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Time inconsistency and the long-run effects of inflation☆

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HIGHLIGHTS

- Recent work indicates that individuals have excessive short-run discount rates.
- Due to the time-inconsistency problem, individuals likely under-save.
- Inflation is a tax that further distorts this problem.

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ABSTRACT

Recent work by Laibson (1997) identifies that individuals' time discount factors evolve over time. This leads to a time-inconsistency problem in which savings are distorted. This paper studies the long-run effects of inflation in the presence of a time-inconsistency problem.

1. Introduction

The inability of agents to commit to future actions is a long-standing issue in many models of monetary economies. For example, in search models of money such as Kiyotaki and Wright (1993) and Lagos and Wright (2005), money is essential for trade because individuals cannot commit to intertemporal contracts. Furthermore, policymakers are susceptible to the same commitment problem—seminal contributions by Kydland and Prescott (1977) and Barro and Gordon (1983) demonstrate the time inconsistency inherent in the design of monetary policy. Notably, economies are subject to inflationary bias because a central banker may be tempted to engineer some unanticipated inflation and exploit the trade-off between inflation and unemployment through the Phillips Curve.

The objective of this paper is to demonstrate that the long-run effects of inflation may be more severe than previously acknowledged. The heart of our argument lies in the inability of agents to commit to future actions. Following observations in experimental work by Laibson (1997), the way that individuals evaluate the future evolves over time. Such individuals are likely to state that they value savings and they intend to save—in the future, when "it is really important". Consequently, their level of savings is lower than someone who evaluates the future in a uniform manner.[1] The contribution of our work is to demonstrate that the long-run effects of inflation may be particularly severe if individuals suffer from the problem of time inconsistency. It has long been argued that inflation is a tax on money—such a tax magnifies the distortion from the inability to commit to foregone consumption.

Models of the standard time-inconsistency problem in monetary economies study the policymaker's inability to commit to policy in the short-run. In this setting, the policymaker plays a game against private sector agents who form expectations of inflation.

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1 Kenkel et al. (2002) study savings behavior when the rate of time preference varies over time due to past consumption of addictive goods.

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Ideally, the central banker would commit to a zero-inflation policy rule. However, the commitment solution is not time-consistent as there is always the temptation to cheat.

In contrast to such 'external' problems previously studied, individuals in our framework face an 'internal' time-inconsistency problem—they play a game against their future selves because the way that they evaluate the future is time-varying. Since individuals cannot commit to the future, standard constrained optimization techniques to solve for the consumption and savings choices cannot be applied. Nevertheless, Krusell et al. (2002) demonstrate that the standard recursive tools used to study the neoclassical growth model can also be valuable if individuals have quasi-geometric discounting. Using specific functional forms, Krusell et al. study Markov perfect equilibria. In particular, the equilibria are the limit of finite-horizon equilibria. The solutions to the individual's dynamic problem are time-consistent because none of the agent's future selves would have any reason to deviate. The tractability resulting from the underlying functional forms leads to closed-form solutions. As a result, the equilibrium to the game is unique.

In contrast to Krusell et al., we study a monetary economy. The transactions role of money is motivated by a simple Sidrauski-type money-in-the-utility function model. The effects of inflation are in part motivated by a standard seigniorage tax in which the monetary authority retains all of the revenue.

As quasi-geometric discounters have different "short-run" time discount factors than "long-run" discount factors, the "short-run" discount factor heavily distorts the individual's savings allocation. We find that the impact of the short-run discount factor on money demand is in stark contrast to the long-run discount factor. Perhaps most important, the impact of inflation on money balances depends on the difference between the short and long-run discount factors—highlighting the costs of inflation if individual behavior is time-inconsistent.

The remainder of the paper is as follows. Section 2 introduces the structure of the model and explains why only recursive methods are suitable for analyzing decision-making if individuals suffer from time-inconsistency. Section 3 analyzes steady-state money demand.

2. The structure of the model and the need for recursive methods

We begin by outlining the structure of the model. We consider a consumer representative who is capable of dictating consumption and portfolio decisions but takes the actions of the monetary authority as given. To introduce a simple transactions role for money, agents derive utility from real money balances:

$$u(c_t, m_t) = \phi \ln(c_t) + (1-\phi)\ln(m_t)$$

where ϕ represents the weight that agents place on utility from consumption. The agent's preferences evolve over time as specified by the following quasi-geometric discount function:

$$U_t(c, m) = u(c_0, m_0) + \delta[\beta u(c_1, m_1) + \beta^2 u(c_2, m_2) + \beta^3 u(c_3, m_3) + \cdots].$$

Notably, β represents the standard "geometric" component to discounting future utility. However, an individual's degree of short-run patience differs from the degree of long-run patience. That is, $\delta\beta$ reflects the rate at which an individual discounts utility from the following period while β represents the rate at which utility is discounted any period thereafter. Consequently, $\delta\beta$ is viewed as an individual's short-run time discount factor and β is the individual's long-run time discount factor. Obviously, if $\delta < 1$, the short-run discount factor differs from the long-run discount factor. In these circumstances, the way that the individual values the future evolves over time. As we elaborate below, individuals cannot commit to future savings plans because once the future arrives they become more impatient than they did at an earlier point in time.

The household budget constraint is deliberately simple in order to maintain tractability. Such tractability is important for proving that the Markov perfect equilibrium of the game is unique. Household income is dependent upon after-tax money balances, $(1-\tau)m_t^{1-\pi}$. Thus, there are two factors which affect the value of money balances over time. The first is a linear tax on money balances, τ. This is meant to serve as a proxy for the standard effects of inflation as a tax on money.[2] However, in the time-inconsistency literature, the costs of inflation are typically represented as a convex welfare loss. In order to capture such non-linear effects of inflation, we assume that the amount of money transferred over time evolves in a non-linear way. For example, Barro (1996) finds evidence of significant non-linearities from inflation. Moreover, Sarel (1996) and Khan and Senhadji (2001) also stress that there are significant non-linear effects of inflation. The degree of non-linearity on economic activity in our framework depends on the parameter π. We interpret the linear and non-linear effects of the tax on money balances as two independent, exogenous parameters. However, one might also posit that there is an equilibrium relationship between them.[3]

After-tax income is divided between current consumption and money balances to carry into the following period. Consequently, money balances evolve in the following manner:

$$m_{t+1} = (1-\tau)m_t^{1-\pi} - c_t.$$

Solving for the level of consumption, we can write the problem in terms of the amount of money balances:

$$c_t = (1-\tau)m_t^{1-\pi} - m_{t+1}.$$

The individual's lifetime utility function would be expressed as:

$$\begin{aligned} U_t(c, m) = {} & \phi \ln((1-\tau)m_t^{1-\pi} - m_{t+1}) + (1-\phi)\ln(m_t) \\ & + \delta\beta\phi \ln((1-\tau)m_{t+1}^{1-\pi} - m_{t+2}) + \delta\beta(1-\phi) \\ & \times \ln(m_{t+1}) + \delta\beta^2\phi \ln((1-\tau)m_{t+2}^{1-\pi} - m_{t+3}) \\ & + \delta\beta^2(1-\phi)\ln(m_{t+2}) + \cdots. \end{aligned}$$

In order to maximize lifetime utility as of period t, the individual's choice of money balances to carry into period $t+1$ is given by:

$$\frac{\phi}{(1-\tau)m_t^{1-\pi} - m_{t+1}} = \frac{\delta\beta\phi(1-\tau)(1-\pi)m_{t+1}^{-\pi}}{((1-\tau)m_{t+1}^{1-\pi} - m_{t+2})}.$$

By comparison, the choice of money balances to carry into period $t+2$ is:

$$\frac{\phi}{(1-\tau)m_{t+1}^{1-\pi} - m_{t+2}} = \frac{\beta\phi(1-\tau)(1-\pi)m_{t+2}^{-\pi}}{((1-\tau)m_{t+2}^{1-\pi} - m_{t+3})}.$$

Yet, once period $t+1$ arrives, the individual's trade-offs between current and future money balances change:

$$\frac{\phi}{(1-\tau)m_{t+1}^{1-\pi} - m_{t+2}} = \frac{\delta\beta\phi(1-\tau)(1-\pi)m_{t+2}^{-\pi}}{((1-\tau)m_{t+2}^{1-\pi} - m_{t+3})}.$$

Thus, the individual at time $t+1$ would disregard the savings plan set in place at time t. As a result, individuals with quasi-geometric discounting cannot commit to future plans. In order to find the solution to this problem, recursive methods must be applied.

[2] As discussed by Krusell et al., it is important to use functional forms in order to derive a closed-form solution and obtain the unique Markov perfect equilibrium in the agent's game. Consequently, we do not explicitly model monetary growth which leads to inflation in the steady-state. To retain the same degree of tractability as Krusell et al., we impose that inflation is a direct tax on money balances. This idea follows Li (1995).

[3] Barro presents evidence that countries with higher average inflation rates also have higher inflation variability.