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Cooperative economic growth ☆

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ABSTRACT

We comparatively study optimal economic growth in a simple endogenous growth model and under two different games, i.e., dynamic sequential game and cooperative stochastic differential game, between a representative household and a typical self-interested politician. Sequential equilibrium solution is derived by applying Backward Induction Principle and corresponding optimal economic growth rate is endogenously determined. Moreover, cooperative equilibrium solution is established with group rationality, individual rationality and sub-game consistency requirements fulfilled, and it is further confirmed that the representative household will save more, and the self-interested politician will tax less, thereby leading to much faster economic growth, when compared to those of the sequential equilibrium solution.

1. Introduction

It is widely argued that institutional difference is one of the major differences between the developing economies and the developed economies. Usually, different institutional arrangements will induce different economic behaviors of the individuals, different fiscal policies of the government, and hence different speeds of economic growth. On the one hand, game structure as a product is endogenously embedded into institutions (see, Amable, 2003; Hurwicz, 1996; North, 1990; Williamson, 2000). On the other hand, institutions themselves can be regarded as the equilibrium outcomes of some given games (e.g., Aoki, 2001; Greif, 2006; Schotter, 1981; Schotter and Sopher, 2003; Sugden, 1989; Young, 1993, 1998). That is, different game structures lead to different institutional arrangements, hence producing different speeds of economic growth. The major goal of the current exploration is to comparatively study optimal economic growth under different game structures, i.e., dynamic sequential game and cooperative stochastic differential game. In a simple model of endogenous economic growth (e.g., Aghion, 2004; Barro, 1990; Dai, 2012; Rebelo, 1991; Turnovsky, 2000), competitive assumption is employed for the firm, endogenous savings rate is determined by the representative household and the goal of the self-interested politician is to choose a tax policy such that the utility from tax revenue, which can be viewed as the rent, is maximized. Leong and Huang (2010) confirm that uncertainty will produce more realistic solution than that of the deterministic case (see, Kaitala and Pohjola, 1990). We also consider a stochastic environment as in Merton (1975), i.e., the source of uncertainty is the population size.

Indeed, the present study reveals that different game structures imply different investment choices of the representative household, different fiscal policies of the self-interested politician, and hence different speeds of optimal economic growth. In particular, it is demonstrated that cooperative stochastic differential game corresponds to much more savings of the representative household, much lower tax rate of the self-interested politician, and hence much faster speed of optimal economic growth, when compared to those of the dynamic sequential game. Accordingly, as a byproduct, it is reasonably argued that the widely employed sequential-equilibrium tax scheme may definitely result in dynamic inefficiency from the perspectives of both economic welfare and economic growth in some cases. Noting that, as in North (1971), the game structures or rules of the game can be interpreted as the fundamental institutional arrangements while the fiscal policies can be viewed as secondary institutional arrangements in the present case, we indeed have proved the following North's (1971) proposition,

Proposition. *The failure to devise and enforce such basic decision rules,* i.e., *fundamental institutional arrangements, is the source of the poor performance of economies in the past and in the present.*

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That is, for the present model economy, the failure to shift from the rules of the dynamic sequential game to the rules of the cooperative stochastic differential game will result in dynamic inefficiency, and hence poor performance of optimal economic growth. Moreover, noting the uniqueness of the game equilibrium of the games discussed here, i.e., there exists a one-to-one correspondence between the fundamental institutional arrangement and the secondary institutional arrangement, it is reasonably argued that the rules of cooperative stochastic differential game will produce much more efficient secondary institutional arrangements, and hence providing much more appropriate incentives for capital accumulation and economic growth than that of the rules of the dynamic sequential game. Last but not least, the present framework can be easily extended to include more than two different game structures, for example, through introducing different informational constraints on the games.

1.1. Related literatures

Here, our review and discussion will proceed around the following three key words, i.e., *game*, which determines the basic decision rules or the fundamental institutional arrangements, *secondary institutional arrangement*, which is induced by the game and can be regarded as the equilibrium outcome of the game, and *economic growth*. Noting that the basic decision rules of the game produce the secondary institutional arrangements that directly determine the optimal rate of economic growth, many existing literatures focus on the role of institutions in the performance of economies. For example, when noticing that transaction costs are a crucial determinant of economic performance (see, Coase, 1960) and also institutions are dominant factors of the cost of transacting, North (1991) argues that the central issue of economic history and of economic development is to account for the evolution of political and economic institutions that create an economic environment that induces increasing productivity, and hence sustained economic growth. North (1994) emphasizes that political and economic institutions are the underlying determinants of economic performance just because institutions form the incentive structures of a society, which, in a game theoretic context, can be summarized as follows, i.e., different game structures imply different incentive structures, thereby inducing different game equilibria with different levels of efficiency. Acemoglu et al. (2005a) empirically study the rise of Western Europe after 1500, and their empirical evidence shows that Atlantic trade contributed to the process of West European growth between 1500 and 1850, not only through direct economic effects, but also indirectly by inducing fundamental institutional change. In other words, they provide empirical evidence on the link between changes in political institutions and Atlantic trade, and it is illustrated that political institutions are essential for the incentives to undertake investments and for sustained economic growth. Acemoglu et al. (2005b) (and some references therein) develop the empirical and theoretical case that differences in economic institutions are the fundamental cause of differences in long-run economic growth. In other words, economic institutions determine the incentives of and the constraints on the economic actors, and hence shaping economic outcomes. In particular, by using a number of historical examples, Acemoglu et al. (2005b) argue that economic institutions encouraging economic growth emerge when efficient political institutions are constructed and sufficiently enforced.

Some seminal papers (see, Chamley, 1986; Judd, 1985; Phelan and Stacchetti, 2001, and among others) study dynamic optimal Ramsey taxation under the crucial assumption that taxes are set by benevolent governments. Nevertheless, in practice and in line with the public choice theory (e.g., Barro, 1973; Buchanan and Tullock, 1962; Ferejohn, 1986), the politician's preferences may diverge from those of his constituents and that he may pursue his self-interest. Indeed, some existing literatures study the dynamic taxation under the assumption that taxes are decided by a self-interested politician. For example, Acemoglu et al. (2008, 2010, 2011) consider the case where the self-interested politicians have the power to set taxes and meanwhile the citizens can discipline politicians using elections or other means. Moreover, Acemoglu et al. (2008, 2010, 2011) analyze the political economy distortions by supplying that the politician has the power to allocate some of the tax revenue to himself as rents or government consumption, and also a formal politician utility, which is usually different from that of the individual or citizen, is supplied. Yared (2010) characterizes optimal tax policies in the presence of rent-seeking politicians whose utilities increase in rents, which are defined as excessive public spending with no social value, and also highlights how the incentives of rent-seeking politicians affect optimal policy prescriptions.

Starting with time inconsistency being introduced by the seminal paper of Kydland and Prescott (1977), latter papers, such as Chari and Kehoe (1990, 1993), argue that fiscal-policy problems should be better studied as a dynamic game between the government and the households. For instance, in a repeated-game framework, Chari and Kehoe (1990) focus on sustainable plans characterized by symmetric perfect Bayesian equilibria. Similar to the sustainable equilibrium defined and analyzed by Chari and Kehoe (1990), Phelan and Stacchetti (2001) provide a formal definition of a sequential equilibrium for the dynamic policy game between the government and the households, and also develop a strategic dynamic programming method. Acemoglu et al. (2008, 2010, 2011) study dynamic taxation policy in the context of a dynamic game between a self-interested government and citizens, and characterize the best sub-game perfect equilibrium of this game from the viewpoint of the citizens. Yared (2010) considers an infinitely repeated game between citizens and rent-seeking politicians with double-sided lack of commitment in which reputation mechanism sustains efficient equilibrium policies. Also, Farhi and Werning (2008) study efficient nonlinear taxation in a dynamic game with political economy constraints and without commitment, it is revealed that reputational mechanism induces a trigger-strategy equilibrium, where a deviation would be followed by the worst possible continuation equilibrium. In our study, it is however illustrated that the unique sub-game perfect equilibrium may result in *dynamic inefficiency* when compared to the cooperative equilibrium, and also sub-game consistency, which is much stronger than time consistency in some sense, has been demonstrated to be met for the current model. Accordingly, these new results would be a new insight relative to existing literatures.

1.2. Outlines

The rest of the paper is organized as follows. Section 2 presents the basic environment, where the technology, preferences and economic growth rate are introduced. Section 3 derives the sequential-equilibrium growth rate in a dynamic game between the self-interested politician and the representative household. Section 4 studies economic growth by employing a framework of cooperative stochastic differential game and compares the results to those in Section 3. Section 5 closes the paper with some concluding remarks.

2. The environment

Here, and throughout the current paper. We, specifically, adopt the following aggregate production function,

$$Y(t) = AK(t). \tag{1}$$

with $A > 0$, as an exogenously given constant. Dividing both sides of Eq. (1) by $L(t)$ and putting $k(t) \triangleq K(t)/L(t)$ as the capital–labor ratio, we thus obtain per capita output as follows,

$$y(t) = f(k(t)) = Ak(t). \tag{2}$$