Effect of Progressive Taxation on Wealth Inequality and the Economy in an Agent-based Artificial Economic System

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Abstract

The effect of progressive taxation on Gross Domestic Product (GDP) as well as well as Gini coefficient was analyzed using agent-based model, the system structure of which has been confirmed to reproduce the effect of tax reduction on GDP. The calculated results showed the followings. The effect of progressive taxation on GDP depends on how much the wealthy spend to purchase consumption and capital goods in their daily lives and for investment. Under the condition where marginal propensity to consume of the rich including the use for investment is smaller than that of the poor, progressive taxation is preferable not only for decreasing wealth inequality but also promoting the economy. The reason is that the excess money of the rich to be saved in the bank is forcibly transferred to the poor by taxation, thereby increasing the funds circulating in the market.

1. Introduction

The increase in wealth inequality worldwide in recent decades is a major policy issue for nations to address. Because wealth inequality is inevitable in a capitalistic economy, an income-redistribution system operated by the government is indispensable from the viewpoint of social welfare. Progressive taxation is an example of such income redistribution. However, progressivity in the income tax structure drastically decreased in the period from 1970 to 2010 in many Organisation for Economic Co-operation and Development (OECD) countries through the reduction of both the number of statutory tax brackets and the top statutory rate [1]. This reduction in progressivity has made the financial merit of tax reduction more remarkable for the rich than for the poor, thus increasing wealth inequality [1]. This policy of reducing progressivity seems to have been supported by the idea that progressive taxation reduces the incentive to build human capital, invest, take risks and conduct entrepreneurial activity because a large share of these activities is conducted by high-income earners. Evidence for this idea was obtained in an empirical study conducted by the OECD, which analyzed a database for 21 OECD countries over the period 1971–2004 and concluded that the progressivity of personal income taxes negatively affects economic growth [2]. However, it is thought to be difficult to exclusively extract the effect of the tax rate structure on gross domestic product (GDP) from historical data for the real world, because historical values of GDP include various scatter factors other than tax-related factors. Moreover, according to a series of studies on macroeconomic phenomena using agent-based modeling [3,4], historical arguments in the literature on the effect of progressive taxation on the economy seem to have neglected the possibility that if much of the earnings of the rich would be saved in a bank without being consumed for investment, such saving activity might negatively affect the economy.

The present study analyzes the effect of the progressive rate structure of income tax on the Gini coefficient and GDP. The study uses an agent-based model, the system structure of which has been confirmed to reproduce the effect of tax reduction on GDP.

2. Agent-based model and calculation conditions

The agent-based model of the present study comprises consumers, producers, a bank and a government; all are autonomous decision-making agents. The model assumes that consumers and producers are each divided into three types of agent: workers, executives and public workers for the former and retailers, raw material makers and an equipment maker for the latter. Each agent is heterogeneous regarding both its state variables and other parameters included in its behavioral rules. The system structure of the model used in the present study is the same as the structure that was confirmed to reproduce the positive effects of income and corporate tax reductions. With this base model, the rate structure of income tax, the dependency of the overall marginal propensity to consume and the inefficiency in public expenditure were changed as experimental levels, and the effects of these factors on the wealth inequality, GDP, asset distribution and income distribution were analyzed.

The details for each of the experimental levels are as follows.

1) The taxation system has a constant rate (20%) or a progressive rate structure where the tax rate is dependent on income levels as expressed in Equation (1), where Ts and D are set to be 0.1 and 0.5, respectively.

2) The withdrawal ratio corresponds to the overall marginal propensity to consume in the consumer's purchasing of both consumption goods and capital goods. The ratio is either constant or decreases according to the income level as shown in Fig. 1.

3) Inefficiency in government expenditure is defined as the ratio of subsidies for firms to the government's total spending which changes from 0 to 1.0 in increments of 0.1.

Each agent's set of actions comprises period-based units, where one period is assumed to correspond to 1 month in the real system. In each period, each agent behaves and interacts with other agents and records transaction data according to the double-entry bookkeeping method. At the end of each period, each agent settles its account, and a GDP value is calculated according to an input–output table obtained by summing the accounting data of each agent. The wealth inequality is evaluated using the Gini coefficient based on the asset distribution.

The wealth inequality and GDP thus calculated are averaged for 360 periods to analyze how they are affected by various factors.

3. Results

Progressive taxation reduces the Gini coefficient for all the experimental levels as shown in Fig. 2. The reason for this is that progressive taxation decreases the funds of the wealthy to be deposited in the bank, thereby increasing the funds circulating in the market and increasing the income level of the poor.

Meanwhile, the effect of progressive taxation on GDP depends on how much the wealthy spend to purchase consumption or capital goods in their daily lives and for investment. In the case that the withdrawal ratio depends on the income level (i.e., the marginal propensity to consume of the rich is less than that of the poor), progressive taxation increases GDP as shown in Fig. 3 (left). This increase in GDP is due to progressive taxation decreasing the funds of the rich to be

deposited in the bank, thereby increasing the funds circulating in the market and increasing the income level of the poor, and thus increasing the demand. In the case that the withdrawal ratio is constant regardless of the income level, the difference in GDP between progressive taxation and the constant tax rate is negligibly small as shown in Fig. 3 (right). The reason for this is that, when the marginal propensity to consume of the rich is high, the rich voluntarily spend much of the surplus money obtained owing to the low tax rate when the tax rate is constant. On the other hand, such excess money of the rich is forcibly deducted from the income of the rich by taxation in the case of the progressive tax rate system. Note that even in this case the progressive tax system does not reduce the GDP.

In the real world, the overall marginal propensity to consume of the rich in purchasing both consumption and capital goods is thought to be small compared with that of the poor. Therefore, progressive taxation is considered to be preferable not only from the viewpoint of wealth inequality but also from the viewpoint of economic growth, because it would enhance the flow of money deposited in the bank accounts of the rich to the market, which will provide someone's income and increase demand.

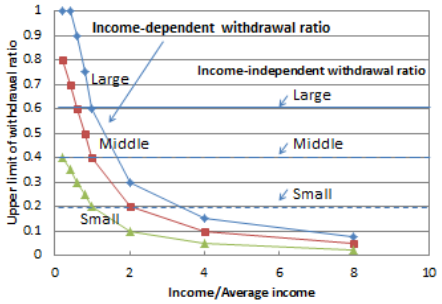

Fig. 1 Withdrawal ratio used for experiment

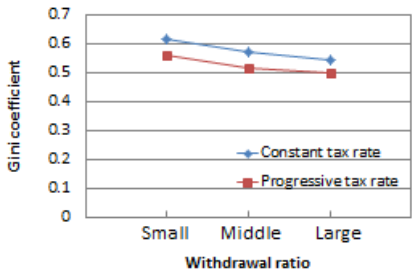

Fig. 2 Gini coefficient in the case of income-dependent withdrawal ratio

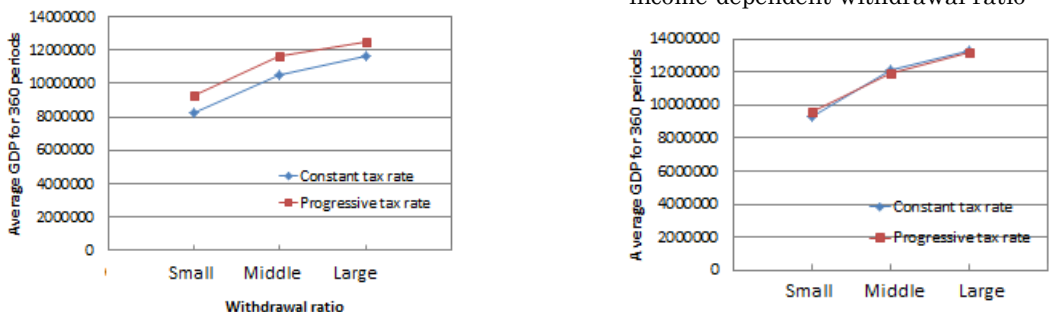

Fig. 3 Influence of progressive taxation on GDP in the case of the withdrawal ratio being income-dependent(on the left) or income-independent(on the right).

References

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