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MONOPOLISTIC COMPETITION, OVERLAPPING GENERATIONS, AND THE ROLE OF MONETARY POLICY*

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This paper studies a simple overlapping generations model (OGM) with monopolistic competition in goods markets. I show that the set of rational expectations equilibria of the model can be characterized by a simple difference equation in the real quantity of money, in the same way as the standard, competitive OGM. The monopolistic competition case results, however, in less output, consumption, and lower welfare relative to the competitive case.

The model is then used to reexamine some issues of monetary policy. Previous studies have stressed that the existence of imperfect competition in goods markets may justify activist monetary policy. I show that this rationale for policy intervention remains true in dynamic models, although transmissions mechanisms and policy prescriptions turn out to be very different. This is shown by discussing the effectiveness of monetary policy, the optimal quantity of money, and the welfare cost of inflationary finance.

1. Introduction

This paper studies the consequences of price setting behavior for dynamic monetary models of optimizing agents. One of the objectives of this study is methodological. Previous models of money assume perfect competition in goods markets, while models of monopolistic competition are usually static. In this paper I study a simple overlapping generations model (Samuelson (1958)) modified to allow for monopolistic competition in the spirit of Dixit and Stiglitz (1977). This model should be useful for many applications.

A second objective of the paper is to analyze the role of monetary policy when goods markets are imperfectly competitive. Much of the recent literature in macroeconomics examines the implications of imperfect competition and price setting behavior for the analysis and design of monetary policy. The logic of the best known papers, such as Blanchard and Kiyotaki (1987) and Ball and Romer (1987), is simple. In the absence of government intervention, imperfect competition in goods markers results in a suboptimal level of output. Monetary policy can be used to boost aggregate demand, and thus to increase output and welfare.

A difficulty with previous models is that they are inherently static, and do not allow easily for the introduction of valued fiat money. As a shortcut, Blanchard and Kiyotaki and Ball and Romer introduce real money balances in the utility function. Still, money is neutral, and they have to appeal to the ex-

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istence of »menu costs» to explain real effects of money and the role of monetary policy.

I show that, in spite of this shortcoming, the logic of previous studies remains the same in a dynamic framework: if monetary policy can affect aggregate demand, then using it to increase equilibrium output is welfare improving. The way monetary policy affects aggregate demand in a dynamic model depends, however, on the functions that money performs in the model. Modeling the demand for money explicitly leads to policy prescriptions that differ substantially from those derived from past research.

The paper has two main parts. In the first part I set up the model and study rational expectations equilibria for a given choice of monetary policy. I show that market equilibria can be characterized by a simple difference equation which corresponds to the »reflected offer curve» of standard, competitive overlapping generations models. Thus, the substitution of price setting behavior for price taking does not fundamentally change the properties of equilibria. The difference between the monopolistic competition case and the perfectly competitive case turns out to be that aggregate output and consumption tend to be smaller in the former. This obtains because price setting behavior reduces output below competitive levels. The differences between the two cases tends to disappear, however, as the elasticity of substitution between varieties of output becomes infinite.

The second part of the paper uses the model to discuss some issues in monetary policy. The first question I ask is: How can monetary policy be used to affect aggregate demand? I show that the effects of monetary policy depend on exactly how the government injects money into the economy. If the government issues new currency to pay interest on existing money holdings, the rate of growth of money does not affect real variables, i.e., money is superneutral. In contrast, if new currency issues are used to finance lump sum transfers to private agents, monetary policy does have real effects. This is, of course, one well known fact in overlapping generations models (see, for instance, Azariadis (1987)). It is worth stressing that this policy lesson remains even in the presence of price setting behavior. Previous papers on monetary policy and monopolistic competition do not make such distinction.

To show that the monopolistic competition model leads to different policy rules from the competitive OGM, I reexamine two well known problems: the optimal quantity of money (Friedman (1969)) and the welfare cost of inflationary finance (Bailey (1953), Phelps (1973)). Friedman (1969) reasoned that, since the social cost of producing fiat money was zero, it was socially optimal to use monetary policy so as to induce the private sector to hold a satiation level of real money balances. He conjectured this would require negative money growth in order to achieve deflation. In competitive overlapping generations models with money, in contrast, the rate of growth that maximizes utility in the steady state is equal to the rate of growth of the economy (see, for instance, the recent study by Abel (1987)). I show this conclusion is no longer true if goods markets are imperfect. In the context of my model the rate of monetary growth that maximizes steady state private welfare is negative. Although this prescription might seem similar to that of Friedman, the two rules are not the same. In my model, that optimal monetary growth is negative has nothing to do with the satiation level of real balances (I do not assume that money provides utility directly). It arises because the imperfection in goods markers causes output to be less than optimal in the absence of government intervention. Reducing monetary growth results, in the steady state, in lower inflation. This increases the real value of money balances in equilibrium. Since aggregate demand and output equal the value of real balances in this model, deflation can be used to increase output to the socially optimal level.

The same intuition applies in the analysis of the welfare cost of inflationary finance. Phelps (1973) stated that, as long as the government is raising revenue with some distortionary tax, it was optimal to impose a positive inflation tax. This prescription is correct as long as the marginal deadweight loss associated with the inflation tax is zero at zero inflation. Thus, (Phelps's) prescription was challenged by Romer (1986) in the context of a dynamic Baumol-Tobin model. In Romer's model, an increase in inflation induces private agents to increase the frequency of their trips to the bank. Since trips are costly, increased inflation causes a deadweight loss. In the context of my model, I also find that the welfare cost of inflation is larger than conjectured by Phelps. My reasons, however, are very different from Romer's. Monopolistic competition reduces output below efficient levels. This implies that at a zero rate of inflation the economy is not at the first best. Positive inflation decreases the demand for real balances, reducing aggregate demand and bringing the economy even farther away from efficiency.

Section (2) describes the model. Individual behavior is analyzed in Section (3), which also defines rational expectations equilibria. Section (4) characterizes equilibria. Section (5) discusses monetary policy issues. Section (6) concludes.

2. *The model*

I will modify a simple overlapping generations model (Samuelson (1958)) to allow for monopolistic competition *a la* Dixit-Stiglitz (1977). This is easily accomplished by assuming that agents produce and consume n differentiated goods.

Time is discrete and indexed by $t = 1, 2, 3\ldots$ At the beginning of each period t a generation of n workers-consumers is born. Each agent lives for only two periods (»youth» and »old age»). Generations are identical to each other. The only exception to this rule is generation zero, born »old» at the beginning of $t = 1$. Members of generation zero live only during period one. Thus, in any period t there are two generations alive, one young and one old.

Each member $h = 1, \ldots, n$ of generation $t \geq 1$ (henceforth called agent (h, t)) produces a variety of a differentiated consumption good. Agents can work only in their youth. I assume for simplicity if agent (h, t) works N_t^h hours he produces N_t^h units of variety h.

All consumption occurs in old age. Consumption goods are not storable. There is only one asset in this economy: fiat money or currency. The government issues currency each period to finance transfers to old age individuals. The evolution of the money supply M_t is given by

$$(1) \qquad M_t = M_{t-1} + \sum_{k=1}^{n} T_t^h$$

where T_t^h denotes the monetary transfer (or tax, if negative) at t to an old member h of generation $(t-1)$. (T_t^h) may be random, in whose case its realization becomes known at the beginning of t. I will assume that the transfer policy $[(T_t^h)]$ and the corresponding money supply process are the only possible sources of uncertainty in this economy.

In order to provide for his old age consumption, a young member of generation t must produce his variety of the differentiated good and exchange it for fiat money. Agent (h, t) can sell his produce for $P_{ht}N_t^h$ units of currency, where P_{ht} denotes the price of variety h in period t. Thus his post transfer holding of money is $M_{t+1}^h = P_{ht}N_t^h + T_{h,t+1}$.

Agent (h, t)'s utility increases with old age consumption and decreases with labor effort according to the function:

$$(2) \qquad E_t\, v(C_{t+1}^h) - u(N_t^h)$$

where

$$(3) \qquad C_{t+1}^h = \left[\frac{1}{n}\sum_{k=1}^{n} C_{k,t+1}^{h\;(\theta-1)/\theta}\right]^{\theta/(\theta-1)}$$

where $C_{k,t+1}^h$ denotes agent (h, t)'s consumption of variety k at $(t+1)$.

Equation (3) is just a CES index of utility on consumption of differentiated goods. The parameter θ measures the degree of substitutability between different varieties. $\theta > 1$ for the model to be well behaved.[1] As θ goes to infinity, goods become perfect substitutes.

Each member h of generation zero is initially endowed with M_0^h units of fiat money. He receives a government transfer T_1^h, and his problem is to choose a consumption vector $(C_{k,1}^h)_{k=1}^n$ to maximize (3) for $t = 0$.

Additivity in the utility function (2) is assumed in order to highlight the essentials of the model. I will also assume that v(.) and u(.) are continuously differentiable, strictly increasing functions. v(.) is strictly concave and u(.) strictly convex. Finally, I will assume that $v'(x)x$ is a strictly increasing function of x. Extensions to more general cases are relatively straightforward and left to the reader.

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[1] *θ is the elasticity of demand for each variety (see eq. (4) below). If $\theta \leq 1$, each producer would try to charge an infinite price.*

3. Individual behavior and market equilibrium

This section starts by solving the problem of agent (h,t). The solution turns out to be simple and tractable. A second objective of this section is to define rational expectations equilibria.

Consider the problem of agent (h,t), $t \geq 0$, when he is old, i.e., at the start of period (t+1). At the beginning of (t+1), agent (h,t) has, after learning the value of the government transfer, M^h_{t+1} units of fiat money in his possession. His problem at that time is to choose an n-tuple $(C^h_{k,t+1})^n_{k=1}$ in order to maximize C^h_{t+1} (given by (3)) subject to the budget constraint $\sum_{k=1}^{n} P_{k,t+1}\, C^h_{k,t+1} \leq M^h_{t+1}$. The solution of this problem is by now, well known and given by:

$$(4) \qquad C^h_{k,t+1} = \left(\frac{P_{k,t+1}}{P_{t+1}}\right)^{-\theta} \frac{M^h_{t+1}}{nP_{t+1}}$$

where:

$$(5) \qquad P_t = \left\{\frac{1}{n} \sum_k P^{1-\theta}_{kt}\right\}^{1/(1-\theta)}$$

is an exact price index associated with the utility index (3). P_t is the consumer price index in this economy.

Replacing (4) in (3) and using (5), it follows that $C^h_{t+1} = \frac{M^h_{t+1}}{P_{t+1}}$ if agent (h,t) chooses consumption optimally.

Now, consider the decision problem of agent (h,t) when young. I assume (h,t) has rational expectations and behaves like a monopolistic competitor in the goods market.[2] The assumption of monopolistic competition implies that (h,t) chooses labor effort N^h_t and the price of his product P_{ht} taking the aggregate price level P_t and the demand function for his product $C_{ht} = \sum_{j=1}^{n} C^j_{ht}$ as given. But from (4),

$$C_{ht} = \left(\frac{P_{ht}}{P_t}\right)^{-\theta} \frac{M_t}{nP_t}$$

where $M_t = \Sigma M^h_t$ is the aggregate supply of fiat money. Thus, agent (h,t)'s problem is to:

$$\underset{N^h_t,\ P_{ht}}{\text{maximize}}\ E_t\, v\left(\frac{M^h_{t+1}}{P_{t+1}}\right) - u(N^h_t)$$

$$\text{subject to } M^h_{t+1} = P_{ht} N^h_t + T^h_{t+1}$$

$$\text{and } N^h_t = \left(\frac{P_{ht}}{P_t}\right)^{-\theta} \frac{M_t}{nP_t}.$$

Define $x_{ht} = P_{ht}/P_t$ as the *relative price of variety h* and $m_t = M_t/nP_t$ as the (per young agent) amount of real balances in the economy. The problem of (h,t) is thus to choose x_{ht} to maximize:

$$(6) \qquad E_t\, v\left(x^{1-\theta}_{ht}\, m_t \frac{P_t}{P_{t+1}} + \frac{T^h_{t+1}}{P_{t+1}}\right) - u(x^{-\theta}_{ht}\, m_t)$$

The solution of the maximization problem (6) depends on whether the old age transfer T^h_{t+1}/P_{t+1} is lump sum or contingent on agent (h,t)'s choices. Notice that, in choosing x_{ht}, agent (h,t) takes m_t as given.

We are ready to define an equilibrium for this economy. A *feasible policy* for the government is a (possibly stochastic) sequence $\{M_t, (T^h_t)^n_{h=1}\}$ that satisfies (1) for all t. Given a feasible policy, a *symmetric market equilibrium* is a stochastic process for the price level $\{P_t\}$ and real balances $\{m_t\}$ such that, for all t:

(a) $x_{ht} = 1$ maximizes (6) given the processes for m_t, P_t, P_{t+1}, and T^h_t

(b) $m_{t+1} = m_t\, P_t/P_{t+1} + (1/n)\ \Sigma_h\, T^h_{t+1}/P_{t+1}$.

Condition (a) states that, given current and future price levels, transfers, and demand, each agent finds it optimal to set the price of its product equal to the aggregate price level. If $x_{ht} = 1$, then market clearing implies that $N^h_t = m_t$. Thus, condition (b) just states that supply equals demand in all markets.

4. Monopolistic competition and market equilibrium

The purpose of this section is to characterize market equilibria and compare this model with the standard competitive overlapping

[2] *Implicitly I am assuming that n is large enough.*

generations model with money. The result is that the set of rational expectations equilibria in the monopolistic competition case is roughly similar to that in the competitive case. However, there is an important difference. The presence of imperfect competition implies that output, consumption and welfare tend to be smaller than in the competitive case. The magnitude of this difference depends on the degree of imperfections in the goods market. As θ goes to ∞ (goods become perfect substitutes), the monopolistic competition case converges to the competitive case.

To focus on the essentials, this section assumes that the government follows a noninterventionist policy: it sets the nominal amount of currency constant at $M_t = 1$, and all taxes and transfers at zero. Given this policy, the problem of agent (h, t) is to choose x_{ht} in order to maximize:

$$v(x_{ht}^{1-\theta}\ m_t\ R_t) - u(x_{ht}^{-\theta}\ m_t)$$

where $R_t = P_t/P_{t+1}$ is the gross rate of return on money (the inverse of the gross rate of inflation). Our assumptions on v(.) and u(.) guarantee that first order conditions are necessary and sufficient for a maximum. Agent (h, t)'s optimal choice of x_{ht} is then given implicitly by the expression:

$$\text{(7)} \quad v'(x_{ht}^{1-\theta}\ m_t\ R_t)\ x_{ht}^{-\theta}\ R_t = \frac{\theta}{\theta-1} u'(x_{ht}^{-\theta}\ m_t)\ x_{ht}^{-\theta-1}$$

In a symmetric market equilibrium $x_{ht} = 1$. Also, the noninterventionist policy implies $R_t = m_{t+1}/m_t$. Substituting these two facts in (7) we obtain the following expression for the equilibrium sequence of real balances (and therefore, the evolution of the price level as well):

$$\text{(8)} \quad v'(m_{t+1})\frac{m_{t+1}}{m_t} = \frac{\theta}{\theta-1} u'(m_t)$$

Equation (8) is a first order difference equation in m_t. Solutions to (8) completely characterize the set of perfect foresight equilibria. In fact, (8) is just the analog of the *reflected offer curve* usually found in the overlapping generations literature (for an introduction, see Azariadis (1987)).

The set of solutions to (8) is well known. There are two steady states. One of them is $m_t = 0$ for all t. In this equilibrium, no agent expects currency to have positive value in the future, which makes currency worthless today. As a consequence, production and consumption are zero in all periods.

There may be a second, *monetary* steady state with a constant price level and a constant value m* of real balances. If it exists,[3] m* is the solution of:

$$\text{(9)} \quad v'(m^*) = \theta u'(m^*)/(\theta - 1)$$

The autarkic steady state is locally stable, whereas the monetary steady state is globally unstable in this case. This implies that for each initial value m_1 in $(0, m^*)$ there is a monetary equilibrium in which real balances, production, and consumption converge monotonically to zero.

For the sake of comparison with the competitive OGM, we will derive the reflected offer curve for the competitive case. Suppose that the economy is as described in Section II, except that agents behave competitively instead of being price setters (that is, agents take all prices as given). In a symmetric equilibrium $P_{ht} = P_t$ for all h, and we are (formally) back to the competitive overlapping generations model. It is now easy to show that the set of perfect foresight equilibria is described by the first order difference equation:

$$\text{(10)} \quad v'(m_{t+1})\frac{m_{t+1}}{m_t} = u'(m_t)$$

Equation (10) is the reflected offer curve associated with the competitive OGM, and completely characterizes the equilibrium set in the competitive OGM. As can be seen from (8) and (10), the only difference between the set of equilibria in the two models is due to the factor $\theta/(\theta - 1)$ in (8), which reflects the effect of monopolistic competition. Moreover, as θ goes to infinity the two models coincide.

[3] *A necessary and sufficient condition for the existence of a solution m*>0 to (9) is that* $v'(0) > \theta(\theta-1)^{-1} u'(0)$. *Note that this is a more stringent requirement than* $v'(0) > u'(0)$, *which is the (Samuelson case) necessary and sufficient condition for the existence of monetary equilibria in the competitive OGM.*

The effect of imperfect competition can be best seen by comparing steady states. Let m** be the stationary solution of (10). From (9), it follows that the equilibrium value of real balances m* in the monopolistic competition case is smaller than the value under perfect competition m**.[4] As a consequence, steady state output, consumption and private welfare are all smaller. Moreover, the monopolistic competition case diverges from the perfect competition as θ becomes one, i.e., as the monopoly power of individual producers increase. This is, of course, what we should have expected: monopolistic competition *must* result in lower output than perfect competition. As θ increases, however, m* increases, tending to m** as $\theta \to \infty$.

5. *Monopolistic competition and the role of monetary policy*

The purpose of this section is to discuss the effects of monetary policy in this model. I will focus on steady state outcomes; interested readers will find no difficulty to extend the results to nonstationary equilibria. The intuition of the examples below can be summarized as follows: monopolistic competition introduces a distortion in goods markets and therefore interventionist monetary policy can improve welfare. However, in order to accomplish this goal monetary must be designed so that equilibrium real money balances, output and consumption increase. This implies that monetary policy can be welfare improving only by *increasing* the rate of return on fiat money, i.e, *decreasing* the inflation rate.

5.1 Does monetary policy have real effects?

One of the main lessons from dynamic models is that the real effects of monetary policy are not independent of the way money is injected into the system. In particular, this is true in the OGM. I will show that this message is not changed by the presence of monopolistic competition.

[4] *A »proof» is as follows: From (9), $\partial m^*/\partial\theta > 0$. Since m** is the limit of m* as θ goes to infinity, the claim follows.*

Assume for instance that money supply follows a stochastic process $M_{t+1} = \mu_{t+1} M_t$, where $\mu_{t+1} > 0$ is a random variable whose realization is known at the beginning of t+1. The government augments the quantity of currency by paying interest on savings. Therefore, $T^h_{t+1} = (\mu_{t+1} - 1)\, P_{ht} N^h_t$. Then the stochastic steady state is independent of the $\{\mu_t\}$ process, i.e., this type of monetary policy does *not* affect real variables.

The proof is straightforward. Given this kind of policy, the problem of agent (h, t) is to choose his relative price x_{ht} in order to maximize $E_t \quad v(x_{ht}^{1-\theta} m_t \mu_{t+1} R_t) - u(x_{ht}^{-\theta} m_t)$. From the first order conditions of this problem and the fact that $x_{ht} = 1$ in a symmetric equilibrium, a necessary condition for equilibrium is:

$$(11) \quad E_t \; v'(m_t \mu_{t+1} R_t)\, \mu_{t+1} R_t = \frac{\theta}{\theta - 1} u'(m_t)$$

From (11), it can be seen that the process $P_{t+1} = \mu_{t+1} P_t$ and $m_t = m^*$ given by (9) is a competitive equilibrium. For, in that case, $\mu_{t+1} R_t = 1$ and the stationary solution of (11) reduces to the solution of (9).

Thus, this kind of monetary policy has no effect on real allocations. It only affects price levels. This should come as no surprise, for in standard overlapping generations models interest payments on money have no effects.

In contrast, if money is injected into the economy through lump sum transfers monetary growth will affect real variables. Suppose that the government follows a deterministic policy of giving the old generation each period a monetary transfer with real value τ, and printing as much currency as needed to finance the transfer. τ can be regarded as a Social Security payment, or a tax reduction. The important aspect is that, from the viewpoint of agent (h, t), the value of his old age transfer does not depend on his actions. This class of monetary policies *does* have real effects, as I now show.

The policy is $T^h_{t+1} = P_{t+1}\tau$, and $M_{t+1} = M_t + P_{t+1} n\tau$. The last equation can be rewritten as $m_{t+1} = R_t m_t + \tau$. Under this policy, the problem of (h, t) is to choose his relative price x_{ht} to maximize:

$$(12) \quad v(x_{ht}^{1-\theta}\, m_t R_t + \tau) - u(x_{ht}^{-\theta}\, m_t)$$

From the first order conditions of this problem, and using the fact that $x_{ht} = 1$ in a market equilibrium, we obtain that a necessary condition for equilibrium is:

$$v'(m_t R_t + \tau) R_t = \frac{\theta}{\theta - 1} u'(m_t)$$

but, using $R_t = (m_{t+1} - \tau)/m_t$, we obtain the following first order difference equation:

$$(13) \quad v'(m_{t+1}) \frac{m_{t+1} - \tau}{m_t} = \frac{\theta}{\theta - 1} u'(m_t)$$

which characteristics the evolution of real balances in equilibrium. (13), like (8), is a reflected offer curve. The difference between (8) and (13) is the presence of τ, the value of the real transfer.

It is obvious, from the comparison of (8) and (13), that this kind of monetary policy does affect equilibrium real balances, output, and consumption. Different values of τ imply different solutions of (13).

The message of these examples is that in models with well specified monetary sectors the real effects of monetary policy depends on the functions that money performs in the model. Recent studies on monopolistic competition and macroeconomics have, in contrast, neglected this distinction.

5.2 The optimal quantity of money

Monopolistic competition implies that monetary policy can improve welfare by increasing aggregate demand. In this model, demand equals the real quantity of money. It follows that monetary policy is beneficial only if it increases the equilibrium quantity of money. Since this requires decreasing the rate of inflation, standard policy prescriptions have to be modified.

To illustrate this reasoning, consider the problem of the optimal quantity of money (Friedman (1969)). Friedman reasoned that, since the social cost of producing fiat money is negligible, the quantity of money should be set to a satiation level. His conjecture was that this would require deflation. In my model, the optimal rate of inflation and money growth turn out to be negative also. But the reasons are completely different.

First we derive the value of real balances that maximizes steady state utility. Let m be the steady state value of the real quantity of money. In the steady state, the utility that old generations derive from consumption is equal to $v(m)$. Also, labor effort and output is equal to m. Therefore, the optimal quantity of money is the value of m that maximizes steady state utility $v(m) - u(m)$, given implicitly by the solution of

$$(14) \quad v'(m) = u'(m)$$

Now we can ask the question: What is the rate of growth of the money supply that maximizes steady state welfare in a *market* equilibrium? As we know from our previous examples, the rate of growth of the money supply affects real allocations only if money is introduced in the economy via lump sum transfers. Thus, we assume that is the case. The government chooses a rate of growth μ of the supply of money and gives the seigniorage proceeds as a lump sum transfer to old generations.

The policy is then: $M_{t+1} = \mu M_t$, $nP_{t+1}\tau = M_{t+1} - M_t$. In the steady state, $M_t/nP_t = m$, and thus $\mu P_{t+1}/P_t = 1/R_t$. By choosing μ, the government chooses the steady state inflation rate. This implies that $\tau = (1 - \mu^{-1})m$. The value of the real transfer τ is just the proceeds of the inflation tax.

By substituting $\tau = (1 - \mu^{-1})m$ in (13) and simplifying we obtain the relationship between μ and the value of m in a steady state market equilibrium:

$$(15) \quad v'(m) \frac{1}{\mu} = \frac{\theta}{\theta - 1} u'(m)$$

From (14) and (15), it immediately follows that the value of μ that results in the optimal quantity of money is $\mu = 1 - \theta^{-1}$.

Thus, the optimal policy is to *contract* the amount of currency in the economy, that is, to impose a lump sum *tax* on old age individuals. The optimal rate of inflation is negative. This policy contrasts with the optimal monetary rule in the competitive case (see, for instance, Abel (1987)), which prescribes a constant amount of currency, zero inflation, and zero taxes or transfers.

Although my optimal money growth rule

seems similar to Friedman's rule, they are totally different. My prescription has nothing to do with satiation in real balances; it is a consequence of the fact that monopolistic competition results in too little output. An increase in aggregate demand helps correcting this deficiency. In this model, aggregate demand and output equal the value of real money balances, which is endogenous. In turn, increasing the equilibrium quantity of money requires lowering inflation.

5.3 The welfare cost of inflationary finance

The presence of imperfect competition in goods markets also modify second best policies. Monopolistic competition implies that the shadow cost of inflation is larger than implied by competitive models. To show this point, in this subsection we reconsider the problem of the welfare cost of inflationary finance, as studied by Phelps (1973) and Romer (1986).

The problem of inflation as a revenue raising instrument is the following: assuming that government expenditure has some given shadow value, what is the shadow cost of using inflation as a tax? Phelps (1973) concluded that as long as the government is raising revenue with some distortionary tax, a positive inflation tax is socially desirable. Implicitly, Phelps assumed that the deadweight loss of the inflation tax was zero at zero inflation. But if there are other distortions in the economy, Phelps's prescription may be misleading. Romer (1986) illustrated the latter point in the context of a general equilibrium version of the Baumol-Tobin model. My model provides a second example.

From the government budget constraint in steady state, we know that τ, the revenue from inflation, is equal to $(1-\mu^{-1})m$. Define $\mu = (1+\pi)$; π is the steady state inflation rate. Thus, in the steady state:

$$(16)\quad \tau = \frac{\pi}{1+\pi}m$$

The analysis in past sections must be modified somewhat to take into account that now the revenue from inflation is not rebated to the private sector but consumed by the government. It is straightforward to derive that given the rate of inflation π the equilibrium value of real balances is given implicitly by the solution of:

$$(17)\quad v'\left(\frac{m}{1+\pi}\right)\frac{1}{1+\pi} = \frac{\theta}{\theta-1}u'(m)$$

Given π, the welfare of all agents in the steady state is given by

$$(18)\quad v(m(1+\pi)^{-1}) - u(m) \equiv W(\pi)$$

As in Romer (1986), we can define

$$(19)\quad q(\pi) = -\frac{W_\pi}{\partial\tau/\partial\pi}\frac{1}{v'(c)} = -\frac{W_\pi}{\partial\tau/\partial\pi}\frac{1}{v'(m(1+\pi)^{-1})}$$

$q(\pi)$ is a measure of the distortionary effects of inflationary finance associated with the rate of inflation π. The numerator in (19) is the decrease in private welfare, normalized by the initial marginal utility of consumption, due to a marginal increase in the inflation rate. The denominator is the increase in government revenues due to a marginal increase in the inflation tax. If the inflation tax were non-distortionary at the margin, $q(0)$ would be equal to one. In this case, if the marginal benefit of government expenditure were greater than one (in terms of v'(.)), it would be optimal to set inflation to a positive level (see Romer (1986), pages 681 – 682 for a detailed discussion).

Differentiating (16) and (18), replacing in (19) and using the equilibrium condition (17) one obtains:

$$(20)\quad q(\pi) = \frac{\dfrac{m}{(1+\pi)^2} - \dfrac{\partial m}{\partial\pi}\dfrac{1}{(1+\pi)\theta}}{\dfrac{\pi}{1+\pi}\dfrac{\partial m}{\partial\pi} + \dfrac{1}{(1+\pi)^2}m}$$

Since $\partial m/\partial\pi < 0$ (as the reader can easily verify by using (17)), $q(\pi) > 1$ for all $\pi \geq 0$. In particular, $q(0) = 1 + \eta(0)\,\theta^{-1}$, where $\eta(\pi) = -\dfrac{1+\pi}{m}\dfrac{\partial m}{\partial\pi}$ is the elasticity of the quantity of money with respect to inflation. Notice that $q(0) \to 1$ as $\theta \to \infty$.

Thus in this model the shadow cost of inflationary finance is, in general, greater than one. As in Romer (1986), the use of inflation as a revenue raising instrument is not recommendable unless the shadow *value* of government revenue exceeds a critical value q which is greater than one. In contrast to Romer (1986), the cost of inflationary finance depends, among other magnitudes, on the degree of imperfection in goods markets. On the other hand, when goods markets are close to competitive (θ is very large) Phelps's prescription is a good approximation.

The intuition for this result is simple. Monopolistic competition implies that in equilibrium the levels of output, consumption, and welfare are too low. Inflationary finance reduces the demand for money, which reduces equilibrium output in this model. Monopolistic competition implies that the economy is not at the first best when inflation is zero. More inflation brings the economy even farther from the first best. Of course, when the economy is »very competitive», that is, when θ is large, standard analyses are good approximations.

6. Final remarks

This paper has studied a simple extension of Samuelson's overlapping generation model to allow for monopolistic competition. I showed that the set of equilibria of the monopolistic competition case is very similar to that of the competitive case. A potentially useful property of the model is that the difference between the monopolistic competition case and the competitive case depends solely on θ, the elasticity of substitution between varieties of the differentiated consumption good. If θ is large, the competitive OGM becomes a good approximation to the imperfectly competitive case. The competitive OGM may be misleading, on the other hand, if the world is actually characterized by imperfect competition and θ is small.

The model developed above has two main implications for the analysis of monetary policy. First, the effectiveness of monetary policy depends on the way money enters the system. This message, familiar from competitive overlapping generations models, was shown in this paper to hold even in the presence of imperfect competition in the goods markets. Second, the existence of monopolistic competition modifies the role of monetary policy. This is because imperfect competition implies a suboptimal level of output in the absence of government intervention. This fact modifies policy prescriptions based on more standard, competitive models.

The model presented in this paper should be useful in studying other problems of monetary questions in the presence of imperfect competition in the goods market. Of course, it will be interesting and useful to see how my conclusions are robust to other assumptions about the nature of competition or the monetary sector. Given that imperfect competition seems to be the norm rather than the exception in the world we live in, this kind of research may be the way to go.

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