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How does the timing of markets affect optimal monetary and fiscal policy in sticky price models?

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ABSTRACT

This paper studies optimal monetary and fiscal policy with the Svensson timing in a sticky price model of a stochastic production economy. In this model, the government collects distortionary taxes, prints money, and issues nominal non-state-contingent bonds to finance an exogenous stream of public spending. The numerical results show that (1) optimal monetary and fiscal policy is quantitatively sensitive to the timing of markets; (2) the fundamental nature of optimal monetary and fiscal policy is not sensitive to the timing of markets; and (3) the findings are robust to key structural parameters.

1. Introduction

Following the tradition begun by Lucas and Stokey (1983) and Chari et al. (1991), numerous works have studied optimal monetary and fiscal policy (OMFP hereafter) in sticky price models. A major goal of these efforts is to quantitatively characterize OMFP with dynamic stochastic general equilibrium (DGSE) models. One ad hoc assumption in this large literature is the Lucas timing of markets with which the money market meets before the goods market in each period and nominal money holdings are freely adjustable in response to shocks (Lucas and Stokey, 1983). A natural concern is whether the key theoretical results in this literature are sensitive to the timing of markets, particularly the Svensson timing with which the goods market meets before the money market in each period. The concern arises because with the Svensson timing, nominal money balances are not freely adjustable in response to shocks and they provide liquidity services (Svensson, 1985). These two features associated with the Svensson timing have different policy implications about OMFP, especially in sticky price models.

First, they imply a different volatility of optimal inflation because the Svensson timing introduces an additional trade-off with respect to the value of using inflation variations as a shock absorber. On the one hand, since nominal money balances, due to the Svensson timing assumption, cannot respond to the shocks, inflation variations across states then will bring a direct cost to households from the demand side.[1] On the other hand, the value of liquidity services provided by nominal money balances is subject to inflation variations and households will, due to the precautionary saving motivation, accumulate relatively more nominal money balances to insure against inflation uncertainty.[2] In addition, from the Ramsey government's perspective, since households cannot adjust money balance (because of the Svensson timing) in order to optimize the transaction cost, the Ramsey government may use inflation fluctuations to tackle the inefficiency associated with the Svensson timing.

Second, they imply a higher mean of optimal inflation. With the Svensson timing, nominal money balances provide liquidity services (Svensson, 1985). From the Ramsey government's perspective, such services should be taxed. This, in turn, implies a higher optimal nominal interest rate, which is the direct tax on nominal money balances and thus an indirect tax on the liquidity services, and which implies a higher mean of optimal inflation than in the Lucas time case. As a result, the introduction of the Svensson timing may help solve one unrealistic feature of OMFP in the literature: the negative mean of optimal inflation.

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[1] In sticky price models with production, inflation variations across states bring a cost from the supply side as well.

[2] The precautionary saving motivation has been identified as an important determinant of households' wealth accumulation (Gourinchas and Parker, 2001; Carroll and Samwick, 1998; Cagetti, 2003 and others).

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This feature is a standard, but widely criticized, result in models with the Lucas timing and has been shown in numerous studies except few works such as Khan et al. (2003) and Schmitt-Grohé and Uribe (2007).[3] It is worth further exploring the impact of the Svensson timing on the mean of optimal inflation because a positive mean of optimal inflation will have a non-negligible impact on OMFP (Ascari and Ropele, 2007).[4]

Third, they imply that the existing near random walk property of real public debt and tax rates may not hold if the volatility of optimal inflation becomes sufficiently large due to the aforementioned trade-off. The near random walk property of tax rates, as an empirical fact, was presented in the descriptions of French and British eighteenth-century public finance in Sargent and Velde (1995). Barro (1979) and Aiyagari et al. (2002) explain such a fact with different theoretical models. Later, Schmitt-Grohé and Uribe (2004) and Siu (2004) show that both real public debt and tax rates follow a near random walk property in sticky price models. As emphasized in Schmitt-Grohé and Uribe (2004), whether such a property remains in a theoretical model in which the Ramsey government issues nominal non-state-contingent debt hinges on a negligible volatility of optimal inflation. Since it is not clear how the aforementioned trade-off will affect the volatility of optimal inflation, it is of theoretical interest to check whether such a near random walk property is sensitive to the timing of markets.

In the presence of the above qualitative policy implications and given that both assumptions on the timing of markets are ultimately ad hoc, it is of interest to check whether the existing results about OMFP are quantitatively sensitive to the timing of markets and to what extent if they are. However, it is surprising that the impact of the Svensson timing, in particular that of the aforementioned trade-off, on OMFP has not been formally analyzed yet. For example, Chugh (2009) has compared OMFP across the two timings of markets in a *flexible* price environment. Nevertheless, Chugh (2009) has not provided a formal analysis of the impact of the trade-off on OMFP. The reason is the well known "surprising inflation" result in the literature: with the Lucas timing, the optimal initial price level in a flexible price environment in standard models [such as the one studied in Chari et al. (1991)] should be infinity when the initial nominal public debt balance is positive. To make the results comparable across the timings of markets in a flexible price model, it is essential to ignore the impact of the positive initial nominal public debt on OMFP, which essentially ignores the aforementioned benefit of the trade-off associated with the Svensson timing. This is exactly what has been done in Chugh (2009). However, in a sticky price model, the optimal initial price level will not be infinity any more even if the initial nominal public debt balance is positive; and we can thus provide a formal analysis of the impact of such trade-off on OMFP and compare OMFP across the timings of markets without ignoring the impact of the positive initial nominal public debt.

This paper quantitatively characterizes OMFP in a sticky price model with the Svensson timing. The economy is driven by two shocks, government expenditure shocks (g-shocks) and productivity shocks (z-shocks). The Ramsey government collects distortionary taxes, prints money, and issues nominal non-state-contingent bonds to finance an exogenous stream of public spending. Following the tradition starting with Lucas and Stokey (1983) and Chari et al. (1991), the Ramsey government in our model chooses the least disruptive policy to finance an exogenous stream of public spending. The criterion under which policies are evaluated is the welfare of the representative household. An assumption maintained is that the Ramsey government has the ability to fully commit to the implementation of announced fiscal and monetary policy.

Our numerical results show that the timing of markets makes quantitative differences with respect to some key features of OMFP in the sticky price model. For example, optimal inflation with the Svensson timing has a larger mean and is more volatile and so do optimal tax rates. Nevertheless, the timing of markets does not fundamentally change the nature of OMFP. For example, optimal inflation with the Svensson timing is still stable, with the standard deviation being close to zero, and has a negligible negative mean. And optimal tax rates have a low standard deviation. These findings are robust: they hold in our benchmark model and are insensitive to key (structural) parameters.

The rest of the paper is organized as follows. Section 2 sets up the model and the Ramsey problem. Section 3 presents the numerical results in the benchmark model. Section 4 carries out the sensitivity analysis. Section 5 concludes.

2. The model

The model is identical to the one studied in Schmitt-Grohé and Uribe (2004) except the timing of markets. This paper assumes the Svensson timing while Schmitt-Grohé and Uribe (2004) assume the Lucas timing.

In this economy, the representative household chooses consumption, c_t, working hours, h_t, and financial assets M_t and D_{t+1} (which denote the nominal money balance and the one-period state-contingent bond, respectively), to maximize its discounted expected lifetime utility function

$$\max_{\{c_t,h_t,M_t,D_{t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t,h_t). \tag{1}$$

where $\mathbb{E}_0$ denotes the mathematical expectation operator conditional on information available in period 0 and $\beta \in (0,1)$ denotes the subjective discount factor. The single period utility function u is assumed to be increasing in consumption, decreasing in work effort, strictly concave and twice continuously differentiable. We follow the literature by assuming that the single period utility function is separable between consumption and hours.

The consumption good c_t is a composite good made of a continuum of intermediate differentiated goods. The aggregation mechanism is given by the Dixit-Stiglitz aggregator. Each household produces one variety of intermediate goods with linear technology, $z_t\widetilde{h}_t$. Here household hours, $\widetilde{h}_t$, are the only input and productivity z_t follows an exogenous process which will be given in Section 3.1. The household is the monopolistic supplier of the intermediate good, and sets the price of the good it supplies taking the level of the aggregate demand as given. And the household is constrained to satisfy demand at that price, that is,

$$z_t\widetilde{h}_t \geq Y_t d(p_t). \tag{2}$$

$Y_t d(p_t)$ denotes the demand for the intermediate input where Y_t denotes the level of aggregate demand and p_t denotes the relative price of the intermediate good in terms of the composite consumption good. Mathematically, $p_t = \widetilde{P}_t/P_t$ where $\widetilde{P}_t$ denotes the nominal price of the intermediate good and P_t is the price of the composite consumption good. The demand function $d(\cdot)$ is decreasing and satisfies $d(1) = 1$ and $d''(1) < -1$. The restrictions on $d(1)$ and $d''(1)$ are necessary for the existence of a symmetric equilibrium. The household hires labor from a perfectly competitive market.

The period budget constraint of the household/firm unit is given by

$$0 = M_{t-1} + D_t + P_t\left[\frac{\widetilde{P}_t}{P_t}Y_t d\left(\frac{\widetilde{P}_t}{P_t}\right) - w_t\widetilde{h}_t - \frac{\theta}{2}\left(\frac{\widetilde{P}_t}{\widetilde{P}_{t-1}} - 1\right)^2\right] + (1-\tau_t)P_t w_t h_t - P_t c_t\left[1+s(v_t)\right] - M_t - \mathbb{E}_t r_{t+1} D_{t+1}. \tag{3}$$

where w_t, v_t, and r_{t+1} denote the real wage rate, the consumption-based money velocity, and the price of the one-period state-contingent bonds multiplied by the probability of the corresponding contingent state, respectively. Here the consumption-based velocity is given by

$$v_t = \frac{P_t c_t}{M_{t-1}}. \tag{4}$$

[3] Fagan and Messina (2009) examine the impact of downward wage rigidity (nominal and real) on optimal steady-state inflation.

[4] Nevertheless, Ascari and Ropele (2007) leave the modeling of positive trend inflation itself unexplored.