The Value of Monetary Policy Commitment under Imperfect Fiscal Credibility*

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Abstract

A central finding of the previous monetary policy research is that commitment to a policy rule results in substantial welfare gains. In this paper, I reevaluate the value of monetary policy commitment in an environment where monetary and fiscal policies are conducted by separate administrative branches of the government which potentially differ in their commitment capacities. I find that welfare gains from monetary policy commitment can be very small if the fiscal policy maker can exercise a certain degree of commitment on his own. Under a reasonable parametrization, a moderate improvement in fiscal commitment capacity can substantially reduce the welfare gains from full commitment in monetary policy. Accordingly, it is in the presence of full fiscal discretion when monetary commitment matters most and results in considerable welfare gains.

Keywords: Quasi-commitment; Optimal fiscal and monetary policy

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1 Introduction

Since the pioneering works of Kydland and Prescott (1977) and Barro and Gordon (1983), numerous studies have investigated the welfare implications of commitment in monetary policy. A fairly common result that emerges from a variety of model specifications is that commitment to a monetary policy rule yields sizable welfare gains. Many studies, however, either entirely ignore the role of fiscal policy or disregard institutional or preferential differences that might potentially characterize the conduct of fiscal and monetary policies. In this paper, I explore the implications of fiscal policy credibility on welfare gains from monetary policy commitment. I analyze an economy in which fiscal and monetary policies are designed by two separate administrative branches of the government. I show that the degree of commitment with which fiscal spending policies are conducted has strong implications on the welfare consequences of commitment in monetary policy. In particular, welfare gains from full monetary commitment can be very small if the fiscal authority is able to independently exercise a small degree of commitment on its own.

In dynamic economies, rational agents' current actions depend on future expectations of government policies. Thus, an optimizing policy maker must account for the influence of its policy choices on private agents' expectations. In the absence of a commitment mechanism that grants the ability to follow a particular contingency plan, the policy maker cannot manipulate future expectations. As is well known, in the face of cost-push disturbances, this results in a less favorable monetary policy trade-off between stabilizing inflation and stabilizing the output gap and often leads to suboptimal equilibrium outcomes. In this paper, I demonstrate that commitment on the part of the fiscal authority can substantially improve the monetary policy trade-off. Since the manner in which government spending policies are conducted has a large impact on future inflation expectations, fiscal policy commitment can potentially remedy the adverse welfare effects of monetary discretion. It is in this sense important to account for the degree of fiscal credibility to accurately assess the welfare gains resulting from monetary policy commitment.

Following much of the literature, I adopt the standard new-Keynesian setup laid out in Clarida et al. (1999) as my departure point. In the considered version, government spending provides direct utility to the household and is determined by the fiscal policy maker so as to maximize social welfare. Since private agents are forward-looking, in the absence of a commitment device, policy makers fail to internalize the effects of their current actions on the past behavior of households and firms. This results in a time-inconsistency problem for both policy authorities. The policy makers tend to deviate from their previously announced plans by creating surprise inflation whenever they revise and reoptimize their ongoing policy strategies.

In the model economy, fiscal and monetary policies are conducted individually in a non-cooperative fashion. In this environment, when a cost-push shock hits the economy, the fiscal policy maker attempts to curb inflationary pressures by executing a persistent cut in spending in excess of what would be implemented had fiscal and monetary policies been conducted by a single benevolent policy maker. This implies an excessive reduction in public good provision, yet, helps to control inflation expectations and, in doing so, improves the trade-off the monetary authority faces between stabilizing inflation and stabilizing the output-gap. Under cost-push pressures, the ability to manipulate future inflation expectations is the key to improved stabilization outcomes. As the commitment capacity of the fiscal policy maker improves, the promise of a contractionary spending policy becomes more credible rendering the fiscal authority more effective in controlling inflation expectations. As a result, monetary policy trade-off improves further and monetary commitment becomes less relevant for welfare outcomes. I find that, under a reasonable parametrization, even a small degree of fiscal commitment can single-handedly deliver a substantial improvement in stabilization terms making monetary commitment significantly less effective in influencing social welfare.

The degree of fiscal credibility in the model is measured by the expected duration of a fiscal commitment episode. Following Schaumburg and Tambalotti (2007), it is assumed that each period, with some probability $\alpha \geq 0$, a new fiscal administrator takes over. Whenever a fiscal regime change occurs, the new administrator revises and reoptimizes the ongoing spending policy, which in general results in a repudiation of the promises made by the previous regime. Each fiscal regime is endowed with a quasi-commitment device which ensures that the regime has the ability to follow a particular policy plan of his choice during his own term. In this setup, the probability α determines the expected duration of a fiscal commitment episode and provides us with a continuous measure of fiscal credibility. The adoption of this measure unveils certain key aspects of the relationship between fiscal credibility and the value of monetary commitment, which otherwise could not be discovered within the framework of the conventional "full discretion vs. full commitment" specification. It is found that the welfare gains from commitment in monetary policy monotonically decrease in the degree of fiscal credibility. Furthermore, the relationship is highly non-linear. A moderate increase in expected duration of fiscal commitment from a single quarter to two quarters has the largest impact on the value of monetary commitment. The marginal improvement in monetary policy trade-off resulting from an extra quarter of fiscal commitment diminishes fast and is almost entirely exhausted once the expected duration of fiscal commitment extends beyond a fiscal year.

This paper contributes to the strand of the literature that quantitatively evaluates the welfare benefits of commitment in monetary policy. Previously, Dennis and Soderstrom

(2006) evaluated the welfare gains from monetary policy commitment using various alternative models and found that they can be as large as the gains resulting from a 3.6% permanent reduction in inflation. Using the standard new-Keynesian model, McCallum and Nelson (2004) find that the welfare gains generated by a shift from optimal discretion to a timelessly optimal policy is about 15% to 20% of the loss under discretion for a plausible range of parameter values. Schaumburg and Tambalotti (2007) study the welfare implications of quasi-commitment in monetary policy and showed that substantial gains accrue at relatively low levels of credibility. Also, Adam and Billi (2007) demonstrate that when the policy maker takes into account the presence of a zero lower bound on nominal interest rates, welfare gains generated by monetary commitment (expressed in terms of permanent consumption) can increase by 65%. In these studies, however, welfare computations are based on the assumption that the monetary authority is able to oversee the entire macroeconomic policy process without having to interact with the fiscal component of the government in a non-trivial manner. On the contrary, empirical studies provide substantial evidence in support of strong interactions between the two policy institutions (see, e.g., Muscatelli et al., 2004a, 2004b). In addition, a large theoretical literature studies monetary-fiscal policy interactions in a variety of contexts (see, e.g., Schmitt-Grohe and Uribe 2007, Adam and Billi 2005, Dixit and Lambertini 2003). In the light of the empirical evidence and theoretical results, it appears highly desirable, if not imperative, to take into account potential interaction channels between monetary and fiscal policies to accurately evaluate the value of monetary policy commitment. To this end, I focus on the interaction of government spending and nominal interest rate policies and show that the welfare gains from monetary policy commitment can be as low as the gains resulting from a 0.1% permanent increase in quarterly consumption if the fiscal policy is able to commit to a spending plan for only 4 quarters on average.

The remainder of the paper is organized as follows. The theoretical model is outlined and the implementability constraints for the optimal policy problem are derived in Section 2. Section 3 describes the fiscal quasi-commitment and monetary commitment problems, characterizes the solutions and discusses the dynamic responses of the economy under the optimal policies. Section 4 presents the welfare analysis and establishes the monotonicity and non-linearity results regarding the relationship between the degree of fiscal credibility and the value of monetary commitment. Welfare implications of an alternative setup in which monetary and fiscal authorities switch roles are also discussed in Section 4. Section 5 summarizes the main results and concludes.

2 Model

The model economy is inhabited by a large number of households, monopolistically competitive firms, and a government, which consists of a fiscal policy maker and a monetary authority.

2.1 Households

Households are infinitely lived, identical and have time-separable preferences that depend on consumption of private and public composite goods and work effort. Households maximize

$$U_s = E_s \left\{ \sum_{t=s}^{\infty} \beta^{t-s} \left(\frac{C_t^{1-\kappa} - 1}{1-\kappa} + \frac{G_t^{1-\eta} - 1}{1-\eta} - \frac{L_t^{1+\phi}}{1+\phi} \right) \right\} \tag{1}$$

where $\beta \in (0,1)$, $\phi > 0$ and $\kappa, \eta > 1$. The variable C_t denotes private consumption, G_t stands for public good consumption and L_t denotes work effort.

The private and public consumption indices are specified as CES aggregates of differentiated products indexed by $i \in [0,1]$. More specifically, $C_t = \left(\int_i C(i)_t^{(\theta_t - 1)/\theta_t} di \right)^{\theta_t/(\theta_t - 1)}$ and $G_t = \left(\int_i G(i)_t^{(\theta_t - 1)/\theta_t} di \right)^{\theta_t/(\theta_t - 1)}$ where $C(i)_t$ and $G(i)_t$ respectively denote the private and public consumption of the i^{th} product. The parameter $\theta_t > 1$ denotes the elasticity of substitution between differentiated products and is assumed to follow a stochastic process of the form $\ln \theta_t = (1-\rho_\theta) \ln \theta + \rho_\theta \ln \theta_{t-1} + \varepsilon_{\theta,t}$ where $\theta > 1$, $0 \leq \rho_\theta < 1$ and $\varepsilon_{\theta,t}$ is *i.i.d.* Note that an aggregate price index can be constructed as $P_t = \left(\int_i P(i)_t^{1-\theta_t} di \right)^{1/(1-\theta_t)}$, where $P(i)_t$ denotes the price level for the i^{th} differentiated product. The aggregate price index gives the minimum expenditure needed to assemble one unit of composite consumption. Further, the CES specification implies that the optimal allocation of demand among differentiated products obeys the rule $C(i)_t = (P(i)_t/P_t)^{-\theta_t} C_t$.

Households provide labor services to manufacturers and have access to a bond market where they trade one-period discount bonds. Households also pay lump-sum taxes or receive transfers. The sequential household budget constraint can be constructed as

$$P_t C_t + B_t \leq W_t L_t - T_t + R_{t-1} B_{t-1} + \int_j \Gamma(j)_t dj \tag{2}$$

where W_t denotes the nominal wage rate, R_{t-1} stands for the gross nominal interest rate, T_t denotes in nominal terms the lump-taxes (or transfers) and $\int_j \Gamma(j)_t dj$ stands for the dividends distributed by firms. Furthermore, each household faces the constraint $\lim_{k \to \infty} E_t (\Pi_{s=0}^{t+k-1} R_s^{-1}) B_{t+k} \geq 0$, which rules out Ponzi schemes. Households choose $\{C_t, L_t, B_t\}_{t=s}^{\infty}$ to maximize (1) subject to (2) and the no-Ponzi-game constraint taking as given $\{W_t, P_t, R_t, T_t, \Gamma_t\}_{t=s}^{\infty}$ and the initial value B_{s-1}. Household optimization yields the standard first-order conditions

$$C_t^{-\kappa} = \beta E_t \left(R_t \frac{P_t}{P_{t+1}} C_{t+1}^{-\kappa} \right) \tag{3}$$

$$\frac{L_t^{\phi}}{C_t^{-\kappa}} = \frac{W_t}{P_t}. \tag{4}$$

Expressions (3) and (4) are respectively the intertemporal substitution and labor supply equations.

2.2 Firms

The production sector is populated by a large number of monopolistically competitive firms indexed by $j \in [0,1]$. Firms hire labor services from a competitive factor market and produce differentiated products using a constant-returns-to-scale technology $Y(j)_t = A_t L(j)_t$, where $Y(j)_t$ denotes the production of the j^{th} good, $L(j)_t$ is the labor input of the j^{th} firm and A_t is a factor productivity parameter, which follows an AR(1) process of the form $\ln A_t = (1-\rho_A)\ln A + \rho_A \ln A_{t-1} + \varepsilon_{A,t}$ where $A > 0$, $0 \leq \rho_A < 1$ and $\varepsilon_{A,t}$ is *i.i.d.* Following Rotemberg (1982), firms are assumed to face quadratic price adjustment costs given in real terms by $\frac{\psi}{2}\left(\frac{P(j)_t}{P(j)_{t-1}} - 1\right)^2$ with $\psi > 0$. Each firm sets the price level for its differentiated product to maximize the expectation of present and future discounted profits. At a symmetric equilibrium (which involves $P(j)_t = P_t \; \forall j$), firm maximization yields

$$\psi \widetilde{\Pi}_t - \theta_t Y_t \left(\frac{W_t}{P_t A_t} - \frac{(\theta_t - 1)}{\theta_t}(1+s) \right) = \psi E_t \left(\frac{\lambda_{t,t+1}}{\lambda_{t,t}} \widetilde{\Pi}_{t+1} \right) \tag{5}$$

where $\widetilde{\Pi}_t = \Pi_t (\Pi_t - 1)$, $\Pi_t = P_t / P_{t-1}$ and $\lambda_{t,t+k} = \beta^k \frac{C_{t+k}^{-\kappa}}{C_t^{-\kappa}}$.

2.3 Government

The government consists of a fiscal policy maker and a monetary authority. The fiscal component of the government chooses the levels of public good provision, government debt and taxes and the monetary authority sets the nominal interest rate. The sequential government budget constraint is

$$P_t G_t + B_t^G = T_t + R_{t-1} B_{t-1}^G \tag{6}$$

where B_t^G denotes the government's net bond position.

The goods market equilibrium condition requires $Y_t = C_t + G_t + \frac{\psi}{2}\left(\frac{P_t}{P_{t-1}} - 1\right)^2$ and the clearing condition for the bonds market implies $B_t + B_t^G = 0$.

3 Fiscal and Monetary Policies

Having laid out the theoretical framework, I next turn to analyze the conduct of macroeconomic policies. First, I consider an environment in which the fiscal component of the government has limited ability to commit to a particular policy sequence. I characterize the optimal fiscal policy under limited commitment and evaluate the optimal monetary policy problem under varying degrees of commitment capacity on the part of the fiscal policy maker.

3.1 Fiscal Quasi-Commitment

The fiscal policy maker seeks to maximize the life-time utility of the representative household subject to the constraints implied by competitive equilibrium allocations and the economy's resource constraint, taking the actions of the monetary authority as given. In the spirit of Rotemberg and Woodford (1997) and Benigno and Woodford (2006), I adopt a linear-quadratic approximation approach to the computation of the optimal policy, which yields a first-order approximation to the exact solution.

As shown in Appendix 1, a second-order Taylor series expansion for the utility function around a non-stochastic steady-state yields a quadratic welfare measure of the form

$$U_s = E_s \sum_{t=s}^{\infty} \beta^{t-s} \{ x_t^\top \Omega x_t + x_t^\top \Gamma z_t \} + t.i.f.p. + \; O\left(\|\varepsilon_\theta, \varepsilon_A\|^3 \right) \tag{7}$$

where $x_t = [c_t, g_t, l_t, \pi_t]^\top$ is a vector of control variables, $z_t = [r_t, \widehat{\theta}_t, a_t]^\top$ is a vector of state variables, Ω and Γ are respectively 4×4 and 4×3 matrices and the lower case letters in x_t and z_t denote the log-deviations of the corresponding variables from their non-stochastic steady-state levels, e.g. $c_t = \log(C_t/C)$. The expression $\|\varepsilon_\theta, \varepsilon_A\|$ is an upper-bound on the magnitude of the stochastic disturbance terms $\varepsilon_{\theta,t}$, $\varepsilon_{A,t}$ and $t.i.f.p.$ stands for "terms independent of fiscal policy". The elements of the matrix Ω are derived in Appendix 1 as functions of the model's structural parameters.[1]

Similarly, the policy constraints faced by the fiscal authority can be derived by formulating first-order Taylor series expansions to the structural equations (3), (4), (5) and the market-clearing conditions, which yields

[1] This representation of household utility is adopted for the sake of compactness. See Section 4 for an alternative expression of household utility in conventional terms (i.e., in terms of inflation and output gap deviations).

$$\Theta E_t x_{t+1} = \Phi x_t + \Psi z_t + O\left(\|\varepsilon_\theta, \varepsilon_A\|^2\right) \tag{8}$$

where and the expressions Θ, Φ and Ψ are respectively (3×4), (3×4) and (3×3) matrices whose elements are derived in Appendix 1 as functions of the model parameters.

A few points regarding the nature of the quadratic welfare criterion and the linear policy constraints are noteworthy. Recall that fiscal and monetary policies are conducted by two separate branches of the government. The log-deviation of the nominal interest rate, r_t, is an exogenous variable from the viewpoint of the fiscal policy maker. This is due to the specification that the two branches interact in a setting where the monetary branch is in a leadership position and the fiscal branch takes the actions of the monetary authority as given. Solution to the fiscal policy problem delivers a reaction function, which describes the best response of the fiscal authority to monetary policy actions. Under monetary leadership, the fiscal reaction function constitutes a constraint on the optimal monetary policy problem. The monetary authority takes into account the manner in which fiscal policy is conducted while forming its policy decisions. This point will be further discussed in the next section. Further note that, the welfare measure (7) does not involve any first-order terms. As discussed in Benigno and Woodford (2006) in detail, this guarantees the accuracy of our linear-quadratic policy analysis in the sense that the solution to the linear-quadratic approximate problem will be an accurate first-order approximation to the exact optimal policy.

Monetary and fiscal authorities share the common objective of maximizing the lifetime expected utility of the representative household. However, the fiscal authority can commit to a policy sequence only for an uncertain amount of time. The duration of a fiscal commitment episode (or a fiscal administrator's tenure) is determined by the realizations of an *i.i.d* Bernoulli trial b_t. If $b_t = 1$, which happens with probability α, a new fiscal administrator takes over. Otherwise, the ruling administrator stays in power for another period. As discussed in Schaumburg and Tambalotti (2007), this specification is equivalent to a setup in which the fiscal authority delegates the objective of welfare maximization to a sequence of fiscal administrators who remain in power for periods of uncertain length. When a new fiscal administrator takes over, he revises and reoptimizes the previous policy plan and, if deems appropriate, repudiates the promises made by the previous administrator. It is assumed that a fiscal administrator has access to a technology which enables him to commit to a particular policy plan during his own term. However, there is no mechanism which requires an incumbent to accord with the policy choices of the previous regime. In this setup, reoptimization probability α can be viewed as a parameter that measures the commitment capacity of the fiscal policy maker. The case $\alpha = 0$ corresponds to full fiscal commitment, $\alpha = 1$ corresponds to full fiscal discretion and intermediate cases $0 < \alpha < 1$

capture varying degrees of fiscal commitment capacity (quasi-commitment).

As argued in Schaumburg and Tambalotti (2007), this specification renders fiscal programming recursive "across regimes". A fiscal administrator solves the problem

$$V^F(z_t) = \min_{\{\Lambda_{t+k+1}\}_{k=0}^{\Delta t}} \max_{\{x_{t+k}\}_{k=0}^{\Delta t}} E_t \left\{ \sum_{k=0}^{\Delta t} \beta^k \mathcal{L}_{t+k} + \beta^{\Delta t+1} V^F(z_{t+\Delta t+1}) \right\} \tag{9}$$

where

$$\mathcal{L}_{t+k} = x_{t+k}^\top \Omega x_{t+k} + x_{t+k}^\top \Gamma z_{t+k} + \Lambda_{t+k+1}^\top (\Phi x_{t+k} + \Psi z_{t+k} - E_t x_{t+k+1})$$

and

$$\Lambda_t = 0.$$

The variable $\Delta t \geq 1$ denotes the random duration of a fiscal regime and Λ_{t+k+1} is a (2×1) vector of Lagrange multipliers. Note that Bernoulli specification implies $E[\Delta t] = 1/\alpha$. The first-order conditions of the problem (9) yields a system of linear first-order difference equations, which can be expressed in the form

$$D\Lambda_{t+k+1} = M\Lambda_{t+k} + Nx_{t+k} + Jz_{t+k} \quad \text{for } 0 < k \leq \Delta t \tag{10}$$

where, D, M, N and J are respectively (3×2), (3×2), (3×4) and (3×3) matrices as explained in Appendix 1.

The sequence of Lagrange multiplier vectors $\{\Lambda_{t+k+1}\}$, often referred to as the *co-state* vectors, describe the value to the fiscal planner of committing to the contingency plan announced at the inception of the regime. When a new fiscal administrator takes over (which happens whenever $b_t = 1$), previous commitments are ignored as implied by the stipulation $\Lambda_t = 0$. Notice that it is technologically feasible for a fiscal administrator to set $\Lambda_{t+k} = 0$ at time $t + k$ for $0 \leq k \leq \Delta t$. As argued in Marcet and Marimon (1999), this is precisely what a policy maker will do if she can reoptimize and neglect past promises at time $t+k$. The limited commitment technology ensures that the administrator will commit to the contingency plan devised at time t and reoptimization will take place only at the inception of a new fiscal regime.

Private agents are aware of the possibility of fiscal reoptimization. Thus, they take into account the possibility of a regime change while they form their inflation expectations. In period t, they understand that, with probability α, a new fiscal administrator will take over in period $t+1$ and set $\Lambda_{t+1} = 0$, which will in general contradict with the contingency plan devised by its predecessor. To highlight this point, it will be useful to reexpress (8) more explicitly as

$$\alpha\Theta E_{t+k}[x_{t+k+1}|b_{t+k+1}=1]+(1-\alpha)\Theta E_{t+k}[x_{t+k+1}|b_{t+k+1}=0]=\Phi x_{t+k}+\Psi z_{t+k}. \quad (11)$$

Note that equations (10), (11) and $\Lambda_t = 0$ completely characterize the evolution of the equilibrium allocations under fiscal quasi-commitment for given sets of sequences for the nominal interest rates, $\{r_t\}_{t=0}^{\infty}$, stochastic productivity and mark-up parameters $\{A_t, \theta_t\}_{t=0}^{\infty}$ and Bernoulli signals $\{b_t\}_{t=0}^{\infty}$.

3.2 The Monetary Policy Problem

As mentioned earlier, fiscal policy actions described by (10), (11) and $\Lambda_t = 0$ identify the set of allocations that are feasible and implemetable for the monetary authority. Therefore, the monetary policy problem can be described as maximization of (7) subject to (10), (11) and $\Lambda_t = 0$.

We shall evaluate the optimal monetary policy problem under full discretion and full commitment on the part of the monetary authority. Under full commitment, the monetary policy maker has access to a technology which allows her to commit to a contingency plan indefinitely. She rationally anticipates that the fiscal quasi-commitment policy is conducted according to (10) and private sector expectations are formed as in (11). Then the monetary problem can be written as

$$\begin{aligned}\min_{\{\Xi_{i,t+k}\}_{i=1}^{2}}\ \max_{\{x_{t+k},\Lambda_{t+k+1},r_{t+k}\}} E_t \sum_{k=0}^{\infty}\beta^k \{ & x_{t+k}^{\top}\Omega x_{t+k} + x_{t+k}^{\top}\Gamma z_{t+k} \\ & + \Xi_{1,t+k}^{\top}(M\Lambda_{t+k}+Nx_{t+k}+Jz_{t+k}-D\Lambda_{t+k+1}) \\ & + \Xi_{2,t+k}^{\top}(\Phi x_{t+k}+\Psi z_{t+k}-E_t x_{t+k+1})\}\end{aligned} \quad (12)$$

with $\Lambda_t = 0$. Furthermore, $\Lambda_{t+k} = 0$ whenever $b_{t+k} = 1$. The expectations that appear in the second group of constraints are formed as in (11) and $\Xi_{1,t}$, $\Xi_{2,t}$ respectively denote (3×1) and (2×1) vectors of Lagrange multipliers.

The first-order conditions of the problem (12) yield a set of linear difference equations that describe the evolution of the endogenous variables under optimal monetary commitment and fiscal quasi-commitment. The system of difference equations can be solved using the standard methods and the solution involves the stipulation

$$\Xi_{2,0} = 0.$$

In order to assess the welfare gains from commitment, I also evaluate (12) under full monetary discretion. In this case, the monetary authority cannot commit to a particular policy plan. Therefore, she is unable to manipulate the private sector's beliefs regarding future realizations of the endogenous variables. As a result, she takes the expectations that appear in the second set of constraints in (12) as exogenous. The solution to this problem reveals that the equilibrium allocations and the optimal monetary policy are history-dependent even under full monetary discretion unless $\alpha = 1$. In the special case $\alpha = 1$, fiscal reoptimization takes place each period ($b_t = 1\ \forall t$) while the monetary authority applies full discretion. This specification results in an environment in which the policy problems faced by the fiscal and the monetary authorities possess the Markovian property in the sense discussed by Kydland and Prescott (1980). In this special case, the optimal policies can be expressed as functions of the current realizations $\{A_t, \theta_t, b_t\}$ only. Yet, a slight deviation of the fiscal reoptimization probability from one suffices to induce lagged-dependence among endogenous variables as described by (10) and equilibrium allocations and policies turn history-dependent.

3.3 Optimal Responses to Shocks

In this section, I employ a calibrated version of the model to compute the optimal responses of the economy to exogenous disturbances.

Table 1 summarizes the benchmark calibration. To facilitate comparison with the related literature, I employ some of the most commonly used parameter values. For the subjective discount factor (β), intertemporal elasticities of substitution (κ and η) and the mean price elasticity of demand (θ), I adopt the values used in Adam and Billi (2007), which are based on the estimates on U.S. data reported in Rotemberg and Woodford (1997). Further, I set the values for the price adjustment cost (ψ) and labor supply elasticity (ϕ) parameters so that the implied slope of the price setting equation (the linearized version of 5) is consistent with the estimates of Sbordone (2004) and the output elasticity of firms' marginal cost are around the figures used in Woodford (2003, Chapter 6). In addition, ρ_A and σ_A are set to match the autoregressive parameters and the standard deviation of the natural interest rate with the values adopted in Woodford (2003, Chapter 6).[2] Finally, I set the volatility of the mark-up shock (σ_θ) so that the standard deviation of the cost-push term in the price setting equation matches the calibrated value in Schaumburg and Tambalotti (2007).

Once again, to render the analysis immediately comparable with the related literature, I focus on the responses of inflation, the output gap and the nominal interest rate to cost-push disturbances.

Figure 1 displays the responses to a 1% negative mark-up shock. To highlight the

[2] The natural interest rate corresponds to the real rate of return that obtains in the costless-price-adjustment counterpart of the model economy. Its percentage deviation from its steady-state value is given by $\kappa(\rho - 1)\left(\frac{1+\phi}{\kappa+\phi}\right) a_t$, where $a_t = \log(A_t/A)$.

implications of fiscal quasi-commitment, the responses are computed for alternative values of $E[\Delta t]$. The output gap corresponds to the percentage deviation of the actual level of output from the level that obtains in a costless-price-adjustment economy, i.e., the natural level of output.[3] The rise in inflation and the fall in the output gap are illustrative of the cost-push nature of the mark-up shock. Note that improvements in fiscal commitment capacity induce substantially milder inflation and output gap responses. This is because the trade-off the monetary authority faces between stabilizing inflation and stabilizing the output gap becomes more favorable as fiscal credibility improves. Further notice that, under full monetary commitment, the responses of inflation and the output gap are almost indistinguishable from those that obtain under full monetary discretion for the cases $E[\Delta t] =$ 16, 8 and 4. For $E[\Delta t] = 1$ and 2, however, commitment responses become markedly distinct from those realized under monetary discretion. It appears that an improvement in fiscal commitment capacity from $E[\Delta t] = 1$ to $E[\Delta t] = 4$ largely eliminates the stabilization gains from monetary policy commitment. Impulse responses do not seem to be notably influenced by monetary commitment once the expected duration of fiscal commitment extends beyond 4 quarters. Thus, the magnitude of the improvement in stabilization outcomes resulting from commitment in monetary policy appears to be diminishing fast in the level of fiscal commitment capacity.

The impulse responses exhibited in Figure 1 are computed conditional on no fiscal reoptimization taking place during the considered time horizon. However, since the continuation probability of a particular fiscal regime diminishes as the time horizon extends, the impulse responses exhibited in Figure 1 become increasingly less informative about the actual responses of the economy over time. Alternatively, impulse responses can be computed conditional on fiscal reoptimization occurring at particular points in time, e.g. fourth, eight and twelfth quarters following the impact. Yet, such an exercise would not necessarily be more representative of the actual responses of the economy than the case presented in Figure 1 as it would also correspond to a specific realization of the Bernoulli signals. To remedy this problem, following Schaumburg and Tambalotti (2007), I next compute the averages of all possible impulse responses each conditioned on a particular realization of the Bernoulli sequence during the considered time period. These average responses, displayed in Figure 2, illustrate the *expected* dynamic behavior of the economy following the shock. Once again, it is observed that improvements in fiscal credibility results in milder inflation and output gap responses regardless of whether the monetary policy maker exercises full discretion or full commitment. Furthermore, here too the responses are very similar in the cases $E[\Delta t] = 16$, 8 and 4, yet, they are substantially alleviated by a relatively modest

[3] Under the baseline calibration, which involves $\kappa = \eta$, the percentage deviation of the natural level of output is given by $\frac{1+\phi}{\kappa+\phi} a_t$.

shift from $E[\Delta t] = 1$ to $E[\Delta t] = 4$. Thus, the average dynamic behavior of the model also suggests that the stabilization gains from monetary commitment is diminishing fast in the level of fiscal credibility.

4 Welfare Analysis

4.1 Gains from Monetary Commitment

This section investigates the welfare gains from full commitment in monetary policy under varying degrees of fiscal commitment capacity. Using the baseline parametrization discussed in the previous section, I evaluate (7) to calculate the gains resulting from a shift from full monetary discretion to full monetary commitment.[4] In order to put the welfare gains in economic context, following Adam and Billi (2007), I calculate compensating consumption variations. This measure corresponds to the percentage decrease in permanent consumption the representative household is willing to bear to live under full monetary commitment. Using a second-order approximation to the utility function (1), the welfare loss resulting from an $x\%$ permanent decrease in private consumption can be expressed as

$$\frac{C^{1-\kappa}}{1-\beta}\left(\frac{x}{100}+\frac{\kappa}{2}\left(\frac{x}{100}\right)^2\right) \tag{13}$$

where C denotes steady-state private consumption. Let U_{com} and U_{disc} respectively denote the life-time discounted utilities under full monetary commitment and full monetary discretion. Then, using (13), the compensating consumption variation that corresponds to the welfare differential $\Delta U = U_{com} - U_{disc}$ can be found as

$$x = \frac{1}{\kappa}\left[\left(1+2\kappa(1-\beta)C^{\kappa-1}\Delta U\right)^{1/2} - 1\right] \times 100. \tag{14}$$

Figure 3 illustrates the welfare gains (defined as in 14) resulting from monetary commitment as a function of the average duration of fiscal commitment. Evidently, gains from monetary commitment decrease monotonically in the expected duration of fiscal commitment episodes. Furthermore, the relationship is observed to be highly non-linear. The gains are negligibly small for all considered values of ρ_θ when the fiscal commitment regime is expected to last for more than five quarters. They also remain moderate for relatively high degrees of fiscal discretion, e.g., gains are below 1% if the fiscal authority can commit for four quarters on average, which corresponds to a fiscal year. Yet, in justification of our previous remarks, welfare gains are observed to increase fast as the fiscal authority's

[4] Life-time welfare in each experiment is calculated by averaging the discounted sum of utilities across 500 simulations each 1000 quarters long.

commitment ability deteriorates further and the expected duration of fiscal commitment becomes shorter than a fiscal year. Under the benchmark calibration, which involves $\rho_\theta = 0$, the gain is equivalent to a 22% permanent increase in private consumption if the fiscal authority can commit only for a single quarter.

Figure 4 exhibits the welfare gains from monetary commitment under alternative parameter configurations. The first case involves a lower value for intertemporal elasticities of substitution ($\eta = \kappa = 2$). In the second case, prices are more flexible relative to the benchmark calibration ($Y\theta/\psi = 11$). The last specification features a higher level of competition ($\theta = 15$). It is observed that, in all cases, gains from monetary commitment monotonically decrease in the degree of fiscal commitment. Furthermore, the gains diminish fast as the commitment capacity of the fiscal authority improves. Thus, the patterns exhibited in Figure 3 seem to be robust to a range of alternative parameter values.

The welfare outcomes displayed in Figures 3 and 4 reveal a key result. Gains from monetary policy commitment can be very small if the fiscal authority can independently exercise a certain degree of commitment. In the outlined environment, due to lack of coordination between fiscal and monetary policy makers, the fiscal authority fails to internalize the stabilizing role of monetary policy. In the face of an adverse mark-up disturbance, in order to curb the inflationary pressure, the fiscal authority carries out a sizable and persistent cut in government spending in excess of what would be implemented in the presence of full coordination between the policy institutions. Although this policy implies an excessive reduction in public good provision, it delivers the intended contractionary impact, which counteracts the inflationary tendency to a desirable extent and lowers inflation expectations. Since current inflation is in part determined by expectations of future inflation, this improves the trade-off the monetary authority encounters in the presence of cost-push (mark-up) disturbances. Consequently, commitment in monetary policy becomes increasingly less relevant for welfare outcomes as fiscal commitment capacity improves and fiscal policy becomes more effective in controlling inflation expectations.

To further clarify this point, Table 2 exhibits the standard deviations of inflation and the output gap under optimal monetary commitment and discretion for alternative degrees of fiscal commitment. It is observed that standard deviations of inflation and the output gap monotonically decrease as the expected duration of fiscal commitment episodes become longer. This pattern is driven by the aforementioned improvement in the monetary policy trade-off. As the terms of stabilization faced by the monetary authority improve with the degree of fiscal commitment, the optimal monetary policy results in more favorable volatility outcomes.

Another key finding is that a moderate improvement in fiscal commitment capacity from full discretion to an expected commitment duration of a few quarters can largely eliminate the welfare gains from monetary policy commitment. As shown in Table 2, the decline in aggregate volatility induced by full commitment in monetary policy is far less pronounced when fiscal commitment is for two quarters on average relative to the case of full fiscal discretion, i.e. commitment for a single quarter. Figures 3 and 4 reveal a similar pattern in welfare gains. The result that gains from monetary commitment can be very small under limited fiscal commitment is driven by the fiscal authority's incentive to implement a persistent cut in spending to tackle inflationary pressures exerted by mark-up shocks. As indicated earlier, this serves to tie down inflation expectations and, in doing so, eases the trade-off the monetary authority faces. A moderate extension of the fiscal commitment horizon from a single quarter to two quarters has the largest alleviating impact on the next period's inflation expectations. Additional increases in fiscal commitment capacity further improves the terms of stabilization faced by the monetary authority, yet, the size of the improvement in monetary policy trade-off resulting from a marginal increase in the expected duration of fiscal commitment diminishes fast. Accordingly, welfare gains from monetary policy commitment declines fast in the expected duration of fiscal commitment.

4.2 Gains from Fiscal Commitment

So far we have assessed the implications of fiscal commitment capacity on the welfare gains from monetary policy commitment. A natural question that arises at this point is whether one can obtain similar results if one examines the implications of monetary commitment capacity on the welfare gains from fiscal commitment. Here, I address this question by considering a setup where monetary and fiscal authorities switch roles.

In this environment, the monetary policy maker has limited commitment capacity. In a fashion similar to the one discussed earlier, the monetary authority is able to commit to a contingency plan only for an uncertain amount of time. The duration of a monetary commitment episode is random and the succession of monetary regimes is governed by the realizations of the Bernoulli trail b_t. Here, the monetary policy maker solves (9). In this case, however, the vector of choice variables for the monetary problem is $x_t = [c_t, r_t, \pi_t, l_t]^\top$ and the state variables are $z_t = [g_t, \widehat{\theta}_t, a_t]^\top$. That is, the monetary authority takes the spending on public goods as exogenous (g_t is included in z_t) and sets the nominal interest rate optimally (r_t is included in x_t). The fiscal policy maker, on the other hand, solves (12). To evaluate the welfare gains from fiscal policy commitment, (12) is solved under full discretion and full commitment on the part of the fiscal policy maker.

Figure 5 illustrates the responses to a 1% negative mark-up shock under varying degrees of monetary commitment. It is observed that improvements in monetary commitment capacity results in milder responses. Interestingly, however, whether the fiscal policy maker exercises full commitment or full discretion does not seem to make a difference in impulse responses. They are similar under full fiscal discretion and full fiscal commitment regardless of the degree of monetary policy commitment.

To gain intuition, it will be useful to evaluate the monetary policy problem in more detail. Consider the following alternative representation of household utility. As explained in Appendices 1 and 2, equation (7) can be reorganized to express the objective function of the monetary policy maker as

$$U_s = E_s \sum_{t=s}^{\infty} \beta^{t-s} \left\{ -\left(\frac{\kappa + \phi s_c}{2 s_c} \right) \widehat{y}_t^2 - \left(\frac{\theta}{2Y} \right) \pi_t^2 \right\} + t.i.m.p. + O\left(\left\| \varepsilon_\theta, \varepsilon_A \right\|^3 \right) \tag{15}$$

where $s_c = C/Y$. The variable $\widehat{y}_t = \log(Y_t/Y_{n,t}) = y_t - y_{n,t}$ denotes the log-deviation of the output gap, $Y_{n,t}$ denotes the natural level of output.[5] The abbreviation, $t.i.m.p.$ stands for "terms independent of monetary policy". Notice that since, in this setup, the monetary authority takes spending on public goods as given, $g_t = \log(G_t/G)$ is perceived as an exogenous process and the terms that involve g_t are classified under the heading "$t.i.m.p.$" by the monetary policy maker. Specifically,

$$t.i.m.p. \equiv \left(\frac{\kappa + \phi s_c}{2 s_c} \right) (y_{n,t})^2 - \left(\frac{s_g}{2} \left(\eta + \frac{s_g \kappa}{s_c} \right) \right) g_t^2 + a_t - \frac{a_t^2}{2}. \tag{16}$$

The constraints faced by the monetary authority (described by 8) can also be expressed in terms of $\widehat{y}_t$ and π_t. The first equation in (8) (the log-linearized version of 3) characterizes the aggregate demand block and the second equation (the log-linearized version of 5) describes a Phillips curve.[6] The Phillips curve equation can be expressed as

$$\beta E_t \pi_{t+1} = \pi_t - \delta \left(\frac{\kappa + \phi s_c}{s_c} \right) \widehat{y}_t - \left(\frac{Y\theta}{\psi(\theta - 1)} \right) \widehat{\theta}_t. \tag{17}$$

where $\delta = Y\theta/\psi$. Note that the policy maker does not need to explicitly account for the constraint that describes the aggregate demand block, which involves the log-deviation of the nominal rate. Once the optimal sequences for π_t and $\widehat{y}_t$ are determined by maximizing (15) subject to (17), the optimal nominal rate deviations can be backed out using the linearized version of the aggregate demand equation (3).

The objective function (15) and the constraint (17) immediately suggest that the optimal inflation and output gap deviations will be functions of the exogenous mark-up deviation $\widehat{\theta}_t$ only. Thus, the fiscal authority is unable to influence the equilibrium volatilities of inflation and the output gap by adjusting public good expenditures. Provided that $\widehat{y}_t$ and

[5] Government spending also enters the definition of the natural level of output. The log-deviation of the natural output can be found as $y_{n,t} = \frac{(1+\phi)s_c}{\kappa + \phi s_c} a_t + \frac{\kappa s_g}{\kappa + \phi s_c} g_t$, where $s_g = G/Y$. See Appendix 2 for a detailed discussion.

[6] See Appendix 1.

π_t are determined independently of g_t and fluctuations in government spending are welfare-reducing (as suggested by 16), the best fiscal spending policy is the one that eliminates all variation in public good provision. Accordingly, government spending is kept constant in response to the mark-up shock regardless of whether the fiscal authority can commit or not. As a result, the economy's responses and welfare outcomes turn out to be identical under full fiscal discretion and full fiscal commitment.

5 Conclusion

This study investigates the implications of imperfect commitment in fiscal policy on the welfare gains from commitment in monetary policy. In the spirit of Schaumburg and Tambalotti (2007), the degree of credibility is measured with the expected duration of the period in which the policy maker accords with previously announced plans. The adoption of this continuous credibility measure, offering an escape clause from the bipolar nature of the "full commitment vs. full discretion" specification, facilitates a deeper welfare analysis and reveals a number of important results. I find that the welfare gains resulting from a shift from full discretion to full commitment in monetary policy decrease in the degree of fiscal credibility. Further, a small improvement in fiscal commitment capacity can largely eliminate the welfare gains from monetary commitment if fiscal policy is initially fully discretionary. A shift from full discretion to full commitment in fiscal policy, on the other hand, have no welfare implications provided that the monetary authority takes the actions of the fiscal policy maker as given.

A potential direction for future research involves incorporating distortionary taxes into the analysis. Inclusion of distortionary measures, by taking into account the deadweight losses associated with tax policies, is likely to improve the quantitative relevance of the welfare computations. Also, this study evaluates the welfare gains from monetary commitment when policy makers have full information about the model economy. Another interesting extension may introduce model uncertainty and assess the implications of robustly optimal policies.

Appendix 1: Linear-Quadratic Form and the Fiscal Quasi-Commitment Problem

The second-order approximation of the utility function (1) around a non-stochastic steady state can be written as

$$E_s \sum_{t=s}^{\infty} \beta^{t-s} \overline{A} \left[(s_c)\, c_t + (s_g) g_t - l_t + (s_c) \left(\frac{1-\kappa}{2} \right) c_t^2 + s_g \left(\frac{1-\eta}{2} \right) g_t^2 \right. \\ \left. - \left(\frac{1+\phi}{2} \right) l_t^2 \right] + O\left(\|\varepsilon_\theta, \varepsilon_A\|^3 \right) \tag{A.1.1}$$

where $\overline{A} = L^{1+\phi}$, $s_c = C/Y$, $s_g = G/Y$ and the lower case letters denote the log-deviations of the corresponding variables from their steady-states, e.g., $c_t = \log(C_t/C)$. A second order approximation to the goods market clearing condition $A_t L_t = C_t + G_t + \frac{\psi}{2}\left(\frac{P_t}{P_{t-1}} - 1\right)^2$ can be used to express the first-order terms in (A.1.1) ($s_c c_t + s_g g_t - l_t$) as a function of second and higher order terms, which yields

$$E_s \sum_{t=s}^{\infty} \beta^{t-s} \overline{A} \left[- \left(\frac{s_c \kappa}{2} \right) c_t^2 - \left(\frac{s_g \eta}{2} \right) g_t^2 - \left(\frac{\phi}{2} \right) l_t^2 - \left(\frac{\theta}{2Y} \right) \pi_t^2 \right. \\ \left. + a_t l_t + a_t + \frac{a_t^2}{2} \right] + O\left(\|\varepsilon_\theta, \varepsilon_A\|^3 \right). \tag{A.1.2}$$

Expression (A.1.2) can be reorganized in the matrix form as in (7) where the weighting matrices are defined as

$$\Omega = \begin{bmatrix} \frac{-s_c\kappa}{2} & 0 & 0 & 0 \\ 0 & \frac{-s_g\eta}{2} & 0 & 0 \\ 0 & 0 & \frac{-\phi}{2} & 0 \\ 0 & 0 & 0 & \frac{-\theta}{2Y} \end{bmatrix} \qquad \Gamma = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

and the terms $a_t + a_t^2/2$ are classified as $t.i.f.p.$

Similarly, a series of first-order approximations to the structural equations (3)-(5) and the market clearing condition $A_t L_t = C_t + G_t + \frac{\psi}{2}\left(\frac{P_t}{P_{t-1}} - 1\right)^2$ can be formulated as

$$\begin{aligned} \beta E_t \pi_{t+1} &= \pi_t - \delta(\phi l_t + \kappa c_t - a_t) + \left(\frac{Y\theta}{\psi(\theta-1)} \right) \widehat{\theta}_t && \text{(A.1.3)} \\ E_t \pi_{t+1} + \kappa E_t c_{t+1} &= r_t + \kappa c_t && \text{(A.1.4)} \\ a_t + l_t &= (s_c) c_t + (s_g) g_t && \text{(A.1.5)} \end{aligned}$$

where $\delta = Y\theta/\psi$, lower case letters denote log-deviations and $\widehat{\theta}_t = \log(\frac{\theta_t}{\theta})$. Equations

(A.1.3)-(A.1.5) can be reorganized in the matrix form as in (8) where the matrices are defined as

$$\Theta = \begin{bmatrix} 0 & 0 & 0 & \beta \\ \kappa & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \quad \Phi = \begin{bmatrix} -\delta\kappa & 0 & -\delta\phi & 1 \\ \kappa & 0 & 0 & 0 \\ s_c & s_g & -1 & 0 \end{bmatrix} \quad \Psi = \begin{bmatrix} 0 & \frac{Y\theta}{\psi(\theta-1)} & \delta \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}.$$

Solution to the fiscal quasi-commitment problem yields the following first-order conditions:

$$(\delta\kappa)\lambda_{t+k+1} + \kappa\mu_{t+k+1} + (s_c\eta)g_{t+k} - (s_c\kappa)c_{t+k} - (\beta^{-1}\kappa)\mu_{t+k} = 0 \qquad \text{(A.1.6)}$$

$$(\delta\phi)\lambda_{t+k+1} - \eta g_{t+k} - \phi l_{t+k} + a_{t+k} = 0 \qquad \text{(A.1.7)}$$

$$-\lambda_{t+k+1} - (\theta/Y)\pi_{t+k} + \lambda_{t+k} - \beta^{-1}\mu_{t+k} = 0 \qquad \text{(A.1.8)}$$

where $\mu_{t+k} = \lambda_{t+k} = 0$ whenever $b_{t+k} = 0$. In addition, $\mu_t = \lambda_t = 0$. Equations (A.1.6)-(A.1.8) can be reorganized in the matrix form as in (10) where the matrices are defined as

$$D = \begin{bmatrix} \delta\kappa & \kappa \\ \delta\phi & 0 \\ -1 & 0 \end{bmatrix} \quad M = \begin{bmatrix} 0 & \frac{\kappa}{\beta} \\ 0 & 0 \\ -1 & \frac{1}{\beta} \end{bmatrix} \quad N = \begin{bmatrix} s_c\kappa & -s_c\eta & 0 & 0 \\ 0 & \eta & \phi & 0 \\ 0 & 0 & 0 & \frac{\theta}{Y} \end{bmatrix} \quad J = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix}.$$

Appendix 2: Flexible-Price Equilibrium and the Alternative Representation of Household Utility

In the flexible-price counterpart of the economy we have $\psi = 0$. Also assume that $\theta_t = \theta\ \forall t$. In this economy, firms' real marginal cost must be equal to unity for all t. Thus, using (4) and (5) one can find $L_{n,t}^{\phi} C_{n,t}^{\kappa} = A_t$ where subscript "n" denotes natural levels. Substituting the market clearing condition ($Y_{n,t} = A_t L_{n,t} = C_{n,t} + G_t$) into this expression we obtain $(Y_{n,t}/A_t)^{\phi}(Y_{n,t} - G_t)^{\kappa} = A_t$. The first-order approximation of this equation gives

$$y_{n,t} = \left(\frac{(1+\phi)s_c}{\kappa + s_c\phi}\right) a_t + \left(\frac{\kappa s_g}{\kappa + s_c\phi}\right) g_t \qquad \text{(A.2.1)}$$

where the lower case letters denote log-deviations from steady-state values. Given (A.2.1) and the linearized version of the market clearing condition ($y_{n,t} = s_c c_{n,t} + s_g g_t$), equations (A.1.2) and (A.1.3) can be reorganized to obtain respectively (15) and (17) in the text.

References

[1] Adam, C., Billi, R., 2007. Discretionary monetary policy and the zero lower bound on nominal interest rates. Journal of Monetary Economics 54, 728-752.

[2] Adam, C., Billi, R., 2005. Monetary and fiscal interactions without commitment and the value of monetary conservatism. Computing in Economics and Finance 2005 62, Society for Computational Economics.

[3] Barro, R., Gordon, D.B., 1983. A positive theory of monetary policy in a natural rate model. Journal of Political Economy 91, 589-610.

[4] Benigno, P., Woodford, M., 2006. Linear-quadratic approximation of optimal policy problems. NBER Working Paper No. 12672.

[5] Clarida, R., Gali, J., Gertler, M., 1999. The science of monetary policy: a new Keynesian perspective. Journal of Economic Literature 37, 1661-1707.

[6] Dennis, R., Soderstrom, U., 2006. How important is precommitment for monetary policy? Journal of Money, Credit, and Banking 38, 847-872.

[7] Dixit, A., Lambertini, L., 2003. Interactions of commitment and discretion in monetary and fiscal policies. American Economic Review 93, 1522-1542.

[8] Kydland, F.E., Prescott, E.C., 1977. Rules rather than discretion: the inconsistency of optimal plans. Journal of Political Economy 85, 473-492.

[9] Kydland, F.E., Prescott, E.C., 1980. Dynamic optimal taxation, rational expectations and optimal control. Journal of Economic Dynamics & Control 2, 79-91.

[10] Marcet, A., Marimon, R., 1999. Recursive contracts. Universitat Pompeu Fabra and European University Institute (mimeo).

[11] McCallum, B. T., Nelson, E., 2004. Timeless perspective vs. discretionary monetary policy in forward-looking models. Federal Reserve Bank of St. Louis Review 86, 45-56.

[12] Muscatelli, A.V., Tirelli, P., Trecroci, C., 2004a. Fiscal and monetary policy interactions: empirical evidence and optimal policy using a structural new-Keynesian model. Journal of Macroeconomics 26, 257-280.

[13] Muscatelli, A.V., Tirelli, P., Trecroci, C., 2004b. Monetary and fiscal policy interactions over the cycle: some empirical evidence. In: Beetsma R., Favero, C., Missale, A., Muscatelli A. V., Natale, P., Tirelli, P., (Eds.), Fiscal Policies, Monetary Policies and

Labour Markets: Key Aspects of European Macroeconomic Policies after Monetary Unification, Cambridge University Press, Cambridge.

[14] Rotemberg, J., 1982. Sticky prices in the United States. Journal of Political Economy 90, 1187-1211.

[15] Sbordone, A., 2002. Prices and unit labor costs: a new test for price stickiness. Journal of Monetary Economics 49, 265-292.

[16] Schaumburg, E., Tambalotti, A., 2007. An investigation of the gains from commitment in monetary policy. Journal of Monetary Economics 54, 302-324.

[17] Schmitt-Grohe, S., Uribe, M., 2007. Optimal simple and implementable monetary and fiscal rules. Journal of Monetary Economics 54, 1702-1725.

[18] Woodford, M., 2003. Interest and Prices. Princeton University Press, Princeton.

Tables and Figures

Parameters	Values
Intertemporal Elasticity of Substitution (Private Goods) - $1/\kappa$	6.25
Intertemporal Elasticity of Substitution (Public Goods)- $1/\eta$	6.25
Labor Supply Elasticity - ϕ	0.42
Discount Factor - β	0.9913
Slope of the Price Setting Equation - $Y\theta/\psi$	1/17.5
Steady State Elasticity of Substitution Between Differentiated Products - θ	7.66
Autoregressive Parameter (Technology Process) - ρ_a	0.8
Autoregressive Parameter (Mark-up Process) - ρ_θ	0
Standard Deviation (Natural Rate Shock)	0.0152
Standard Deviation (Cost-Push Shock)	0.0130

Table 1: Baseline parameter values

$E[\Delta t]$	Full Monetary Discretion		Full Monetary Commitment	
	St.Dev. (Inf.)	St.Dev. (Out. Gap)	St.Dev. (Inf.)	St.Dev. (Out. Gap)
1 Quarter	0.018	0.458	0.013	0.134
2 Quarters	0.013	0.253	0.011	0.110
4 Quarters	0.010	0.108	0.009	0.095
8 Quarters	0.009	0.082	0.009	0.081
16 Quarters	0.008	0.075	0.008	0.075

Table 2: Standard deviations of inflation and the output gap

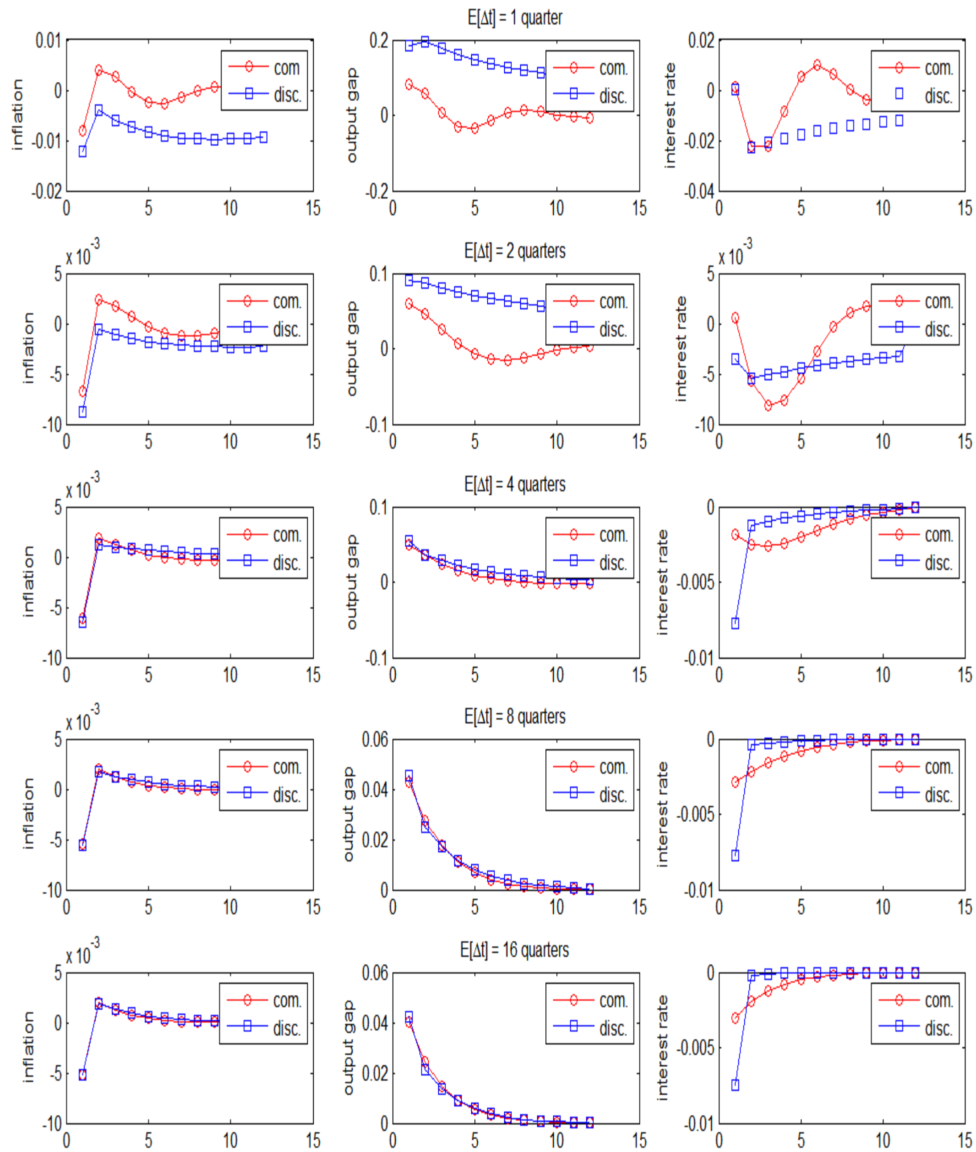

Figure 1: Responses to a 1% mark-up shock under full monetary discretion (disc.) and full monetary commitment (com.). The responses are computed for varying degrees of fiscal quasi-commitment conditional on fiscal reoptimization taking place only at $t = 0$.

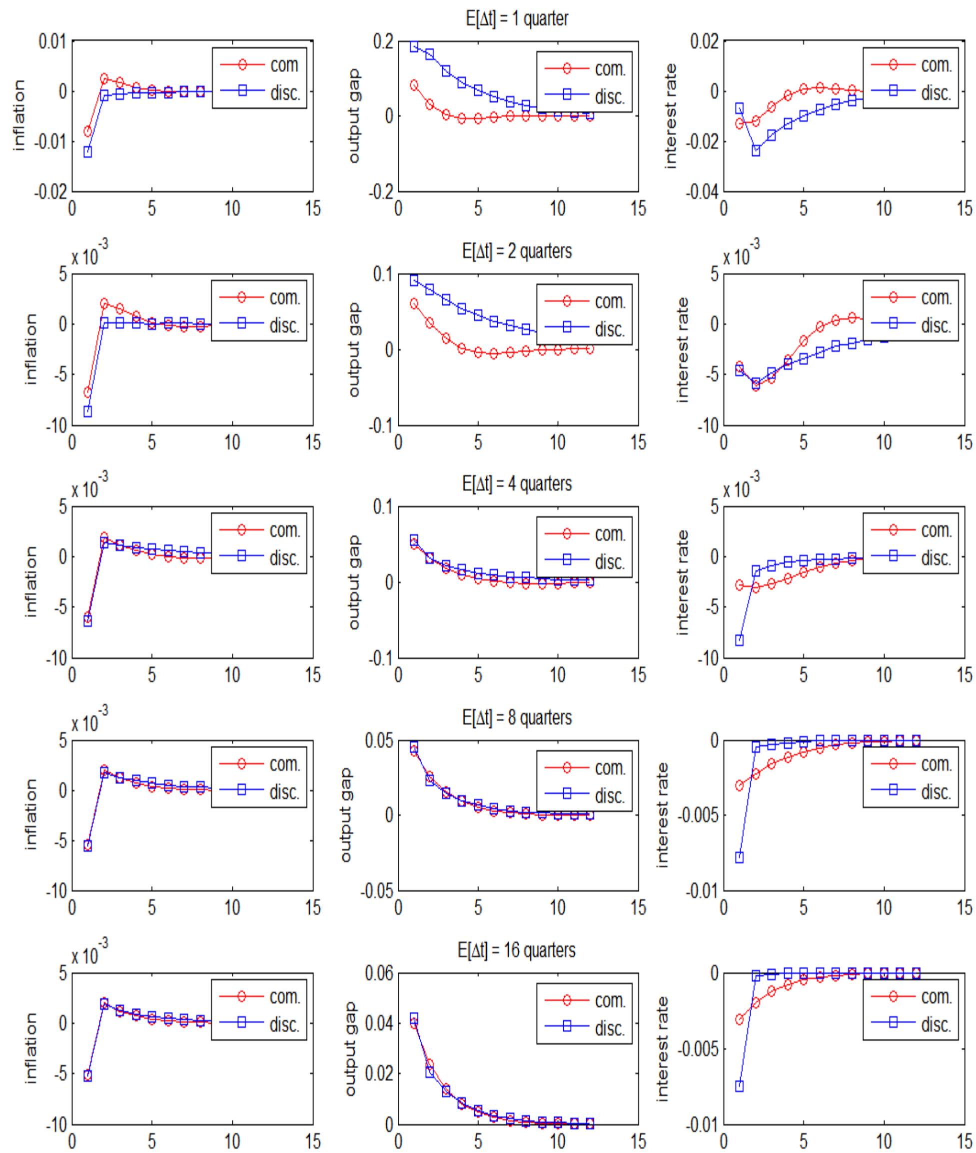

Figure 2: Responses to a 1% mark-up shock under full monetary discretion (disc.) and full monetary commitment (com.). The responses are computed for varying degrees of fiscal quasi-commitment and averaged accross possible realizations of the Bernoulli Trails.

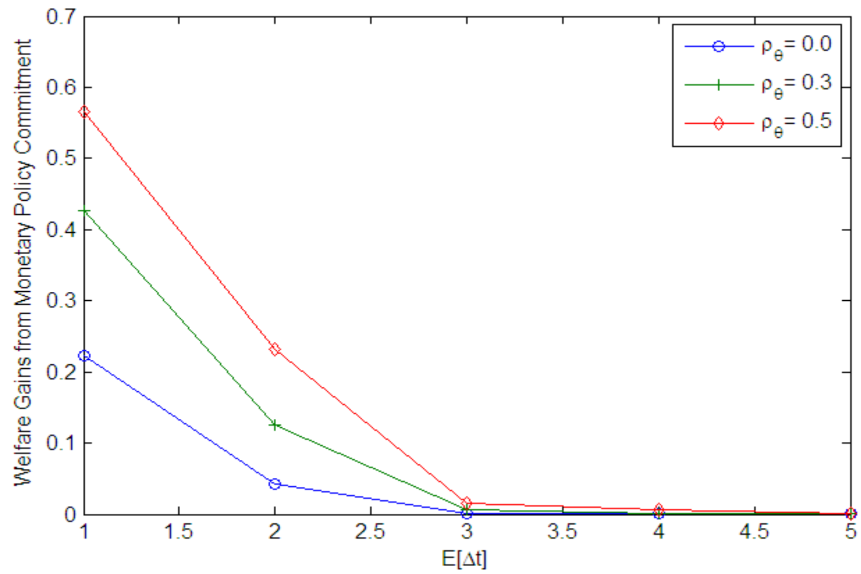

Figure 3: Welfare gains from commitment in monetary policy as a function of fiscal commitment capacity. Gains are expressed as fractions of quarterly permanent consumption.

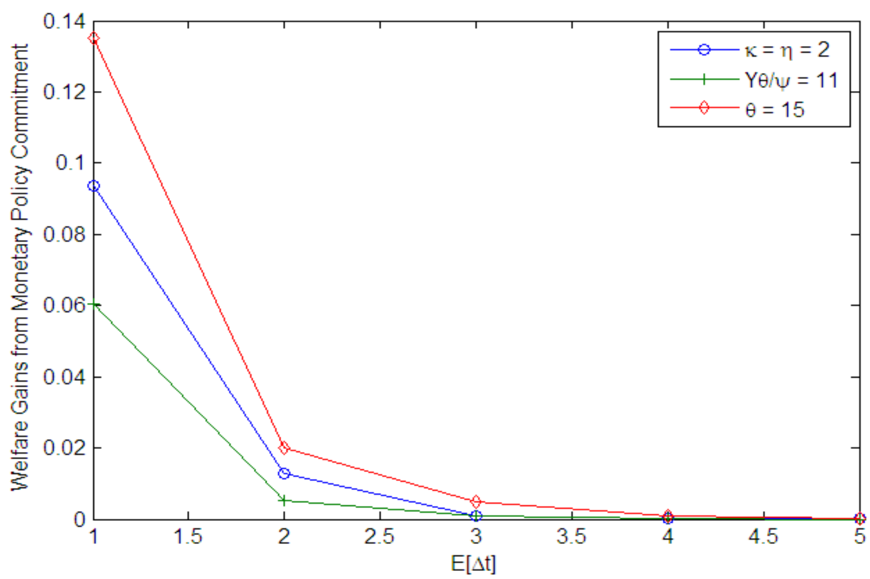

Figure 4: Welfare gains from commitment in monetary policy as a function of fiscal commitment capacity under alternative parameter values. Gains are expressed as fractions of quarterly permanent consumption.

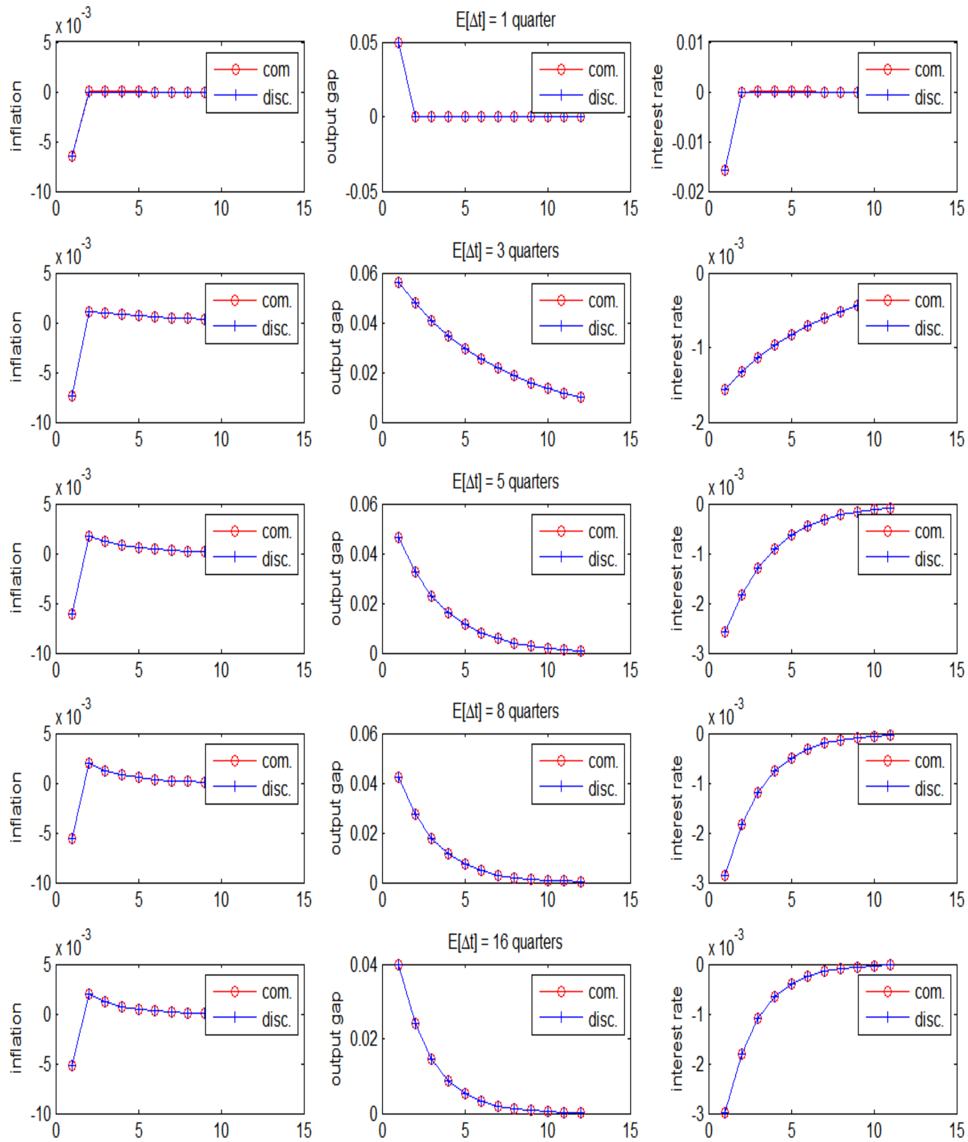

Figure 5: Responses to a 1% mark-up shock under full fiscal discretion (disc.) and full fiscal commitment (com.). The responses are computed for varying degrees of monetary quasi-commitment conditional on monetary reoptimization taking place only at $t = 0$.