Original Articles

Income distribution inequality, globalization, and innovation: A general equilibrium simulation

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Abstract

Utilizing simulation approach, this paper examines if the income distribution inequality of a country expands through *globalization and/or innovation*, somewhat modifying the traditional Heckscher–Ohlin model. First, independently of *innovation*, the *globalization* is examined for a country A with two industries (commodities) and four consumers: the (aggregate) worker, the (aggregate) capitalist, and two entrepreneurs. It is shown that there is a clear tendency for the inequality to expand by *globalization*. Furthermore, when country A is small, the inequality-promoting tendency is stronger. Second, the *innovation* is examined independently of *globalization*, by the procedure in which the *new*-third industry (commodity) and the *new*-third entrepreneur are introduced, so that there are five consumers. When *innovation* emerges in country A in autarky, it is shown that the *innovation* has tendency to cause inequality expansion. Finally, the *innovation* and *globalization* are examined in an integrated manner. We start with the country in the second case. It is shown that when the *new*-third commodity is produced only in country A and is a *non-traded* commodity, inequality tends to expand through the *globalization*. It is shown, furthermore, that when the third commodity is produced in both countries and is a *traded* commodity, we have stronger tendency. Thus, there is a clear tendency for the inequality to expand through the *globalization and/or innovation*.

1. Introduction

As developing countries, such as China and India, attained the economic development, the inequality of income distribution has been discussed. This theme was also discussed in the United States from the socio-economic viewpoint by prominent economists such as Krugman [13], Stiglitz [20] and Summers [21]. The key concept used in their arguments on the causes of the expanded income distribution inequality is *the globalization and innovation*. They did not conduct the theoretical examination of the cause itself. While accepting it, they provide *political* argument on how to solve the problem. Meanwhile, pure-research papers on this topic have been dominated by empirical ones, such as Pikketty and Saez [17]. Theoretical contributions have been provided by Mitra and Trindade [16] on the *globalization*, by Aghion and Howitt [1], Aghion [2], Baumol [3], Dasgupta and Stiglitz [4] on the *innovation*, and by Krugman [12], Leamer [15] on the *globalization and innovation*. Their common interest, however, is in how wages

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vary when they investigate the income distribution changes. Furthermore, the main interest for Aghion and Howitt [1], Baumol [3], and Dasgupta and Stiglitz [4] is whether the investment for *innovation* is excessive or not compared with the optimum level. Recently, Fukiharu [10] provided a theoretical examination on the *globalization and innovation*, with income distribution inequality measured by Gini coefficient. While it is similar to Krugman [12], in the sense that they both utilize general equilibrium trade model and the *innovation*, transferred from the developed country to the developing one, implies the creation of new commodity, there is an essential difference between the two. The motivation in Krugman [12] is to show that the higher wage rate in the developed country stems from the creation of new commodities in the developed country, while the one in Fukiharu [10] is to examine whether the *innovation* in the developed country worsens the income distribution inequality *within that country*. As is expected, the conclusion depends on the parameters of the model. The distinctive feature in [10] is to compute the *probability* of the worsened cases utilizing the simulations with random selection of those parameters. This approach was established in Fukiharu [5], whose motivation is to overcome the problem inherent in the calibration method of Applying General Equilibrium [19]. While Fukiharu [10] conducted a theoretical examination, the treatment on *innovation* is not satisfactory. The aim of the present paper is to conduct the integrated examination of *the globalization and innovation*'s effects on income distribution inequality, extending [10].

We start with the independent examinations of the *globalization* and the *innovation*, proceeding to the integrated one. The independent examination of *globalization* is conducted by utilizing traditional Heckscher–Ohlin (H–O) model, which is an application of general equilibrium theory for the two-commodity-two-factor-of-production economy with trading two countries, A and B [5]. In the present paper, in order to focus on the income distribution, a modification is made somewhat into the traditional model, in such a way that the two production functions are under decreasing returns to scale, so that positive profit accrues to the entrepreneurs. Thus, there are four consumers of goods: the (aggregate) worker, the (aggregate) capitalist, and two entrepreneurs. In this modified model, first, Gini coefficient is computed for the income distribution with four economic agents when country A is in autarkic general equilibrium. Next, supposing that the country A opens its economy to country B, Gini coefficient is computed for the income distribution with four economic agents in a country A, in the general equilibrium with trade. If the former is smaller than the latter, it is defined that the income inequality expands through the *globalization*. In this paper, a simulation approach is adopted to compute the Gini coefficients: i.e. specifying parameters in Cobb–Douglas type production and utility functions for two countries and initial endowments of working hours and capital goods, selected for country A and for country B, we compute country A's general equilibrium incomes for the four economic agents and compare Gini coefficients.

The independent examination of *innovation* is conducted on the five-economic-agent model, by introducing the *newly produced*-third commodity and the *new*-third entrepreneur into the four-economic-agent model. It is examined if the *innovation* causes the expansion of income distribution inequality when country A is in autarky. The integrated examination the *globalization* and the *innovation* starts from the situation, in which country A is in autarky and the *innovation* has emerged: i.e. it has five economic agents. Supposing that country A begins trade with country B, we examine if the income inequality in country A expands by this globalization, when the new commodity is a *non-traded* commodity produced and consumed only in country A. Finally, further modifying the assumption in such a way that the *innovation* is transferred to country B and new commodity is a *traded* commodity produced and consumed in both countries, we examine if the income inequality in country A expands compared with the *non-traded* commodity case.

2. The four-economic-agent model: globalization

We start with the independent examination of the *globalization* by somewhat modifying the traditional two-commodity-two-factor-of-production Heckscher–Ohlin (H–O) model, in which only the (aggregate) worker and (aggregate) capitalists are active economic agents. The property of two economic agents within each country stems from the assumption of constant returns to scale of the production functions. With the addition of profit maximization assumption, the maximum profit for each sector is zero at the general equilibrium, so that entrepreneurs for the two sectors cannot act as utility-maximizing households. As is well known, the constant-returns assumption gives rise to the well-known factor price equalization between the trading two countries [14]. It is also well-known that this equalization is not observed in the actual world. Taking account of this fact, the constant-returns assumption of production functions in the traditional H–O model is replaced by the decreasing returns assumption, so that each entrepreneur for two industries becomes an active economic agent as utility-maximizing household with positive profit in this section.