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Central bank design with heterogeneous agents

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ABSTRACT

We study alternative institutional arrangements for the determination of monetary policy in a general equilibrium model with heterogeneous agents, where monetary policy has redistributive effects. Inflation is determined by a policy board using either simple-majority voting, supermajority voting, or bargaining. We compare the equilibrium inflation rates to the first-best allocation.

1. Introduction

This paper studies alternative decision-making models for the determination of monetary policy. We consider a general equilibrium model with heterogeneous consumers. Differences in preferences yield diverse inflation aversions. Monetary policy is decided within a policy board that represents the agents' preferences. This allows us to compare the outcome of the following central bank designs: first, we analyze simple-majority voting and supermajority voting, i.e. majority voting with veto power for the minority. Then, we analyze a policy board, where the representatives of each group of agents bargain over the money growth rate with and without allowing for lump-sum transfers.[1]

Our framework builds on the representative agent model of Lagos and Wright (2005). Their model is useful because it allows us to introduce heterogeneous preferences for consumption while still keeping the distribution of money balances tracktable. Agents have either high or a low utility from consumption. The main consequence is that there is a two-point distribution of money holdings and, therefore, monetary policy has redistributive effects as the inflation tax affects agents differently.[2]

The following results emerge from the model. First, the social planner's desired inflation rate is the Friedman Rule, i.e. an inflation rate at the rate of time preferences. This efficient outcome is attained if, under simple-majority voting, the agents with low-inflation preferences have the majority. Under bargaining, first-best can only be attained when transfers are feasible. Second, under all other central bank designs the equilibrium outcome does not attain the first-best allocation. In particular, under some simple-majority voting, when the agents with high inflation preferences have a majority, the resulting inflation is strictly above the Friedman Rule. The same is true for bargaining and for supermajority voting.

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[1] See Persson and Tabellini (2000) and Gerling et al. (2003) for expositions and surveys on different decision-making mechanisms.

[2] Redistributive effects of monetary policy in a different context have been studied in Berentsen et al., 2005, Bhattacharya et al. (2005a, b), Boel and Camera (2006), Molico (2006), or Haslag and Martin (2007).

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An interesting aspect of our findings is that when we study two separate economies, one populated by agents with low preferences for consumptions and the other populated by agents with high preferences for consumptions, each prefers the Friedman Rule. In particular for any central bank design the outcome will be the Friedman Rule in each economy. If these two economies form a monetary union, then a deviation of the Friedman Rule can be the outcome. This is due to the redistributional effect of inflation in an economy with heterogeneous agents.[3]

Bullard and Waller (2004) have the most closely related analysis. They discuss the advantages of various alternative decision-making models in an overlapping-generations model. First, they find that if the inflation-averse agents have a minority, the resulting inflation is infinite. In contrast, under the same institutional rule, the equilibrium inflation rate in our model is above the Friedman Rule, but it is finite. This major difference is due to their use of the overlapping-generations model where the young generation prefers a hyperinflation. Second, in their model, a constitutional rule (i.e. supermajority voting) implements the first-best allocation. In our model, however, supermajority voting never yields the first-best allocation. As they remark (p. 112), "the problems with majority voting and bargaining are remedied by giving the older, minority generation a veto over proposed policy changes [using supermajority voting]. This acts as a form of commitment, causing the young to choose monetary policy based on lifetime utility, and thus to create a stationary equilibrium at the social optimum".

We propose a different solution to attain the first-best allocation: bargaining with transfers. Appropriate transfers allow the economy to move to the Friedman Rule from any status quo inflation rate since the agents who lose from the change of monetary policy are compensated. If the transfers are lump-sum, they yield a Pareto superior allocation. One interpretation of our result is that monetary policy needs to be linked to fiscal policy since this allows for such transfers.

We organize the paper as follows. In Section 2, we present the environment. Section 3 analyzes monetary equilibria and the optimality of the Friedman Rule. Section 4 then examines alternative institutional arrangements for the determination of monetary policy and discusses the results. Extending our model in Section 5 allows us to interpret our results similar to those of Erosa and Ventura (2002). Finally, we provide a brief conclusion.

2. The model

Time is discrete. There is a [0,1] continuum of infinite-lived agents. In each period, two Walrasian markets open and close sequentially.[4] Only one market is open at any one time. We assume there are two perishable goods produced and consumed by all agents. Agents get utility $U(x)$ from consuming $x \geqslant 0$ of a generalized good with $U(0)=0$, $U'(x)>0$, $U'(0)=\infty$, $U'(+\infty)=0$, and $U''(x)<0$ in the *first market*. In the *second market*, an agent gets utility $\varepsilon u(q)$ from consuming the specialized good $q \geqslant 0$ where $u(0)=0$, $u'(q)>0$, $u'(0)=\infty$, $u'(+\infty)=0$, $u''(q)<0$, and $u'''(q)>0$.[5] In the first market, agents provide working hours h at the linear cost function $c(h)=h$. The cost of producing a good in the second market is linear, i.e. $c(q)=q$.

There are three types of agents: sellers, labeled s, and two types of buyers, labeled l and h, as explained below. Sellers produce in the second market and consume in the first market. Buyers, however, consume in the second market and produce and consume in the first. The timing is as follows: at the beginning of each period, the first market opens. Then, after settling all trades, the second market opens. Fig. 1 provides a simple illustration of our model's timing.

The two buyer types differ in their marginal utility as follows. The low type, l, receives utility $\varepsilon^{\mathrm{l}}u(q)$ and the high type, h, utility $\varepsilon^{\mathrm{h}}u(q)$ when they consume q in the second market, where $0<\varepsilon^{\mathrm{l}}<\varepsilon^{\mathrm{h}}$. In the first market, all agents, regardless of their state, can provide labor h as well as consume the homogeneous good x. The measures of buyers and of sellers are each normalized to 1. The measure of low-type buyers is n^{l} and the measure of high-type buyers is n^{h} with $n^{\mathrm{l}}+n^{\mathrm{h}}=1$. The common discount factor is β.

While consumption and production goods are non-storable, there is a storable object called *money*. Money is perfectly divisible and agents can hold any quantity up to the total nominal stock, i.e. $0 \leqslant m \leqslant M$. Money (e.g. a simple piece of paper) has no intrinsic value, i.e. so called 'fiat money'. Since agents are anonymous and there is no double coincidence of wants, agents need money to trade.[6]

We assume that there is a monetary authority called *central bank* that prints fiat money at zero cost. The supply of money M changes according to $M_t=\mu M_{t-1}$. We assume that the central bank, in the first market, injects money through lump-sum transfers $\tau=(\mu-1)M_{t-1}$. If $\mu<1$, this means that the central bank has the ability to tax agents.

2.1. Consumption and production

Let p_1 be the price of goods in the first market. We study equilibria where beginning-of-period real money balances are time-invariant:

$$M_t p_{1,t} = \frac{M_{t-1}}{p_{1,t-1}} \tag{1}$$

[3] This result, although derived in a very different context, is in accordance with von Hagen and Süppel (1994).
[4] By assuming competitive pricing in all markets, we depart from Lagos and Wright (2005) as for example in Rocheteau and Wright (2005).
[5] The CRRA utility functions, for example, satisfy these requirements.
[6] See also Wallace (2002) for a discussion about anonymity.