\omega_t}{\pi_{t-1}^{\delta_w}} - 1\right)^2. \tag{12}$$

The competitive equilibrium is thus a set of plans $\{C_t, l_t, \lambda_t, \mathrm{mc}_t, \pi_t, v_t\}_{t=0}^{+\infty}$ that, given the policies $\{R_t, \tau_t\}_{t=0}^{+\infty}$, the exogenous processes $\{z_t, g_t\}_{t=0}^{+\infty}$, and the initial conditions, satisfies the first-order conditions (6)–(12).

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2.5. Ramsey Solution

The Ramsey solution is a set of plans $\{R_t, \tau_t\}_{t=0}^{+\infty}$ that maximizes the expected value of (1) subject to to the competitive equilibrium conditions (6)–(12), the government budget constraint (5), and the exogenous stochastic processes driving the fiscal and technology shocks.[8]

3. FUNCTIONAL FORMS AND CALIBRATION

We assume that the instantaneous utility for the representative household (i) takes the form of a simple log-log function,

$$u(C_{t,i}, l_{t,i}) = \ln C_{t,i} + \eta \ln(1 - l_{t,i}), \tag{13}$$

and we formalize $s(v_{t,i})$ as

$$s(v_{t,i}) = \left(A v_{t,i} + \frac{B}{v_{t,i}} - 2\sqrt{AB} \right) C_t^{-\theta}. \tag{14}$$

When $\theta = 0$, equation (14) is as in Schmitt-Grohé and Uribe (2004a). In this case, as B approaches zero, (14) becomes linear in velocity and the implicit demand for money has the Baumol–Tobin square-root form with respect to the opportunity cost of holding money.[9] When $0 < \theta < 1$, monetary transaction costs exhibit decreasing returns to scale and the consumption elasticity of the implicit money demand function is smaller than 1.

By combining (8) and (14), we can now derive an explicit money demand function:

$$\frac{M_t}{P_t} = \frac{C_t^{1-\theta}}{\sqrt{\frac{B}{A} + (R_t - 1)\frac{1}{A}}}. \tag{15}$$

The solution of the Ramsey plan requires numerical simulations. We set the subjective discount factor β at 0.96, consistent with a steady-state 4% real interest rate (the time unit is meant to be a year).[10] Following Schmitt-Grohé and Uribe (2004a), transaction cost parameters A and B are set at 0.011 and 0.075, respectively, and the consumption scale parameter θ is set at 0. The price markup, μ^p, is set at 1.2, as in Schmitt-Grohé and Uribe (2004a). We choose 1.05 for μ^w. The annualized Rotemberg price and nominal wage adjustment costs (ξ_p, ξ_w) are set at 4.375,[11] in line with Hofmann et al. (2012), who also report that these parameters are rather stable during the postwar period.

We allow time variation in the degree of inflation indexation and in the fiscal ratios B/Y, G/Y, T/Y (Table 1). The inflation indexation parameters are taken from Hofmann et al. (2012); the fiscal variables are obtained from the National Accounts (NIPA) data and from the Economic Report of the President.

Table 1 and Figures 1 and 2 reflect the dynamics of fiscal variables and price and wage indexation. Public debt as a percentage of GDP fell rapidly in the post–World War II period. It reached a low first in 1973 under the Nixon administration.

TABLE 1. Time-varying parameters

Sample period	B/Y	G/Y	T/Y	δ_p	δ_w
1960–2005	0.49	0.15	0.095	0.4	0.5
1960–1969	0.48	0.17	0.055	0.3	0.4
1970–1984	0.36	0.16	0.09	0.8	0.9
1985–2005	0.55	0.14	0.10	0.2	0.2

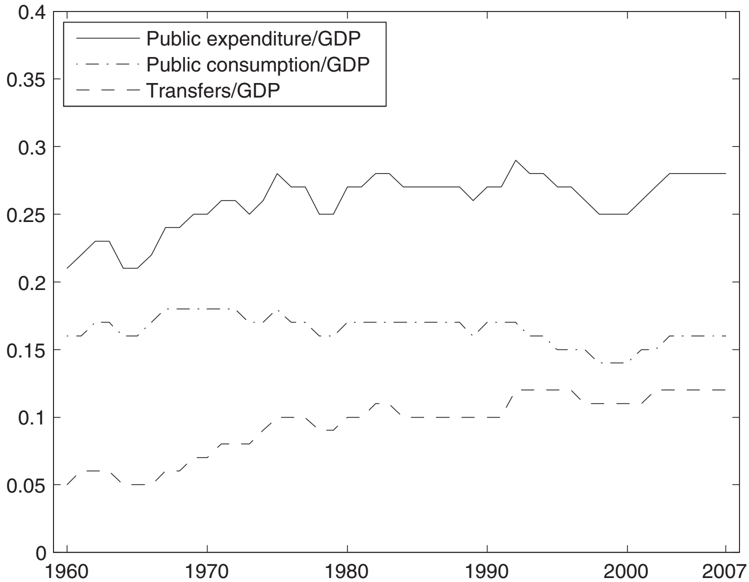

FIGURE 1. Fiscal outlays.

The debt burden then increased until the mid-1990s. In the early 2000s, sharp increases in deficits have implied a new inversion in the debt dynamics. Government consumption remains fairly constant in the entire sample at about 15%. During the Kennedy and Johnson years, the budget share going to transfers was stable and relatively low. During the Nixon[12] and successive administrations, transfer payments increased from 5% to 10%. This level wa reached around 1980 and remained stable thereafter.

Microeconomic data on indexation show that, from the late 1960s onward, the coverage of private sector workers by cost-of-living adjustment clauses steadily increased to levels around 60% in the mid-1980s, after which there was again a decline toward 20% in the mid-1990s, when the reporting of coverage was discontinued. The estimation of Hofmann et al. (2012) supports the idea of time variation in price and wage indexation. In particular, they show that lagged price inflation had a significant impact on wage inflation until the early 1980s, but they

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TABLE 2. Predicted and observed inflation

Sample period	π_{av}	π_{av}^{R}	π_{av}^{SGU}
1960–2005	4.26	2.08	−0.46
1960–1969	2.35	0.61	−0.63
1970–1984	7.00	3.15	−0.82
1985–2005	3.05	2.03	−0.11

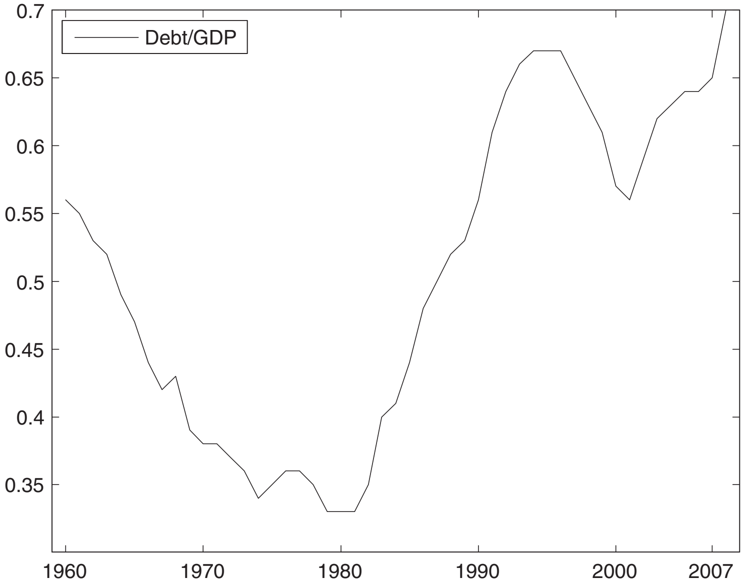

FIGURE 2. Real debt dynamics.

do not find a significant effect afterward. Theodoridis et al. (2012) find a similar path for both price and wage time-varying indexation by a time-varying parameter VAR in the seven U.S. variables used to estimate the model of Smets and Wouters (2007).

4. RESULTS

In Table 2 we report the Ramsey optimal inflation rate, π_{av}^{R}, its corresponding value obtained when transfers are neglected as in Schmitt-Grohé and Uribe (2004a), π_{av}^{SGU}, and observed average-inflation values, π_{av}, for the whole sample period (1960–2005) and for the subsamples 1960–1969, 1970–1984, and 1985–2005. In addition, to get more insights into how the dynamic pattern of fiscal expenditure variables affects optimal inflation rates, in Figure 3 we plot π, π^{R}, and π^{SGU}, where

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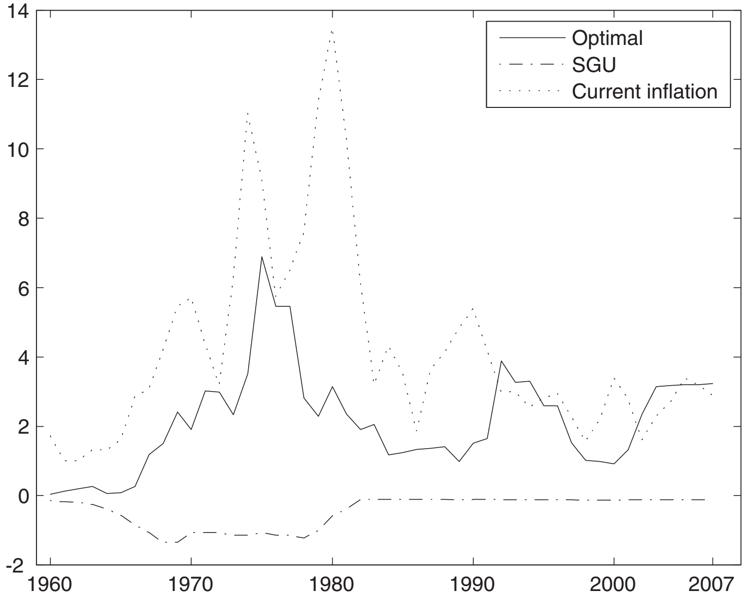

FIGURE 3. Inflation dynamics.

the latter two variables are obtained assuming that, in the absence of shocks, the policy maker reacts to the contemporaneous values of fiscal variables (described in Figures 1 and 2) as if they were at their steady-state values.[13] This is an admittedly rough-and-ready method for capturing the shifting government targets for these variables, but the alternative of filtering actual public expenditure variables to obtain implicit time-varying targets would not produce substantially different results.

The table and figure highlight a trade-off between the need, imposed by price adjustment costs and monetary transaction costs, to keep the inflation rate close to zero and the need to finance public expenditures. By taking account of transfers, in fact, we are able to predict positive optimal inflation rates, resurrecting the Phelps argument of using inflation for financing public expenditures. The trade-off is also influenced by the degree of indexation in prices and wages, which mitigates the costs of deviating from a zero inflation rate.

According to Schmitt-Grohé and Uribe (2011), public transfers may support a positive inflation rate, as they represent an inelastic source of income for the household. For this reason, the Ramsey planner wishes to tax this type of income heavily. Di Bartolomeo et al. (2013) provide a complementary explanation based on the finding that transfers and public consumption imply different Laffer curves for inflation revenues, where the one associated to public consumption is unambiguously steeper. In fact, a permanent change in public consumption causes a fall in private consumption and in demand for real money balances, eroding the inflation tax base. In contrast, an equivalent increase in public transfers has no direct effect on demand for real money balances. Thus, the optimal financing mix gradually tilts toward stronger reliance on inflation as transfers become relatively larger.

Looking at Table 2 and Figure 1, the pattern of π^{SGU} is clearly unrelated to observed inflation. It is interesting to note that during the Great Inflation the relatively large degree of inflation indexation induces the policy maker to choose an inflation rate that is even closer to the Friedman rule! A theoretical interpretation of this result is provided in Schmitt-Grohé and Uribe (2011), who show that inflation indexation tilts the optimal inflation rate toward the Friedman rule when the public finance motive does not matter. In contrast, Di Bartolomeo et al. (2013) show that indexation causes a substantial increase in the optimal inflation rate when public transfers are sufficiently large. In fact, π^{R} is characterized by a strong increase in the 1970s and tracks actual inflation fairly closely since the beginning of the 1990s.

Note that π^{R} is very small in the 1960s and its increase *follows* the surge in the level and persistence in actual inflation that we observe since the mid-1960s.[14] In a sense, we see a complementarity between our results and previous interpretations of U.S. inflation that emphasized the role of shocks and learning about the true structure of the economy. Up until the mid-1960s, the optimal inflation rate was virtually nil. Then the contemporaneous increase in public transfers and in the degree of inflation indexation caused a strong increase in the optimal inflation target, 6% by the mid-1970s. In the last part of the sample, the reduction in inflation indexation and the stabilization in the level of public transfers cause a fall in the optimal inflation rate.

To complete our analysis, we discuss the dynamics of tax variables. In Figure 4 we plot observed taxes as a ratio of GDP and the predicted tax revenue ratios associated with the τ^{R}, τ^{SGU} tax rates obtained when computing π^{R}, π^{SGU}. It is easy to see that fiscal revenues under τ^{SGU} simply follow the dynamics of public consumption expenditures. Under τ^{R}, predicted fiscal revenues track the increase in actual revenues fairly closely up to the end of the 1970s, but they are systematically higher than actual revenues during the rest of the sample. This result is obviously related to the pattern of debt dynamics reported in Figure 3, where the end of the 1970s marks a clear turning point. In the first part of the sample, the policy mix allowed a large reduction in the debt-to-GDP ratio. Since then, tax policies have caused a complete reversal in debt dynamics, and particularly so between 2000 and 2007. This result is puzzling in the light of received interpretations of the observed patterns of inflation and output volatility during the Great Inflation and Great Moderation episodes. In fact, a debt increase should have been observed at a time of adverse shocks and uncertainty—the Great Inflation episode—and such accumulation should have been reversed during the more favorable Great Moderation period [Schmitt-Grohé and Uribe (2004a); Di Bartolomeo et al. (2013)].

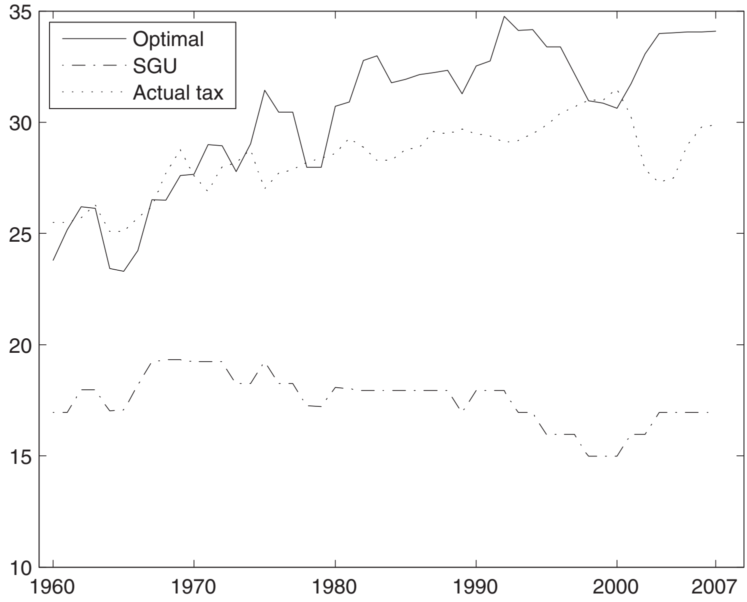

FIGURE 4. Tax dynamics.

In comparing inflation and tax dynamics, it is worth noticing that our predicted optimal inflation rate is very close to observed inflation, but tax policies appear considerably more lax, exactly at the time when the controversial Bush tax cuts occurred. The rule of this "fiscal deviation" may be underestimated in the ongoing debate about the Great Deviation of U.S. monetary policy, which focuses on monetary policy and post-2009 discretionary interventions. Some roots of the Great Deviation can be found in the tax laxness of the early 2000s, which has required successive policy adjustments. However, the issue needs further investigation that is beyond the scope of the present paper.

5. CONCLUSIONS

This paper reconsiders the issue of Ramsey-optimal inflation and tax policies in the context of the U.S. economy. We are able to rationalize the existence of a positive, time-varying optimal inflation rate, whose dynamics are driven by the public finance motive put forward in Phelps (1973) and by changing degrees of price and nominal wage indexation. Our interpretation is broadly consistent with interpretations that see a combination of learning and changes in the stochastic processes driving structural shocks as the key factors behind the Great Inflation and the Great Moderation episodes.

We uncover a puzzling pattern of tax policies, which, in contrast with theoretical macro-models, generated the reduction of public debt at a time of great uncertainty

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and of adverse shocks, and its accumulation later on, when the economic context was relatively favorable. Interpretations of the Great Moderation typically overlook the role of fiscal policies. Our contribution calls for further research about the (temporary) effect of these policies in dampening macroeconomic fluctuations.

NOTES

1. See Sargent (2001), Cogley and Sargent (2005), Primiceri (2005), and Sargent et al. (2006).

2. There are a few exceptions based on special assumptions. For example, de V. Cavalcanti and Villamil (2003) find that the optimal inflation tax is positive when the existence of a large informal sector is assumed; however, their results only hold for some developing countries. Graham and Snower (2013) show that low positive rates of inflation can be optimal, assuming hyperbolic discounting.

3. On the effects of Bush tax cuts, see among others Auerbach (2002), Gale and Orszag (2004a, 2004b), Krugman (2007), and Bartels (2008).

4. See, e.g., Sims (1994), Schmitt-Grohé and Uribe (2004a, 2011), Guerron-Quintana (2009), Altig et al. (2011).

5. We assume that $\ln z_t$ follows an $AR(1)$ process.

6. Note that the focus of the paper is the identification of the optimal financing mix, where optimality is driven by efficiency considerations. Justifying the existence of government transfers as an optimal outcome would require some form of heterogeneity across households. This is beyond the scope of the paper.

7. In the following we assume the symmetrical equilibrium and subindices i, j are therefore dropped. In addition, we rule out Ponzi schemes.

8. Solution requires numerical simulations. These are obtained by implementing Schmitt-Grohé and Uribe (2004b)'s approximation routines. We report a first-order approximation. A second-order approximation leads to similar results [see also Schmitt-Grohé and Uribe (2004a); Di Bartolomeo et al. (2011, 2013)].

9. Moreover, it would be easy to parameterize (14) to replicate a Cagan (1956) demand function (proof available upon request).

10. Results are robust with respect to different assumptions on the interest rate. A change of 1% in the steady-state real interest rate has second-order (quantitative) effects on our results. Simulations are available upon request.

11. This implies that contracts are reoptimized every 9 months on the average.

12. Between Nixon's inauguration and his resignation, transfer payments by the national government rose from 24% to 43% of the U.S. budget.

13. Note that public expenditure components include interest payments on previous-period government debt. We also allow time-varying price and wage indexation parameters, as in Hofmann et al. (2012). More specifically, we use averages for the pre-Great Inflation, Great Inflation, and Great Moderation periods (see Table 1) and smooth the transition between one sample period and the subsequent one using a four-point linear interpolation.

14. We found that Granger causality runs from observed to predicted inflation and not vice versa. Results are available upon request.

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