Robert A. Becker is a professor of economics at Indiana University. He thanks Chris Waller for an interesting conversation on the subject of rules vs. discretion in macroeconomic models and Nicolas Spulber for his usual insightful comments.

Commentary

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Discussions of *rules* vs. *discretion* have occupied a central place in the analysis of macroeconomic policies in dynamic models. Costas Azariadis and Vincenzo Galasso have presented a new model that shows how a discretionary policy regime can lead to a more volatile fiscal policy than one pursued under a constitutional rule. They set up a simple fiscal policy story and examine the potential for discretionary policy to produce cyclical or chaotic dynamics that they regard as a volatile outcome.

I discuss their results by reasoning with analogy to games of tacit cooperation and bargaining. In particular, I argue that some classical insights of Thomas Schelling can help us understand the reason discretionary policies in the Azariadis and Galasso model can generate multiple equilibria and the appearance of a random fiscal policy, whereas a regime of rules does not.

The Azariadis and Galasso model is based on the simplest overlapping generations model. The only policy variable in their framework is the choice of a social security transfer payment from the young generation to the old generation. Their model of discretionary policy is the determination of the level of the transfer by a median voter or majoritarian voting arrangement. Because the median voter can costlessly change the transfer at each time, this is a discretionary regime. This model has multiple equilibria that reflects a fundamental indeterminacy problem. Some of these equilibria can also be dynamically inefficient, although they are all individually rational and satisfy a subgame perfection constraint. Volatility takes the form of a potentially cyclic or chaotic transfer sequence. Fiscal policy can appear to be random even though it is generated by a deterministic dynamic process. In contrast, Azariadis and Galasso show that the constitutional rule produces a different result. The indeterminacy problem disappears, and the resulting equilibrium profile is dynamically efficient.

TACIT COORDINATION AND DISCRETION

The conduct of fiscal policy in the Azariadis and Galasso overlapping generations model is a tacit coordination game. The model's structure shows that players can improve their welfare if they devise an appropriate pay-as-you-go social security system. This is the only possible fiscal policy in their story. The demographic makeup of the game excludes the possibility that the generations can communicate and thereby reconcile their common interests in conducting a suitable fiscal policy. The double infinity of traders and markets implies that Julius Caesar cannot communicate with Bill Clinton, who in turn is unable to communicate with that famous 24th century resident Capt. Picard, and so on.[1] Coordination of fiscal policy requires Caesar to form expectations about Clinton and so forth into the indefinite future. The impossibility of doing this produces the multiple equilibria that drives Azariadis and Galasso's volatility result.

Schelling (1960) referred to a strategic situation where individuals have common interests but cannot communicate with each other as a tacit coordination game. Examples include the Battle of the Sexes, which is depicted in Figure 1. Two players prefer to be with each other on a date than to not be with each other. Player 1 (the row player) prefers to go to an opera, whereas player 2 (the column player) prefers to attend a ball game. The payoff cells show how coordination or matching is better than failure to coordinate or producing a mismatch.[2]

[1] Shell (1971) discusses the double infinity of traders and markets as the source of the overlapping generations model's interesting economic properties.

[2] Battle of the Sexes can also be interpreted as a game where two firms choose a product standard. They are better off (obtain higher profits) by operating on a common standard than when they adopt different standards.

Figure 1

Battle of the Sexes Payoff Matrix

1 \ 2	ball game	opera
ball game	• (2, 1)	(0, 0)
opera	(0, 0)	• (1, 2)

(payoff (1), payoff (2))

Battle of the Sexes has two pure-strategy Nash equilibria indicated by the black spot in the corresponding payoff cells. A third equilibrium strategy exists for this game. It is a mixed strategy where each player selects one of the pure strategies with a randomizing device. Player 1 chooses the ball game with probability 2/3 and goes to the opera with probability 1/3. The second player chooses the ball game with probability 1/3 and the opera with probability 2/3. This mixed-strategy equilibrium also pays each player, on average, less than either pure-strategy equilibrium would pay. This is so because the mixed-strategy equilibrium can produce a mismatch where the players fail to coordinate their strategies.

I contend that this simple, well-known coordination game produces the same qualitative features of the majoritarian voting game modeled by Azariadis and Galasso. Of course, their article offers a significant twist to tacit coordination games. The overlapping generations model creates infinitely many coordination problems.

Shell (1971) suggested the Hilbert-Gamow Hotel as a metaphorical way of understanding the paradoxes arising in an overlapping generations model.[3] This hotel has countably many rooms and always has one guest in each room. A new patron can always be accommodated by assigning her to the first room and moving everyone else one room number higher. Hence, this hotel is always full and at the same time can always show its vacancy sign.

Now suppose that we modify this hotel story and create a tacit coordination game according to the following rules. There are countably many players; each one currently resides in one of the hotel's rooms. A cash prize is offered to all guests, provided they all congregate in the same room and participate in an awards ceremony. If they do not, they receive nothing. Each guest would prefer to have the meeting take place in his room rather than bear the cost of hiking to another room. Each guest would also rather walk to another guest's room rather than miss out on the cash prize. A payoff sequence $\{\pi_1, \pi_2, \pi_3, ...\}$ gives the payoffs to each player for each particular strategy choice he can make. For example, the payoff sequence where everyone chooses to go to room 1 is {2, 1, 1, ...}. If at least one person goes to a different room, then the players get {0, 0, 0, ...}. Similarly, the payoff sequence is {1, 2, 1, 1, ...} when everybody locates in room 2, is {0, 0, 0, ...} if someone behaves differently, and so on. A player's best response depends on what he expects the other guests to choose. For instance, player 1 will choose to stay in his room if he expects everyone else to come to his room, but he will go to room 10 if he thinks everyone else will be there too. In the first case, he earns \$2 and in the second case \$1. Both outcomes are better than the zero payoff he gets if he mismatches. Hence, he will always try for a match. The same logic works for the other players. There are an infinite number of pure-strategy equilibria in this game. It always pays to be in the same room as everyone else when the ceremony starts, and it never pays to be in a different room than the other guests.

The fact that there are at least a countable number of pure-strategy equilibria in this game does not really solve the game. A guest aware that there are infinitely many equilibria still does not know what to do. There is no way to tell a guest to which room he should go. Mixed strategies only make things worse because random play will produce some mismatches. Reasoning by analogy to the two-player game, one

[3] This story originates in Gamow (1988), which was originally published in 1946. Shell (1971) adapted this story to discuss the economics of the overlapping generations model and explain the inefficiency of competitive allocations discovered by Samuelson (1958). Shell attributes the hotel story to Gamow, who in turn credits David Hilbert.

would expect mixed strategies to exist and produce payoffs on average worse than any of the pure-strategy equilibria.

The problem with this meeting room game is that each guest must form expectations about which room he or she expects the other guests to select as the common meeting room. There is no way to pin down the expectations of the guest in the first room since that expectation inevitably depends on what the asymptotic guest at infinity will do.

The coordination game played by Azariadis and Galasso's overlapping generations model players is no different. There is no way for the median voter in any generation to determine how the median voter at infinity will behave. This is driven by the critical demographic feature of the overlapping generations model that prevents agents from communicating across time. It is not surprising that many possible equilibria may exist, and among them some might involve the analog of a mixed strategy that in Azariadis and Galasso's world would amount to a volatile transfer policy sequence.

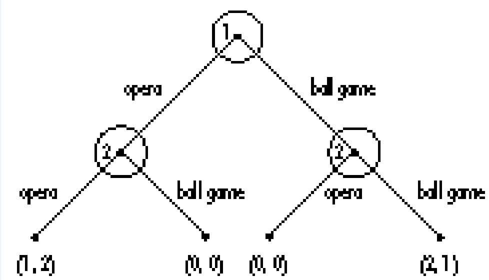
RULES AND BARGAINING

The problem with fiscal policy in the majoritarian voting game is that there is no focal point. There is no strategy or fiscal policy that agents can somehow see as the obvious way to play their coordination games. The condition of subgame perfection is a necessary but not a sufficient condition to solve the Azariadis and Galasso coordination game.

The case of a constitutional rule is different, and Schelling's work gives us a clue as to why this is so. Schelling wrote the following passage in his classic *The Strategy of Conflict* (p. 22), in the context of strategic choice in bargaining situations:

> The essence of these tactics is some voluntary but irreversible sacrifice of freedom of choice. They rest on the paradox that *the power to constrain an adversary may depend on the power to bind oneself*; that, in bargaining, weakness is often strength, freedom may be freedom to capitulate, and to burn bridges behind one may suffice to undo an opponent.

Figure 2



This strategic principle also applies to some coordination games. In those cases, it can be used to cut through the multiple equilibria and produce a single equilibrium that solves the game. For example, in Battle of the Sexes, one partner can obtain a *first mover advantage*. This is done by calling the other and declaring that she will be at the ball game and then hanging up. The caller then proceeds to cut off all communication until game time. This means he or she disconnects the fax, e-mail, phone, cellular phone, answering machine, and beeper. He or she goes to the game. What does the partner do? The first mover advantage is obtained by taking an irrevocable act.[4] This is easy to display using the extensive form game shown in Figure 2. The capacity of the first player to constrain himself or herself is modeled by giving that player the first move. This player has the right to precommit by taking the opening move. Simple backward induction shows that player 2 will show up at the ball game.

The same logic used to study Battle of the Sexes operates in the Azariadis and Galasso fiscal policy game with a constitution. The critical assumption is the irrevocability of the constitution. This means, that by assumption, all generations are committed to follow the constitutional

[4] If the act taken is revocable or costless, the resulting action is called *cheap talk* by game theorists. Cheap talk by itself does not change the set of equilibria in Battle of the Sexes. The coordination problem persists.

rule when they are born and no revolution can overturn it.

Each young person in this overlapping generations model has two direct adversaries—the current generation and the to-be-born next generation. The constitution acts as a constraint on the current generation's transfer policy proposal. The constitution gives the current generation the right to propose a change in the status quo, but gives the old generation the veto. The agenda setting of the young gives them a first mover advantage that is constrained by the constitution. The young give up the right to drive the old generation to their subsistence level by use of this rule. The current generation also does this because it wants the next generation to treat it in the same way. The golden-rule payoff emerges (as a stationary subgame perfect equilibrium) because the constitution compels golden-rule behavior. Each generation does unto its elders what it will want the next generation to do unto it during its old age. This constrains the current younger generation's behavior and supports the golden-rule outcome. The constitutional rule removes the coordination problem, and the economy achieves a dynamically efficient allocation.

QUESTIONS AND COMMENTS

The use of a constitutional rule rather than majoritarian discretion to resolve the coordination problem is an interesting approach to comparing fiscal policy institutions. However, I do feel there is a slight weakness in the constitutional argument. The players do not voluntarily sacrifice anything to precommit, since the key modeling assumption regarding the irrevocability of the constitution is already in place before the first generation must make a decision. Azariadis and Galasso seem to be making an implicit assumption that all agents agree to a constitutional arrangement behind a veil of ignorance.[5] Agents do not know which generation they will belong to before the creation of their world. Therefore, agents agree to the Azariadis and Galasso constitutional rule as a way of ensuring their equal treatment after the veil is dropped and time begins.

Azariadis and Galasso's implicit use of the veil of ignorance seems to me an artificial device that allows agents to avoid making the sacrifices called for by Schelling's commitment principle. Agents bind themselves behind the veil of ignorance but do not give up real resources or bear a real cost at that time. They cannot renege on their commitment to constitutional rule because it is assumed to be impossible, not because it might not be in their best interest. I believe young agents should have to make a costly commitment during their youthful period to constrain their elders' behaviors, as well as the behavior of next period's young people. The game model should include the device used to bind players as part of their strategic choices. Azariadis and Galasso have certainly given us some hints about how they might do this. I think solving that problem is central if they are to provide a convincing argument for the superiority of rules as a way of eliminating undesirable volatility in this type of coordination game.

The central volatility result for the discretionary policy regime and the corresponding Folk-like Theorem do not address the explicit welfare of the cyclic or chaotic equilibrium transfer schemes. There is certainly a strong presumption that they are dynamically inefficient, just as the mixed strategy equilibrium of Battle of the Sexes is inefficient. However, this needs a proof. Hence, it would be interesting to show that the equilibria in their example exhibiting complicated dynamics are in fact inefficient. Otherwise, declaring the volatility property of those equilibria a bad thing would seem to rest on grounds other than welfare considerations.

[5] The notion of the veil of ignorance appears in Rawls (1971).

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