

早稲田大学現代政治経済研究所

The transfer paradox in a pay-as-you-go pension system

Kojun Hamada

Akihiko Kaneko

Mitsuyoshi Yanagihara

No. E1405

Working Paper Series

Institute for Research in
Contemporary Political and Economic Affairs

Waseda University

169-8050 Tokyo, Japan

The transfer paradox in a pay-as-you-go pension system*

Kojun Hamada[†]
*Faculty of Economics,
Niigata University*

Akihiko Kaneko[‡]
*Faculty of Political Science and Economics,
Waseda University*

Mitsuyoshi Yanagihara[§]
*Graduate School of Economics,
Nagoya University*

July 10, 2014

Abstract

We examine how international transfer affects welfare levels of a donor with a higher marginal propensity to save and a recipient with a lower marginal propensity to save, when both countries adopt a pay-as-you-go (PAYG) pension system using a one-sector overlapping generations model. A PAYG pension scheme is found to lead to impairment of the donor and of the recipient as a result of the transfer under the dynamic efficiency condition. This is because the transfer increases the divergence in the rate of return between PAYG and private savings.

JEL Classifications: D91; E21; F35; F43; H55

Keywords: Pay-as-you-go pension; Transfer paradox; Overlapping generations model

* We acknowledge financial support from MEXT/JSPS Grant-in-Aid for Scientific Research (C) No. 25380286 (Kojun Hamada), and No. 26380360 (Mitsuyoshi Yanagihara) and Waseda University Tokutei Kadai (Kiso Grant) No. 2014K-6007 (Akihiko Kaneko). The usual disclaimer applies.

[†] Address: Faculty of Economics, Niigata University, 8050 Ikarashi 2-no-cho, Nishi-ku, Niigata City 950-2181, Japan
Tel. and Fax: +81-25-262-6538, Email: khamada@econ.niigata-u.ac.jp

[‡] Corresponding author.
Address: Faculty of Political Science and Economics, Waseda University, 1-6-1 Nishi-Waseda, Shinjuku-ku, Tokyo 169-8050, Japan
Tel. and Fax: +81-3-3208-1197, Email: akaneko@waseda.jp

[§] Address: Graduate School of Economics, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Aichi 464-8601, Japan
Tel.: +81-52-789-5952, Email: yanagi@soec.nagoya-u.ac.jp

1 Introduction

This paper examines how international transfer affects welfare levels of both a donor with a higher marginal propensity to save and a recipient with a lower marginal propensity to save, each of which adopts a pay-as-you-go (henceforth PAYG) pension system in a one-sector overlapping generations (henceforth OLG) model.

The PAYG pension system is common in developed countries, such as Japan, England, Germany and Canada, and even in developing countries such as China.¹ In Japan, the total extent of social security benefit is about 1.1 trillion U.S. dollars, which is equivalent to more than one-fifth of GDP (2013). Even looking at pension benefits alone, the figure is about 0.5 trillion U.S. dollars and exceeds 10% of GDP. The influence of the pension system, and in particular the PAYG, cannot be ignored. There has been a lively discussion about an ideal pension system (see World Bank (1994) and Orszag and Stiglitz (2001)). This discussion made clear the various factors, including influence on economic growth, administrative cost of pension system management and political risk of pension systems, that must be considered when comparing PAYG and fully-funded pension systems. The present paper exposes a further demerit of the PAYG pension system.

The means by which international transfer has an effect on the welfare of the donor and recipient countries have been argued for decades. Beginning with the discussion between Keynes (1929a, 1929b) and Ohlin (1929), the argument involves a possible occurrence of the transfer paradox: The donor becomes better off and/or the recipient becomes worse off. Following intensive investigation in the static framework by many researchers, Galor and Polemarchakis (1987) show that the transfer paradox can arise in a dynamic framework, and specifically in an OLG model.²

There are two reasons why the transfer paradox can occur in an OLG model. First, the market equilibrium may be dynamically efficient or inefficient, depending on the (time) preference of individuals. When the economy is dynamically inefficient, paradoxical effects can occur because the less capital that accumulates, the better the welfare becomes. Second, there is an indirect effect of transfer in the OLG model, as a result of the change in the interest rate. The indirect effect itself comprises two parts: The golden rule effect, and the international capital movement effect. In the golden rule effect, if the world capital level (per capita) approaches the golden rule level at which the amount of consumption is maximized in the steady state, then the welfare levels of both countries rise. The international capital movement effect is such that if the interest rate rises (or the capital level decreases), then the higher-

¹In China, there are two types of pension system. The PAYG pension system is adopted in cities, and a fully-funded scheme in rural areas.

²Following Galor and Polemarchakis (1987), Haaparanta (1989) demonstrates the occurrence of a transfer paradox even if the transfer is of one-shot form, when the governments issue their bonds. Yanagihara (1998) incorporates public goods affecting productivity in the private production sector and considers transfer in the form of a lump sum, debt relief, and public goods. Yanagihara (2006) provides a graphical picture of the transfer paradox set out in Galor and Polemarchakis (1987). Cremers and Sen (2005) investigates the possibility of transfer paradoxes in the transitional path to the steady state, as well as in the steady state.

saving country, the creditor, becomes better-off as the return from lending capital to the lower savings country, the debtor, increases. The lower savings country then becomes worse off. As a result the indirect effect can increase the welfare of the donor and reduce that of the recipient, if the donor is the creditor and the recipient is the debtor, even in a dynamically efficient region.

A PAYG pension system is indispensable and fundamental for intergenerational income redistribution in modern capitalist economies, because it complements self-help private savings.³ PAYG pensions have been treated in many papers using an OLG model. For example, Fanti and Gori (2012) and Cipriani (2014) analyze the relationship between birth rate and pension benefit. Roberts (2003), Kaganovich and Zilcha (2012) and Bruce and Turnovsky (2013) investigate the effect of a PAYG pension on capital accumulation. However, there is few articles that examine the international transfer between countries with a PAYG pension system in a dynamic setting.

We investigate how PAYG social security alters the effect of international transfer on welfare levels in a one-sector OLG model. Upon taking a classical approach in which physical capital is accumulated only, we investigate whether social security fosters or impairs improvement of welfare of the donor and/or deterioration of the welfare of the recipient. We show that, when the higher saving donor and the lower saving recipient both adopt a PAYG pension system, the transfer inhibits capital accumulation and increases the interest rate; this is referred to as the negative golden rule effect of the transfer. The negative effect leads to widen the gap between the rate of return from PAYG pension, that is the population growth rate, and that from private saving, the interest rate. Consequently, a weak transfer paradox, in which both donor and recipient countries become worse off due to the transfer, is more likely to occur.⁴

The reminder of the paper is as follows: Section 2 sets out our one-sector, two-country OLG model. Section 3 indicates the conditions for static and dynamic stability. Section 4 presents our main results and considers their implications. Concluding remarks are stated in Section 5.

2 The model

We consider a one-sector OLG model. In this world economy there exist two countries, a donor country and a recipient country in an international income transfer; these are denoted by country indexes $i = D$ and R respectively. These two countries are identical except for the time preferences of individuals. We introduce a pay-as-you-go pension system in both countries. Capital is fully mobile between the two countries, but goods and labor are immobile. The populations of both countries grow equally, with a gross population growth rate of $(1 + n) \geq 1$.

³The introduction of a fully-funded pension system into an OLG model does not alter any outcome, because a fully-funded pension works exactly as private savings do.

⁴A weak paradox was named for the first time by Yano (1983).

2.1 Individuals

In each period both countries are populated by two generations, the young who supply one unit of labor inelastically and earn wages, and the old who retire and consume savings accumulated in their youth. All individuals live for two periods. Individuals born in period t , which is denoted as generation t , and living in country $i = D, R$, choose consumption in their youth t and in their old age $t + 1$, (c_t^i, d_{t+1}^i) , so as to maximize their utility, subject to the budget constraints in their respective young and old periods.

The intertemporal utility of generation t in country i is given by

$$u^i(c_t^i, d_{t+1}^i). \quad (1)$$

Here it is assumed that u^i is twice differentiable, and $u_c^i, u_d^i > 0$, u_{cc}^i , and $u_{dd}^i < 0$.

The budget constraints on the respective young and old periods for generation t in country i are as follows:

$$c_t^i + s_t^i = w_t^i + T^i - P^i \quad \text{and} \quad d_{t+1}^i = (1 + r_{t+1}^i)s_t^i + (1 + n)P^i, \quad (2)$$

where r^i , w^i , and s^i respectively denote the net interest rate, wage rates, and savings in country i . Here, T^i and P^i denote a permanent transfer and the pension contribution in country i . The intertemporal budget constraint can be rewritten as

$$c_t^i + \frac{1}{1 + r_{t+1}^i} d_{t+1}^i = I_t^i \quad (3)$$

where $I_t^i \equiv w_t^i + T^i - \frac{(r_{t+1}^i - n)P^i}{1 + r_{t+1}^i}$, which denotes the lifetime income of generation t in country i evaluated at period t . This expression has the properties that $\frac{dI_t^i}{dw^i} = 1$ and $\frac{dI_t^i}{dr^i} = -\frac{1+n}{(1+r^i)^2}P^i < 0$.⁵ Throughout the paper, we only consider the case in which the economy is dynamically efficient, so that $r_t^i \geq n$ for all t . Then, as is well known, intergenerational transfer by a PAYG pension system reduces the lifetime income. As we consider a permanent transfer from country D to country R , in what follows T denotes the amount of the permanent transfer from country D to country R , i.e., $T \equiv T^R = -T^D > 0$.

Utility maximization yields the savings function, $s^i(I_t^i, r_{t+1}^i)$ and an indirect utility function. It is assumed that savings increase as lifetime income increases, $0 < s_I^i < 1$, and as the interest rate increases, $0 < s_r^i$, (where the subscript I and r represent the partial derivative of s^i with respect to each variable.)

2.2 Firms

Firms in both countries produce their output using the inputs of labor and capital under perfect competition. The production function is constant returns to scale, independent of time, and is identical in both countries. From the properties of the production function given above, the per capita production function can be written as $f(k_t^i)$, where k_t^i represents the per capita capital in country i in period t . We

⁵It is assumed that $w^i + T^i - P^i > 0$ for all periods.

assume that the per capita production function satisfies the following conditions: (i) $f(k_t^i)$ is continuously differentiable; (ii) $f(k_t^i) > 0$, $f'(k_t^i) > 0$, and $f''(k_t^i) < 0$ for all $k_t^i > 0$; and (iii) $f(0) = 0$, $\lim_{k_t \rightarrow 0} f'(k_t) = \infty$, and $\lim_{k_t \rightarrow \infty} f'(k_t) = 0$ (the Inada conditions).

Firms maximize their profit in per capita terms, denoted by $\pi(k_t^i) \equiv f(k_t^i) - r_t k_t^i - w_t^i$. Profit maximization requires the equivalence of the marginal productivity and the price of each input as:

$$f'(k_t^i) = r_t^i \quad \text{and} \quad f(k_t^i) - f'(k_t^i)k_t^i = w_t^i. \quad (4)$$

From (4), the level of capital stock as well as the wage rate can be represented as a function of r_t^i . As capital is perfectly mobile, the factor prices and the level of capital stock become the same in each country due to factor price equalization, so that $r_t^D = r_t^R \equiv r_t$, $w_t^D = w_t^R \equiv w_t$, and $k_t^D = k_t^R \equiv k_t$. In sum, we obtain $k_t = k(r_t)$ and $w_t = w(r_t)$ and the following relationships:

$$k_r \equiv \frac{dk_t}{dr_t} = \frac{1}{f''(k_t)}, \quad w_r \equiv \frac{dw_t}{dr_t} = -k_t. \quad (5)$$

2.3 Capital market equilibrium

The world capital market equilibrium condition in per capita terms in period t can be expressed as

$$(1+n)k^D(r_{t+1}) + (1+n)k^R(r_{t+1}) = s^D(I_t^D, r_{t+1}) + s^R(I_t^R, r_{t+1}). \quad (6)$$

The right-hand side of (6) represents the supply of capital from individuals in both countries in the present period, t . The left-hand side shows the demand for capital by firms in both countries; this is utilized in the next period, period $t+1$. As the lifetime income I_t^i depends not only on the interest rate in period $t+1$ but also on the wage rates in period t , this world capital market equilibrium condition involves the dynamics of the interest rates of r_t and r_{t+1} . Full international capital mobility then causes the level of per capita capital in each country to be the same: $k^D(r) = k^R(r) \equiv k(r)$. By rewriting (6) we therefore obtain the result that

$$2(1+n)k(r_{t+1}) = s^D(I_t^D, r_{t+1}) + s^R(I_t^R, r_{t+1}). \quad (7)$$

3 Stability analysis

In this section we check the static and dynamic stability conditions for this economy. To consider first the static stability, so-called Walrasian stability, we define the excess demand in the world capital market as $D(w(k_t), r(k_{t+1}); T, P^i) \equiv 2(1+n)k_{t+1} - s^D(I_{t+1}^D, r_{t+1}) - s^R(I_{t+1}^R, r_{t+1})$. Walrasian stability requires that excess demand for capital should decrease in r_{t+1} . As the lifetime income I_t^i depends on r_{t+1} for a given level of transfer T and pension contribution P^i , total differentiation of (7) gives:

$$2(1+n)k_r dr_{t+1} = s_I^D \left[-\frac{(1+n)P^D}{(1+r_{t+1})^2} \right] dr_{t+1} + s_I^R \left[-\frac{(1+n)P^R}{(1+r_{t+1})^2} \right] dr_{t+1} + s_r^D dr_{t+1} + s_r^R dr_{t+1}. \quad (8)$$

The condition for Walrasian stability is then satisfied when

$$\Omega_t < 0, \quad (9)$$

where $\Omega_t \equiv 2(1+n)k_r - s_I^D \left[-\frac{(1+n)P^D}{(1+r_{t+1})^2} \right] - s_I^R \left[-\frac{(1+n)P^R}{(1+r_{t+1})^2} \right] - s_r^D - s_r^R$. To satisfy (9), the negative effect on the lifetime income represented by $-\frac{(1+n)P^i}{(1+r_{t+1})^2}$ must not be so large. Throughout this paper we assume that condition (9) holds in order to satisfy the Walrasian stability condition.

We next consider dynamic stability of this economy. For the equilibrium to be stable, then $0 < dr_{t+1}/dr_t < 1$.⁶ Upon differentiating (6) with respect to r_t and r_{t+1} , we obtain

$$\begin{aligned} 2(1+n)k_r dr_{t+1} = & s_I^D \left[\frac{(1+n)P^D}{(1+r_{t+1})^2} \right] dr_{t+1} + s_I^R \left[-\frac{(1+n)P^R}{(1+r_{t+1})^2} \right] dr_{t+1} \\ & + s_r^D dr_{t+1} + s_r^R dr_{t+1} + s_I^D w_r dr_t + s_I^R w_r dr_t. \end{aligned} \quad (10)$$

Rearrangement of this yields

$$\frac{dr_{t+1}}{dr_t} = \frac{s_I^D w_r + s_I^R w_r}{2(1+n)k_r} - s_I^D \left[-\frac{(1+n)P^D}{(1+r_{t+1})^2} \right] - s_I^R \left[-\frac{(1+n)P^R}{(1+r_{t+1})^2} \right] - s_r^D - s_r^R. \quad (11)$$

From (5) and (9), $\frac{dr_{t+1}}{dr_t} > 0$ always holds. We also derive the condition $\frac{dr_{t+1}}{dr_t} < 1$, as follows:

$$\begin{aligned} \frac{dr_{t+1}}{dr_t} = \frac{s_I^D w_r + s_I^R w_r}{\Omega_t} & < 1 \\ \Leftrightarrow \Gamma_t \equiv \Omega_t - s_I^D w_r - s_I^R w_r & < 0, \quad \forall t. \end{aligned} \quad (12)$$

Consequently, (12) is obtained as the sufficient condition for dynamic stability.

4 Main results

After deriving the optimal conditions and stability conditions, we discuss the effect of the transfer on social welfare in an economy in which a PAYG pension system is introduced in each country. The arguments are limited below to the effect of steady state utility in the donor and recipient countries.

4.1 Effect on the world interest rate

As in the literature on the transfer paradox problem in an OLG framework, the effect of the transfer on welfare can be broadly decomposed into two components. The first is the direct effect, which corresponds to changes in the levels of income induced directly by the transfer. This direct income effect is positive in the recipient country and negative in the donor country. The second effect is the indirect effect, due to changes in the interest rate induced by the transfer. The occurrence of transfer paradoxes depends on

⁶Strictly, "stability" here refers to the situation in which the interest rate (or equivalently, capital level) converges monotonically to the steady-state value.

whether the indirect effect dominates the direct effect. It is therefore important to derive the effect of the transfer on the world interest rate before investigating the effect on welfare. The following lemma clarifies what marginal propensities to save of the donor and the recipient countries would raise the world interest rate.

Lemma. *Consider the transfer from a donor with a higher marginal propensity to save to a recipient with a lower one. The transfer raises the world interest rate.*

Proof. In the steady state, $r_{t+1} = r_t \equiv r$. Then, $\partial I^D / \partial T = -1$, and $\partial I^R / \partial T = 1$. By differentiating (7) with respect to r and T , we have

$$2(1+n)k_r dr = s_I^D \left[-\frac{(1+n)P^D}{(1+r)^2} \right] dr + s_I^R \left[-\frac{(1+n)P^R}{(1+r)^2} \right] dr \\ + s_r^D dr + s_r^R dr + s_I^D w_r dr + s_I^R w_r dr - s_I^D dT + s_I^R dT.$$

The donor country is assumed to have a higher saving propensity, so that $s_I^D > s_I^R$. From this assumption, and (5) and (9), we can conclude that

$$\frac{dr}{dT} > 0.$$

□

This result is intuitive: By transferring resources from a country with a higher saving propensity to a country with a lower one, the level of capital in the world decreases, so that the rental rate on capital, r , increases. This has been already mentioned in previous studies such as Galor and Polemarchakis (1987). In the present paper, therefore, it remains to investigate how the indirect effect, the effect on the interest rate, is magnified or contracted in an economy in which a PAYG pension system exists in both countries.

4.2 Effect on the donor's welfare

We now investigate the effect of the transfer on welfare of the donor in a steady state situation. Denote the indirect utility function of each member of generation t in country i by $V_t^i \equiv V^i(I_t, r_{t+1})$ for $i = D, R$. Then the effect of a permanent transfer on welfare of the donor at the steady state is

$$dV^D = V_I^D [dw - dT] + V_r^D \left[1 - \frac{(1+n)P^D}{(1+r)^2} \right] dr. \quad (13)$$

In (13), the direct effect, or the income effect, on welfare can be seen in the first term. The indirect effect, or the interest rate effect, can be seen in the second term. As in previous paper on the transfer problem in an OLG model, this indirect effect corresponds to $V_r^D dr$ in the second term. Novel here is a further element in the indirect effect. This additional indirect effect is brought about by the change in the profitability of a PAYG pension compared to the return from savings, which corresponds to $V_r^D \frac{(1+n)P^D}{(1+r)^2} dr$ in the second term. That is, since $I_r < 0$, when the interest rate – or equivalently the return from savings – rises, the return from a PAYG pension, n , comparatively falls, so that the level of welfare is reduced.

We set the marginal utility of income, V_I , to unity for analytical convenience. In addition, Roy's Identity implies that $V_r^D = s^D(I_t, r_{t+1})/(1+r_{t+1})$, so that (13) can be rewritten as:

$$\begin{aligned} \frac{dV^D}{dT} &= -1 + \left[-k - \frac{(1+n)P^D}{(1+r)^2} + \frac{s^D}{(1+r)} \right] \frac{dr}{dT} \\ &= -1 + \frac{1}{1+r} [(n-r)k] \frac{dr}{dT} + [s^D - (1+n)k] \frac{dr}{dT} - \frac{(1+n)P^D}{(1+r)^2} \frac{dr}{dT}. \end{aligned} \quad (14)$$

The first term on the right hand side of (14) is of course the direct income effect, which is negative, as in previous literature. The other terms represent the indirect effect, which correspond to the effect of the transfer on the level of welfare due to a change in the return from savings through a change in the interest rate. In (14) this indirect effect is decomposed into three components. The first component, shown in the second term, is called the golden rule effect: As the capital level approaches the golden rule level, welfare increases. In our setting, from the lemma above, the transfer increases the world interest rate. In the case that the economy is dynamically efficient, the increase in the interest rate widens the gap between capital levels of the golden rule level and the current level. This causes the welfare level of the country to decrease. The second component, shown in the third term, represents the international capital movement effect: The capital lending (borrowing) country gains (loses) from the increase in the interest rate. In a closed economy, the capital market equilibrium condition is $s/(1+n) = k$, so that per capita domestic saving is equal to per capita capital in the next period. The assumption that the donor is a country with a higher marginal propensity to save implies that $s^D > (1+n)k$, or that the donor is the creditor. Consequently, the sign of the sum of these two indirect effects is ambiguous. The last term represents the third component of the indirect effect, implying the profitability of a PAYG pension as just explained. Because this is negative, it worsens the donor country's welfare. The level of contribution, P^D , determines the magnitude of this effect.

Summing up, even under the circumstance that the direct effect is negative, if the indirect effect is positive and large enough to dominate the direct effect, then welfare improvement in the donor country occurs. Further, because a PAYG pension adds a negative effect on welfare, it can be concluded that a PAYG pension suppresses the possibility for the occurrence of the paradoxical effect on the donor's welfare.

Proposition 1. *Suppose that the economy is dynamically efficient and the donor is a higher saving country. Then a PAYG pension system with more contributions lowers the possibility of improvement of the donor's welfare.*

4.3 Effect on the recipient's welfare

By following a similar procedure for the donor, we can derive the effect of the transfer on the recipient country, as follows:

$$\begin{aligned}\frac{dV^R}{dT} &= 1 + \left[-k - \frac{(1+n)P^R}{(1+r)^2} + \frac{s^R}{(1+r)} \right] \frac{dr}{dT} \\ &= 1 + \frac{1}{1+r} [(n-r)k] \frac{dr}{dT} + [s^R - (1+n)k] \frac{dr}{dT} - \frac{(1+n)P^D}{(1+r)^2} \frac{dr}{dT}.\end{aligned}\quad (15)$$

As with the donor, the direct effect can be seen in the first term and the indirect effect in the other three terms. The first term represents the direct effect of the transfer of income and is necessarily positive. Of the indirect effects, the second term, the golden rule effect, is negative, as with the donor. The third term, the capital movement effect, is also negative.⁷ The other indirect effect, relating to the profitability of a PAYG pension and seen in the fourth term, is necessarily negative, as with the effect on the donor. Consequently, a PAYG pension weakens the positive effect of the transfer on the recipient. In sum, the indirect effect is always negative for the recipient.

In conclusion, we can state the following proposition:

Proposition 2. *Suppose that the economy is dynamically efficient and the donor is a higher saving country. Then a PAYG pension system with more contributions strengthens the negative indirect effect of the transfer on the recipient.*

Intuitively, in the case that the economy is dynamically efficient, a PAYG pension acts to reduce the welfare levels of both countries when transfer takes place.

4.4 The transfer paradox and PAYG pensions

Based on the results above, we finally summarize the occurrence of the transfer paradox in the following proposition:

Proposition 3. *Suppose that the economy is dynamically efficient and the donor is a higher saving country. Then a PAYG pension system with more contributions raises the possibility of occurrence of the weak transfer paradox in which both countries deteriorate.*

This proposition implies that, when a PAYG pension system is adopted in both countries, a further negative indirect effect, which represents the profitability of a PAYG pension, is superimposed on the effects of the transfer on welfare. When the marginal propensity to save in the donor is larger than that in the recipient, as above, the transfer reduces the world capital level, leading to an increase in the interest rate. This increase widens the gap between the returns from savings and from a PAYG pension. Consequently, as long as both countries adopt a PAYG pension system, PAYG becomes less beneficial,

⁷Because the recipient is a capital borrower, $s^R < (1+n)k$ holds.

so that the weak transfer paradox applies and both countries become worse off. The transfer may bring about a Pareto inferior result in the case in which a PAYG pension is adopted.

In the above discussion we have supposed that the marginal propensity to save in the donor is larger, so as to reflect real economic circumstances. It is also interesting to see the effect of the transfer on welfare when the marginal propensity to save in the recipient is larger. From (14) and (15), the following corollary is easily verified:

Corollary. *Suppose that the economy is dynamically efficient and the donor is a lower saving country. Then an increase in a PAYG pension increases the possibility of a weak transfer paradox in which both countries improve.*

5 Conclusion

In this paper we introduced a PAYG pension system in a two-country OLG model in order to investigate how PAYG influences the effect of the transfer on welfare. It was shown that a PAYG pension system makes a weak transfer paradox more likely to arise. When the marginal propensity to save in the donor country is higher than that in the recipient country, then as the interest rate rises the return from a PAYG pension becomes less beneficial for both countries. This situation corresponds to a weak transfer paradox in which both countries become worse off.

It is well known that a PAYG pension crowds out savings and capital accumulation. This implies that a PAYG pension degrades the effect of the transfer. The present paper has clarified how such an effect arises in an OLG economy.

Our model can be extended in several directions. The first extension is to endogenize fertility. Above, we have assumed a constant population growth, but if the fertility rate is endogenized then transfer will affect the determination of the fertility of each family, which obviously influences the population growth rate. Since the return on a PAYG pension system appears as the population growth rate itself, the effect of transfer on welfare will be changed via the change in the population growth rate. The second extension is to consider human capital accumulation. It might be also worthwhile to introduce the human capital of children into the utility for their parents. Then, when human capital accumulation, which is the source of economic growth, is considered, the transfer will change the growth rate of two countries. In considering the transfer there will then be an effect of growth as well as an effect due to the interest rate. Low levels of human capital in developing countries is a major concerns in economic development.

References

- [1] Bruce, N., and Turnovsky, S.J. 2013. Social security, growth, and welfare in overlapping generations economies with or without annuities. *Journal of Public Economics* 101, May: 12–24.

- [2] Cipriani, G. 2014. Population aging and PAYG pensions in the OLG model. *Journal of Population Economics* 27, no. 1: 251–256.
- [3] Cremers, E.T., and Sen, P. 2005. The transfer paradox in a one-sector overlapping generations model. *Journal of Economic Dynamics and Control* 32, no. 6: 1995–2012.
- [4] Fanti, L., and Gori, L. 2012. Fertility and PAYG pensions in the overlapping generations model. *Journal of Population Economics* 25, no. 3: 955–961.
- [5] Galor, O., and Polemarchakis, H. 1987. International equilibrium and the transfer paradox. *Review of Economic Studies* 54, no. 1: 147–56.
- [6] Haaparanta, P. 1989. The intertemporal effects of international transfers. *Journal of International Economics* 26, no. 3–4: 371–82.
- [7] Kaganovich, M., and Zilcha, I. 2012. Pay-as-you-go or funded social security? A general equilibrium comparison. *Journal of Economic Dynamics and Control* 36, no. 4: 455–467.
- [8] Keynes, J.M. 1929a. The German transfer problem. *Economic Journal* 39, no. 153: 1–7.
- [9] Keynes, J.M. 1929b. The reparation problem: A discussion II. A rejoinder. *Economic Journal* 39, no. 154: 179–82.
- [10] Ohlin, B. 1929. The reparation problem: A discussion I. Transfer difficulties, real and imagined. *Economic Journal* 39, no. 154: 172–78.
- [11] Orszag, P.R., and Stiglitz, J.E. 2001. Rethinking pension reform: Ten Myths about Social Security Systems. In *New Ideas About Old Age Security: Toward sustainable pension systems in the 21st century* ed. Robert Holzmann and Joseph E. Stiglitz : The World Bank.
- [12] Roberts, M.A. 2003. Can Pay-as-You-Go pensions raise the capital stock? *The Manchester School* 71, no. s1: 1–20.
- [13] The World Bank. 1994. *Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth*, Oxford: Oxford University Press.
- [14] Yanagihara, M. 1998. Public goods and the transfer paradox in an overlapping generations model. *Journal of International Trade and Economic Development* 7, no 2: 175–206.
- [15] Yanagihara, M. 2006. The strong transfer paradox in an overlapping generations framework. *Economics Bulletin* 6, no 3: 1–8.
- [16] Yano, M. 1983. Welfare aspects of the transfer problem. *Journal of International Economics* 15, no 3-4: 277–289.