Effect of Trade Liberalization on Regional Income Inequality in an Endogenous Growth Model

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Abstract

This paper constructs a footloose capital and endogenous growth model with agriculture, manufacturing, and service goods. We show that globalization increases, decreases, or does not change inequality in the regional income. This is because regional real income is defined as expenditure divided by price index of manufacturing and price of service good. Globalization leads to decreases inequalities in expenditure and price index of service while increases inequality in price of manufacturing goods. Thus, interregional minus intraregional knowledge spillovers in the service goods from manufacturing sector determines the sign of globalization on inequality in regional income.

Key words: globalization, regional income inequality, service goods, foot loose capital, endogenous growth

1. Introduction

Many theoretical and empirical papers in the economic geography have been examining the effect of globalization on inequality in regional income. In terms of empirical work, Jian, Sachs, and Warner (1996) shows that convergence occurs from 1978 to 1990 and divergence occurs after then. Moreover, Bouvet (2010) shows that globalization does not change regional income inequality. Ezcurra and Rodríguez-Pose (2013) and Lessmann and Seidel (2017) show that globalization leads to divergence.

In terms of theoretical work, Dupont (2007) examines this topic using a variety expansion endogenous growth and the footloose capital model with agriculture and manufacturing goods. He shows that regional income inequality unambiguously shrinks because real income depends on expenditure relative to price index, and inequality in expenditure decreases and inequality in price index increases. Moreover, Minniti and Parello (2011) extends Dupont (2007) into a semi endogenous growth model. They show that globalization does not change regional income inequality at all because inequalities in expenditure and price index do not change at all. Cerina and Mureddu (2014) examines effects of agglomeration on inequality in regional income by introducing service sector which is the main industry in advanced countries, but they did not examine effects of globalization on inequality in regional income. Fukuda (2018) shows that globalization increases or does not change inequality in regional income in a semi endogenous growth model with service sector because interregional spillover minus intraregional spillover in the service sector affect inequality in service price index.

These theoretical results seem not to be consistent with empirical evidence above explained. Motivated by this, we reexamine the effect of globalization on inequality in regional income in an endogenous growth model with agriculture, manufacturing, and service goods. We show that globalization increases, decreases, or does not change inequality in regional

income. This is because inequalities in expenditure and service price decrease, but inequality in manufacturing price index increases. Moreover, inequality in service price index depends on the size of intraregional knowledge spillover minus interregional knowledge spillover from manufacturing sector. Effects on inequality in regional income depends on this effect. This result seems to be consistent with empirical evidence explained above because this model shows all of empirical results.

The rest of the paper is organized as follows. In section 2, we describe and explain the model. In section 3, we examine the effects of globalization on regional income inequality. Finally, we provide our concluding remarks.

2. The Model

2.1 Basic model structure

We examine two countries footloose capital model. North has a larger amount of capital than South. Each consumer supplies one unit of labor inelastically in each period. Labor is the only production factor and serves as the numeraire. There are tradable manufacturing goods in the monopolistically competitive sector, tradable and numeraire agriculture goods in the perfectly competitive sector, and non-tradable service goods in the perfectly competitive sector. Each manufacturing firm chooses the location of production comparing profit levels. In the service sector, there are knowledge spillover from manufacturing goods sector. In the R&D sector, each firm chooses the location of R&D activity comparing the R&D costs. Due to intertemporal knowledge spillover, the number of varieties keep increasing. Consumer can invest in R&D activities in North or South.

2.2. Consumer

The utility function is given by

$$u(D_t) = \int_0^{\infty} e^{-\rho t} log\ C_Y^{\alpha} C_S^{\gamma} C_M^{\beta} dt,\ \alpha + \beta + \gamma = 1, \tag{1}$$

where ρ is the individual's subjective discount rate, C_Y is consumption of agricultural goods, C_S is consumption of non-traded service goods, and C_M is consumption of manufactured goods which depends on the consumption of a continuum of varieties given by

$$C_M = \left(\int_0^{n} c_i(t)^{\frac{\sigma-1}{\sigma}} di + \int_0^{n^*} c_j(t)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}, \sigma > 1, \tag{2}$$

where n is the Northern varieties, n^* is the Southern varieties, $c_i(t)$ is the demand of domestically-produced i-th variety, $c_j(t)$ is the demand of imported j-th variety and $\sigma > 1$ is the elasticity of substitution between varieties. Instantaneous budget constraint is

$$C_Y + P_M C_M + P_S C_S = E \tag{3}$$

where P_M is price index of C_M, P_s is the price of service goods, and E is aggregate expenditure. Following Dupont (2007), Minniti and Parello (2011), and Fukuda (2018), price of agricultural goods is unity. Consumer's maximization problem is consisting of the third stage. The first stage derives the demands for domestically produced and exported manufacturing goods, and it is

$$c_i(t) = \frac{p_i^{-\sigma} E_M(t)}{P_M^{1-\sigma}} \text{ and } c_j(t) = \frac{(\tau p_j)^{-\sigma} E_M(t)}{P_M^{1-\sigma}}, \tag{4}$$

where $P_M = (\int_0^n p_i^{1-\sigma} di + \int_0^{n^*} \tau^{1-\sigma} p_j^{1-\sigma} dj)^{\frac{1}{1-\sigma}}$ is the price index of manufacturing good in the North and $E_M(t)$ is the northern expenditure for manufacturing goods.

The second stage yields expenditure share for each good, and it is given by

$$Y = \alpha E, E_M(t) \equiv P_M C_M = \beta E, \text{and } P_S C_S = \gamma E. \tag{5}$$

Third stage is the dynamic utility maximization problem. The flow budget constraint is

$$\dot{A}(t) = r(t)A(t) + L(t) - E(t), \tag{6}$$

where $r(t)$ is the rate of return on riskless bond and $A(t)$ is stock of financial asset. The Euler equation is given by

$$\frac{\dot{E}(t)}{E(t)} = r(t) - \rho. \tag{7}$$

2.3 Production

The agriculture good is produced in the perfectly competitive sector, and the production factor is the labor. One unit of labor produces one unit of agriculture goods. We assume that both countries produce this good, and wage in both countries are unity due to numeraire. Following Cerina and Mureddu (2014), the service good is non-traded goods, produced in the perfectly competitive sector, and the production factor is the labor. The production function is

$$C_s = \frac{L_s}{a_s};\ C_s^* = \frac{L_s^*}{a_s^*}, \tag{8}$$

where a_s is unit labor requirement for service goods in the North and a_s^* is unit labor requirement for service goods in the South. Profit maximization yields

$$P_s = a_s(n, n^*) \text{ and } P_s^* = a_s^*(n, n^*), \tag{9}$$

where n is the number of northern manufacturing firms and n^* is the number of southern manufacturing firms.
Following Cerina and Mureddu (2014), unit labor requirement for service good depends negatively on agglomeration of manufacturing firms in the North and South as follows:

$$\frac{\partial a_s(n, n^*)}{\partial n}, \frac{\partial a_s(n, n^*)}{\partial n^*},\ \frac{\partial a_s^*(n, n^*)}{\partial n}, \text{and } \frac{\partial a_s^*(n, n^*)}{\partial n^*} < 0. \tag{10}$$

Moreover, we assume local knowledge spillover is equal to or strictly greater than international spillover, and it is

$$|\theta_n(n, n^*)| \geq |\theta_n^*(n, n^*)|, \forall (n, n^*); |\theta_{n^*}^*(n, n^*)| \geq |\theta_n^*(n, n^*)|, \forall (n, n^*), \tag{11}$$

where

$$\begin{bmatrix} \frac{\partial a_s(n, n^*)}{\partial n}\frac{n}{a_s(n, n^*)} & \frac{\partial a_s(n, n^*)}{\partial n^*}\frac{n^*}{a_s(n, n^*)} \\ \frac{\partial a_s^*(n, n^*)}{\partial n}\frac{n}{a_s^*(n, n^*)} & \frac{\partial a_s^*(n, n^*)}{\partial n^*}\frac{n^*}{a_s^*(n, n^*)} \end{bmatrix} \equiv \begin{bmatrix} \theta_n(n, n^*) & \theta_{n^*}(n, n^*) \\ \theta_n^*(n, n^*) & \theta_{n^*}^*(n, n^*) \end{bmatrix}, \tag{12}$$

is the knowledge spillover matrix. Finally, they assume a symmetric spillover matrix as follows:

$$\theta_n(n, n^*) = \theta_{n^*}^*(n, n^*) < 0 \text{ and } \theta_{n^*}(n, n^*) = \theta_n^*(n, n^*) < 0. \tag{13}$$

2.4 Manufacturing firms

Manufacturing goods are produced in the monopolistically competitive sector. Each firm need produce one unit of capital in the R&D sector and the number of world-wide manufacturing firms is the same with the amount of world-wide capital stock (see, i.e. Dupont 2007; Minniti, and Parello 2011; Ottaviano and Martin 1999). β units of labor can produce one unit of differentiate goods. Each firm chooses the location of the manufacturing comparing the profits in both countries. Moreover, serving the foreign market needs iceberg costs measured by τ. The amount of world-wide capital is the same with the number of world-wide manufacturing firms.

$$K^w(t) = K(t) + K^*(t) = n(t) + n^*(t) = N(t). \tag{14}$$

Using demand function (4), profit maximizing derives the profit maximizing prices are given by

$$p = p^* = \frac{\sigma\beta}{\sigma - 1}. \tag{15}$$

Using (4) and (15), we derive profit functions in each country as follows:

$$\pi = \frac{\sigma\beta}{\sigma - 1}x \text{ and } \pi^* = \frac{\sigma\beta}{\sigma - 1}x^*, \tag{16}$$

where

$$x = \frac{\alpha(\sigma - 1)}{\beta\sigma}\left[\frac{E}{n + \delta n^*} + \frac{\delta E^*}{\delta n + n^*}\right] \text{ and } x^* = \frac{\alpha(\sigma - 1)}{\beta\sigma}\left[\frac{\delta E}{n + \delta n^*} + \frac{E^*}{\delta n + n^*}\right], \tag{17}$$

are sizes of firms in the North and South. In the equilibrium where manufacturing firms locate in both countries, Northern and Southern profits are equalized. Thus, the fraction of northern manufacturing firms is

$$s_n \equiv \frac{n}{N} = \frac{1}{2} + \left(\frac{1 + \delta}{1 - \delta}\right)\left(s_E - \frac{1}{2}\right), \tag{18}$$

where $s_E \equiv \frac{E}{E^w}$ is the fraction of northern expenditure share. Substituting this back into the size of manufacturing firms yields

$$x = x^* = \frac{\alpha(\sigma - 1)E^w}{\beta\sigma N}. \tag{19}$$

2.5 R&D

The production function for varieties (capital) is given by

$$\dot{N}(t) = \frac{L_I(t)}{b_I(t)}, \tag{20}$$

where

$$b_I(t) = \frac{1}{N(t)[s_n + \lambda(1 - s_n)]}, \tag{21}$$

is the intertemporal knowledge spillover, $L_I(t)$ is the R&D labor, and $1 > \lambda > 0$ is international spillover.

The R&D sector is the perfectly competitive. In the equilibrium with R&D activity, the value of capital denoted by $V(t)$ must be equalized with the R&D cost. Thus, following condition holds.

$$V(t) = \frac{1}{N(t)[s_n + \lambda(1 - s_n)]}. \tag{22}$$

Consumer saves in two ways. The first way is riskless bond. The second is firms' share whose rate of return is given by capital gain and dividend. So, the no-arbitrage condition is given by

$$\frac{\dot{V}(t)}{V(t)} + \frac{\pi(t)}{V(t)} = r(t). \tag{23}$$

The world-wide labor demand is composed of service goods, agriculture goods, manufacturing goods, and R&D. The world-wide labor supply is given by $2L$. The world-wide labor constraint is given by

$$2L = L_M + L_s + L_Y + L_I = \frac{\alpha(\sigma - 1)E^w}{\sigma} + (1 - \alpha)E^w + \frac{g}{s_n + \lambda(1 - s_n)}. \tag{24}$$

From now, we pay attention to the steady state equilibrium. Rewritten the no-arbitrage condition yields following relationship between growth rate, the world-wide expenditure, and the fraction of northern firms as follows:

$$-g + \alpha E^w[s_n + \lambda(1 - s_n)] = \rho. \tag{25}$$

We finally derive the northern and southern expenditures using budget constraint. Rewritten budget constraints lead to

$$E = \frac{s_K\rho}{s_n + \lambda(1 - s_n)} + L \text{ and } E^* = \frac{(1 - s_k)\rho}{s_n + \lambda(1 - s_n)} + L. \tag{26}$$

The world-wide expenditure and the northern expenditure share are given by

$$E^w = \frac{\rho}{s_n+\lambda(1-s_n)} + 2L \text{ and } s_E = \frac{\frac{\rho s_k}{s_n+\lambda(1-s_n)}+L}{\frac{\rho}{s_n+\lambda(1-s_n)}+2L} = \frac{1}{2} + \frac{\frac{\rho}{s_n+\lambda(1-s_n)}(s_k-\frac{1}{2})}{\frac{\rho}{s_n+\lambda(1-s_n)}+2L(t)}, \tag{27}$$

where $s_k \equiv \frac{K}{K+K^*}$ is the northern share of physical capital.

Combining (18) and (27), we derive the northern share of manufacturing firms, and it is given by

$$s_n = \frac{1}{2} + \left(\frac{1+\delta}{1-\delta}\right)\frac{\rho(s_k-\frac{1}{2})}{\rho + 2L(t)[s_n+\lambda(1-s_n)]}. \tag{28}$$

The left-hand side of (28) is 45-degree line through the origin while the right-hand side of (28) is decreasing function of the northern share of manufacturing firms and lower limit of the right-hand side of (28) is 1/2, as shown in figure 1. Large population size ensures unique and existence of the northern share of manufacturing firms from (28). Moreover, (26) and (27) determine the northern expenditure, the northern expenditure share, and the world-wide expenditure. The no-arbitrage condition determines the growth rate in (25).

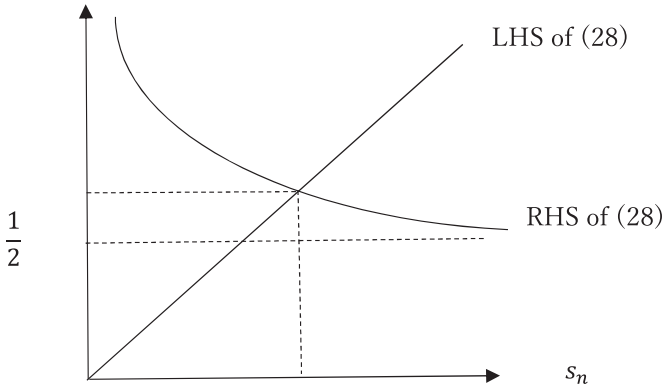

Figure 1. Determination of the northern share of manufacturing firms

3. Effects of globalization on regional income inequality

We examine effects of globalization on regional real income inequality in the steady state. The real income is defined as nominal expenditure divided by price index of manufacturing and price of service goods. We derive the effect of globalization on expenditure as follows:

$$\frac{\partial E}{\partial \delta}\frac{1}{E} - \frac{\partial E^*}{\partial \delta}\frac{1}{E^*} = \frac{1}{s_E(1-s_E)}\frac{\partial s_E}{\partial \delta} = \frac{\rho L(1-\lambda)(1-2s_k)\frac{\partial s_n}{\partial \delta}}{s_E(1-s_E)\{\rho+2L[s_n+\lambda(1-s_n)]\}^2} < 0. \tag{29}$$

As Dupont (2007) derived, the effect of globalization on the nominal expenditure inequality is negative because the north has a larger capital, and value of capital decreases due to globalization and knowledge spillover in the R&D sector. Northern expenditure decreases more, and the nominal expenditure inequality decreases as in Dupont (2007).

We turn to derive the effect of globalization on inequality in manufacturing price index as follows:

$$\frac{\partial P}{\partial \delta}\frac{1}{P} - \frac{\partial P^*}{\partial \delta}\frac{1}{P^*} = \frac{-[\delta(1+\delta)\frac{\partial s_n}{\partial \delta} + 1 - 2s_n]}{(\sigma-1)[s_n+\delta(1-s_n)][1-(1-\delta)s_n]} \tag{30}$$

$$= \frac{-(1+\delta)^2\frac{\partial s_E}{\partial \delta}}{(\sigma-1)[s_n+\delta(1-s_n)][1-(1-\delta)s_n]} > 0.$$

As Dupont (2007) pointed out, the effect of globalization on inequality in the manufacturing price index is composed of a direct openness effect, an indirect static effect, and an indirect dynamic effect. An indirect dynamic effect is common and does not affect inequality as in Dupont (2007). A direct openness effect is positive for both countries, but its effect is stronger for the South because $\frac{2s_n-1}{(\sigma-1)[s_n+\delta(1-s_n)][1-(1-\delta)s_n]} > 0$ measures differences between direct openness effect in the North and South. An indirect static effect is positive for the north but negative for the south, and $\frac{-\delta(1+\delta)\frac{\partial s_n}{\partial \delta}}{(\sigma-1)[s_n+\delta(1-s_n)][1-(1-\delta)s_n]} < 0$ measures differences between indirect static openness effect in the North and South. A direct openness effect dominates an indirect static effect. So, the southern manufacturing price index decreases more, and inequality in manufacturing price index increases as in Dupont (2007).

We turn to effect of globalization on inequality in the service price index, and it is derived as follows:

$$\frac{\partial P_s}{\partial \delta}\frac{1}{P_s} - \frac{\partial P_s^*}{\partial \delta}\frac{1}{P_s^*} = \frac{\partial s_n}{\partial \delta}\left[\frac{\theta_n - \theta_n^*}{s_n(1-s_n)}\right] \lessgtr 0. \tag{31}$$

As in Fukuda (2018), intraregional knowledge spillover is stronger or equal to interregional knowledge spillover in the service sector. Thus, the price of northern service price index may decrease relative to southern service price index, and the inequality in the service price index decreases or remain constant as in Fukuda (2018).

From (29)−(31), globalization leads to increases in inequality in the regional real income if the intraregional knowledge spillover in the service goods sector is larger than the interregional knowledge spillover, and its size is large. Moreover, globalization leads to decrease in inequality in the regional real income if the intraregional knowledge spillover in the service goods sector is equal to the interregional knowledge. This result does not hold without footloose capital in this paper because southern manufacturing price index decreases relative to northern price index while the northern service price index does not change relative to southern price index due to globalization.

This result is different from existing theoretical results of footloose capital model because Dupont (2007) shows that inequality in the regional income decreases in an endogenous growth model with manufacturing and agriculture goods, Minniti and Parello (2011) shows that inequality in the regional income does not change in a semi endogenous growth model with manufacturing and agriculture goods, and Fukuda (2018) shows that the inequality in regional income increases or does not change in a semi endogenous growth model with manufacturing, agriculture, and service goods.[1]

Because empirical paper shows that globalization may not affect or affect positively or negatively, the theoretical result seems to be consistent with empirical evidence.

4. Conclusion

This paper examines effects of globalization on inequality in regional income in an endogenous growth model with the agriculture, manufacturing, and service goods. We show that effects of globalization may positive, negative, or zero because the service price index and expenditure converge while the manufacturing price index diverges. Differences between interregional knowledge spillover minus intraregional knowledge spillover in the service sector determines the sign of the inequality in regional income.

Endnote

[1] As Martin and Ottaviano (1999) shows, growth rate measured by growth rate of number of varieties is common in both countries in steady state, and there is positive effects of globalization on growth rate through northern manufacturing agglomeration.

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