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Intergenerational altruism and the transfer paradox in an overlapping generations model

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Abstract

This paper investigates how intergenerational altruism affects the possibility of the transfer paradox occurring in a one-sector overlapping generations model. The paper deals with the situation in which each generation in a country has intergenerational altruism for the next generation in the country. We demonstrate that the condition under which the transfer paradox occurs in the steady state is not affected at all by whether the individuals in both countries have intergenerational altruism. This result is in sharp contrast to the results of previous research, which found that when both a donor and a recipient country have altruism towards each other, the condition under which the paradox occurs changes.

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1 Introduction

In this paper, we investigate how intergenerational altruism contributes to the occurrence of the transfer paradox in a two-country, one-sector overlapping generations model. The paper deals with intergenerational altruism, under which each generation in a country cares about the utility of the next generation in the country.

Many economists, particularly macroeconomists, have been interested in intergenerational altruism in itself and the issues that arise within a framework of intergenerational altruism.\(^1\) In their seminal papers, Bernheim and Ray (1987) considered the properties of equilibrium behavior in an aggregative growth model with intergenerational altruism and analyzed the normative properties of the steady-state equilibrium. Ray (1987) and Hori and Kanaya (1989) specified the characteristics of the steady-state equilibrium and investigated the conditions for its existence and uniqueness in a model of nonpaternalistic intergenerational altruism. Regarding welfare analysis, Bernheim (1989) characterized the welfare properties in the dynastic equilibrium within a framework of intergenerational altruism. Hori (1997) considered dynamic allocation in an altruistic overlapping generations economy and pointed out the possibility that an equilibrium path is generally Pareto suboptimal. Following these papers, a considerable number of papers has dealt with various issues related to intergenerational altruism. For example, environmental issues such as pollution externalities are a significant concern within a framework of intergenerational altruism because future generations suffer from negative pollution externalities. In a typical paper, Jouvet et al. (2000) dealt with pollution externalities when individuals have intergenerational altruism.

This paper focuses on another issue related to intergenerational altruism, analysis of the transfer problem, which holds a central place in the literature of the theory of international trade in both static and dynamic frameworks. The transfer problem has long attracted the attention of economists, since Keynes (1929) pointed out that, in contrast to the general perception, a transfer is likely to reduce the transferer’s welfare. The possibility of such a paradoxical result, namely the transfer paradox, occurring has attracted major attention in the theory of the international trade. In the static framework in which the transfer problem is dealt with, it is widely established that some distortions or hindrances to free trade are required for the transfer paradox to occur in a two-country model, such as exogenous distortions of trade barriers (tariffs or subsidies) or endogenous distortions (rent-seeking or administrative cost of transfer).\(^2\) In contrast, in a dynamic framework, the existing literature has clarified that, because of capital

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\(^1\) Michel et al. (2006) have comprehensively surveyed intergenerational altruism in neoclassical growth models.

\(^2\) For a seminal paper, see Bhagwati et al. (1985). Brakman and Marrewijk (1998) presented a concise survey of the transfer problem in a static model.
accumulation and international capital movements, the transfer paradox can occur under free trade and
dynamic efficiency, even when there is no distortion. Using an overlapping generations (henceforth OLG)
model, Galor and Polemarchakis (1987) argued that a permanent lump-sum transfer can bring about the
transfer paradox in the steady-state equilibrium. Haaparanta (1989) proved that a transfer paradox can
occur when the temporary transfer is financed by public debt in the donor country and/or is used for
debt relief in the recipient country. This is because a temporary transfer involving debt-financed debt
relief is equivalent to a permanent lump-sum transfer. Cremers and Sen (2008) extended the analysis to
the transition to the steady state and proved that the results obtained in Galor and Polemarchakis (1987)
could also be applied to the transition. Overall, in a dynamic framework, it is not unusual for the transfer
paradox to occur in the dynamically efficient region.

Thus, we have a question: if individuals are intergenerationally altruistic within a country, is the
transfer paradox likely to occur in the steady state? Generally, when individuals are altruistic, they
take the utility of other individuals into account as a component of their own utility, which implies that
altruism could be regarded as a type of externality and, as a result, it could cause a distortion. Thus,
the introduction of altruism in the dynamic model might change the condition under which the transfer
paradox occurs. Although very few papers have examined the transfer paradox with altruism in an OLG
model, Hamada and Yanagihara (2013) clarified how the introduction of altruism towards individuals
of the other country in the model affects the likelihood of the transfer paradox in the steady state under
dynamic efficiency. They demonstrated that no transfer can enrich a donor as long as the donor is
highly altruistic, whereas a transfer may immiserize a recipient if the recipient is highly altruistic. Stated
differently, in contrast to the conventional wisdom, as individuals become highly altruistic, the transfer
is likely to cause a Pareto-inferior outcome for both countries. However, Hamada and Yanagihara’s
paper dealt only with altruism that exists between a donor country and a recipient country, not with
intergenerational altruism within a country. Hitherto, few studies have tried to examine the transfer
paradox with intergenerational altruism in a dynamic framework.

This paper attempts to examine whether and how the condition under which the transfer paradox
occurs in the steady state is affected by the introduction of intergenerational altruism into a one-sector
OLG model. This paper demonstrates that although intergenerational altruism amplifies the effect of the
transfer on welfare, it never affects whether the transfer paradox occurs. This result is in sharp contrast
to the established result in existing studies such as Hamada and Yanagihara (2013), in which it was
found that, when both a donor and a recipient country have altruism towards each other, the condition
under which the paradox occurs changes. Both of these results indicate that, depending on what kind of
altruism one considers, the effect of the altruism on the likelihood of the transfer paradox differs.

The remainder of this paper is organized as follows. Section 2 describes the one-sector OLG model
wherein each generation in a country has intergenerational altruism for the next generation in the country. Section 3 presents the condition under which the transfer paradox occurs when the intergenerational altruism exists. Section 4 provides concluding remarks.

2 The model

We consider a one-sector OLG model with two countries. A donor and a recipient of an international income transfer, indexed by \( i = D \) and \( R \), respectively, are identical except for the time preferences of individuals. Between the two countries, capital is fully mobile, but goods and labor are immobile. Time is discrete and the economy lasts forever. The populations of both countries grow equally and exogenously with the population growth rate of \( (1 + n) \geq 0 \), which is constant over time.

2.1 Individuals

In each period, both countries are populated by two generations, the young, who supply one unit of their labor inelastically and earn wages either to consume or to save, and the old, who retire and consume savings accumulated in the young period. All individuals live for both periods. Individuals who are young in period \( t \) in country \( i = D, R \) choose levels of consumption in their young period \( t \) and in their old period \( t + 1 \), \( (c_i^t, d_{i+1}^t) \), to maximize their utility, subject to the budget constraints in their respective young and old periods. Henceforth, we call the individuals who are young in period \( t \) generation \( t \).

We formalize the intergenerational altruism, defined as the situation in which generation \( t \) in a country cares about the next generation \( t + 1 \) in the country, as follows. The utility of generation \( t \) in country \( i \) consists of two subutilities. The first is the subutility obtained from consuming goods by themselves, which is often acknowledged in the usual OLG model. We call this a self-subutility. We define this subutility of generation \( t \) in country \( i \) as \( u_i^t(c_i^t, d_{i+1}^t) \), which is referred to as the self-subutility of generation \( t \) in country \( i \). It is assumed that the self-subutility function is twice differentiable, increasing, and quasi-concave in \( (c_i^t, d_{i+1}^t) \). The second subutility is that of the next generation, which represents the intergenerational altruism of generation \( t \). We call this an altruistic subutility. As the altruistic subutility of generation \( t \) in country \( i \) is denoted as \( u_i^{t+1}(c_{i+1}^t, d_{i+2}^t) \), we can define the utility of generation \( t \) in country \( i \) with intergenerational altruism as follows:

\[
U_i^t \equiv U_i^t(u_i^t, u_i^{t+1}) = U_i^t(u_i^t(c_i^t, d_{i+1}^t), u_i^{t+1}(c_{i+1}^t, d_{i+2}^t)).
\]
We call $U^{i,t}$ the total utility of generation $t$ in country $i$. It is also assumed that the total utility function is twice differentiable, increasing in $(u^{i,t},u^{i,t+1})$: $U^{i,t}_c \equiv \frac{\partial U^{i,t}}{\partial c^i_t} > 0$ and $U^{i,t}_{r+1} \equiv \frac{\partial U^{i,t}}{\partial r_{i+1}} \geq 0$. Moreover, we assume that $U^{i,t}_c \geq U^{i,t}_{r+1}$, which implies that the effect of the generation’s own self-subutility on total utility is larger than the effect of the altruistic subutility.

The budget constraints of generation $t$ in their respective young and old periods are as follows:

$$c^i_t + s^i_t = w_t + T^i$$
$$d^i_{r+1} = r_{i+1}s^i_t,$$ (2)

where $r$, $w$, and $s$ denote the gross interest rate, wages, and savings, respectively. $T^i$ denotes a permanent international transfer and satisfies $T^D < 0$, $T^R > 0$, and $T^D + T^R = 0$. By arranging (2), the intertemporal budget constraint of generation $t$ is obtained as follows:

$$c^i_t + \frac{1}{r_{i+1}}d^i_{r+1} = w_t + T^i.$$

(3)

When generation $t$ in country $i$ decides on consumption levels so as to maximize the total utility (2), they simply maximize their own self-subutility $u^{i,t}$ given the altruistic subutility $u^{i,t+1}$, because they cannot choose the consumption levels of the next generation. In short, the total utility maximization is equivalent to the self-subutility maximization for each generation. Thus, the utility maximization problem for generation $t$ in country $i$ is formulated as follows:

$$\max_{\{c^i_t,d^i_{r+1}\}} u^{i,t}(c^i_t,d^i_{r+1}), \text{ s.t. } c^i_t + \frac{1}{r_{i+1}}d^i_{r+1} = w_t + T^i.$$ (4)

The first-order condition for the utility maximization problem (4) can be given by $u^{i,t}_c = r_{i+1}u^{i,t}_d$, where $u^{i,t}_c \equiv \frac{\partial u^{i,t}}{\partial c^i_t}$ and $u^{i,t}_d \equiv \frac{\partial u^{i,t}}{\partial d^i_{r+1}}$. The second-order condition is satisfied by the quasi-concavity of the self-utility function. By this first-order condition and the intertemporal budget constraint (4), we obtain the optimal consumption bundle, $(c^i_t(w_t + T^i, r_{i+1}), d^i_{r+1}(w_t + T^i, r_{i+1}))$, as well as the savings function, $s^i_t = \delta^i_t(w_t + T^i, r_{i+1})$. Here, we assume that the savings function is increasing both in the wage and in the interest rate, that is, $\delta^i_w \equiv \frac{\partial \delta^i_t(w_t + T^i, r_{i+1})}{\partial w_t} > 0$ and $\delta^i_r \equiv \frac{\partial \delta^i_t(w_t + T^i, r_{i+1})}{\partial r_{i+1}} > 0$, which guarantees that consumption is a normal good.

Substituting the optimal consumptions and savings into the total utility function, we can obtain the indirect utility function:

$$V^{i,t}(w_t + T^i, r_{i+1}, w_{r+1} + T^i, r_{i+2}) \equiv U^{i,t}(u^{i,t}(c^i_t(w_t + T^i, r_{i+1}), d^i_{r+1}(w_t + T^i, r_{i+1})), u^{i,t+1}(c^i_{r+1}(w_{r+1} + T^i, r_{i+2}), d^i_{r+2}(w_{r+1} + T^i, r_{i+2})))$$

(5)
It should be noted that the indirect utility depends only on the wages and the interest rates confronted by the present and the next generation, not on those confronted by all succeeding generations.\(^3\) As \(u_c i_t \frac{\partial c_i}{\partial w_i} + u_d i_t \frac{\partial d_{i+1}}{\partial w_i} = u_c i_t > 0\) and \(u_c i_t \frac{\partial c_i}{\partial r_{i+1}} + u_d i_t \frac{\partial d_{i+1}}{\partial r_{i+1}} = u_d i_t s_i\) hold from the first-order condition, the indirect utility function has the following properties:\(^4\)

\[ V_{w_i}^{i,t} = u_i^{i,t} \left( u_c i_t \frac{\partial c_i}{\partial w_i} + u_d i_t \frac{\partial d_{i+1}}{\partial w_i} \right) = U_i^{i,t} u_c i_t > 0, \]  

\[ V_{r_{i+1}}^{i,t} = U_i^{i,t} \left( u_c i_t \frac{\partial c_i}{\partial r_{i+1}} + u_d i_t \frac{\partial d_{i+1}}{\partial r_{i+1}} \right) = U_i^{i,t} u_d i_t s_i > 0, \]  

\[ V_{w_{r_{i+2}}}^{i,t} = U_i^{i,t} \left( u_c i_t \frac{\partial c_i}{\partial w_{r_{i+2}}} + u_d i_t \frac{\partial d_{i+2}}{\partial w_{r_{i+2}}} \right) = U_i^{i,t} u_d i_t s_i > 0, \]  

\[ V_{r_{i+2}}^{i,t} = U_i^{i,t} \left( u_c i_t \frac{\partial c_i}{\partial r_{i+2}} + u_d i_t \frac{\partial d_{i+2}}{\partial r_{i+2}} \right) = U_i^{i,t} u_d i_t s_i > 0, \]  

\[ V_T^{i,t} = V_{w_i}^{i,t} + V_{r_{i+1}}^{i,t} = U_i^{i,t} u_c i_t + U_i^{i,t} u_d i_t s_i > 0. \]  

Without loss of generality, the marginal self-utility of the consumption in the young period can be normalized to unity (\(u_c i_t = u_c i_t + 1\)), so that \(u_d i_t = \frac{1}{r_{i+1}}\) is obtained. Likewise, it can be assumed that the marginal effect of the generation’s own self-utility on their total utility is normalized to unity, \(U_i^{i,t} \equiv \frac{\partial U^{i,t}}{\partial u_i} = 1\). Moreover, it is permissible to assume that the marginal effect of the altruistic utility on the total utility evaluated at equilibrium is less than unity, \(U_{r_{i+1}}^{i,t} \equiv \frac{\partial U^{i,t}}{\partial r_{i+1}} = \beta^{i,t} \in [0, 1]\). Here, \(\beta^{i,t}\) can be regarded as the degree of intergenerational altruism of generation \(t\) in country \(i\) for the next generation in the country. As a result, (6)–(10) can be rewritten as:

\[
V_{w_i}^{i,t} = 1 > 0, \\
V_{r_{i+1}}^{i,t} = \frac{s_i}{r_{i+1}} > 0, \\
V_{w_{r_{i+2}}}^{i,t} = \beta^{i,t} > 0, \\
V_{r_{i+2}}^{i,t} = \beta^{i,t} \frac{s_i}{r_{i+2}} > 0, \text{ and} \\
V_T^{i,t} = 1 + \beta^{i,t} > 0. 
\]

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\(^3\) In this regard, the indirect utility of our framework differs from that of the previous literature, represented by Blanchard and Fisher (1989, Ch.3) and Philippe and Venditti (1997), in which indirect utility depends on the wages and the interest rates of all succeeding generations. This difference arises from different assumptions about whether the total utility of individuals depends on the subutility of the next generation or their total utility.

\(^4\) The subscripts of the indirect utility function imply partial differentiation. That is, \(V_{w_i}^{i,t} = \frac{\partial V^{i,t}}{\partial w_i}, V_{r_{i+1}}^{i,t} = \frac{\partial V^{i,t}}{\partial r_{i+1}}, V_{w_{r_{i+2}}}^{i,t} = \frac{\partial V^{i,t}}{\partial w_{r_{i+2}}}, V_{r_{i+2}}^{i,t} = \frac{\partial V^{i,t}}{\partial r_{i+2}}, \) and \(V_T^{i,t} = \frac{\partial V^{i,t}}{\partial T}\).
2.2 Firms

Firms in both countries produce their outputs under perfect competition. The aggregate production function \( F(K_t, L_t) \) exhibits constant returns to scale in capital \( K_t \) and labor \( L_t \), independent of time, and is identical in both countries. This aggregate production function can be rewritten as the per capita production function, \( f(k_t') \), where \( k_t' \equiv K_t'/L_t \) represents the per capita capital in country \( i \) in period \( t \). This per capita production function is assumed to satisfy the following conditions: (i) \( f(k_t') \) is continuously differentiable and (ii) \( f(k_t') > 0 \), \( f'(k_t') > 0 \), and \( f''(k_t') < 0 \) for all \( k_t' > 0 \). Moreover, we assume the Inada conditions: (iii) \( f(0) = 0 \) and (iv) \( \lim_{k_t' \to 0} f'(k_t') = \infty \) and \( \lim_{k_t' \to \infty} f'(k_t') = 0 \).

Firms maximize their profit in per capita terms, denoted by \( \pi(k_t') \equiv f(k_t') - r_t k_t' - w_t \). The profit maximization, with no capital depreciation, requires the equivalence of the marginal productivity and the price of each input as:

\[
\frac{f'(k_t')}{f''(k_t')} = r_t \quad \text{and} \quad f(k_t') - f'(k_t')k_t' = w_t. \tag{11}
\]

From the first equation of (11), we obtain the capital demand function represented by \( k_t'(r_t) \), where \( k_t'(r_t) = 1/f''(r_t) \). This implies that the (per capita) demand for capital is decreasing in the interest rate \( r_t \). Similarly, from the second equation of (11), \( w_t'(r_t) = -k_t < 0 \) can be obtained.

2.3 Equilibrium

We consider a world capital market equilibrium in period \( t \), which requires the sum of per capita savings of generation \( t \) of both countries to be equal to the sum of per capita capital demand in the subsequent period \( t+1 \). As capital is perfectly mobile, the interest rates in both countries become the same, so that \( k_t^{D}(r_t) = k_t^{R}(r_t) \equiv k_{t+1} \) holds, by factor price equalization. Thus, the capital market equilibrium in period \( t \) can be expressed as follows:

\[
2(1+n)k_{t+1}(r_{t+1}) = s^D(w_t(r_t) + T^D, r_{t+1}) + s^R(w_t(r_t) + T^R, r_{t+1}). \tag{12}
\]

We define the excess demand in the world capital market as \( D(w_t, r_{t+1}) \equiv 2(1+n)k_{t+1}(r_{t+1}) - s^D(w_t + T^D, r_{t+1}) - s^R(w_t + T^R, r_{t+1}) \). Then, under the assumption that savings is increasing in the interest rate,

\[
\Delta_t \equiv \frac{\partial D(w_t, r_{t+1})}{\partial r_{t+1}} = 2(1+n)k_{t+1}'(r_{t+1}) - s^D_r - s^R_r = \frac{2(1+n)}{f''} - s^D_r - s^R_r < 0 \tag{13}
\]

holds. Therefore, the Walrasian stability condition is satisfied in the capital market equilibrium in each period.
3 The transfer paradox

We examine the condition under which the transfer paradox occurs in the steady state. The transfer paradox can be acknowledged if the donor is enriched and/or the recipient is immiserized by the transfer. As is usually assumed, we limit the analysis of the steady state to the case where the economy is dynamically efficient, i.e., \( r_t > 1+n \) holds for all \( t \).

From (12), we immediately obtain the equilibrium condition of the world capital market in the steady state as follows:

\[
2(1+n)k(r) = s^D(w(r) + T^D, r) + s^R(w(r) + T^R, r). \tag{14}
\]

For the economy to converge monotonically to the steady-state equilibrium, we assume the dynamic stability condition, i.e., \( 0 < \frac{d\ln k}{dr} < 1 \). This condition is arranged as follows:

\[
\Gamma \equiv \frac{dD(w(r), r)}{dr} = 2(1+n)k'(r) - s^D - s^R - (s_w^D + s_w^R)w'(r) = \Delta + (s_w^D + s_w^R)k < 0. \tag{15}
\]

It should be noted that by comparing (13) with (15), when \( D(w(r), r) \) is differentiated by \( r \) in the steady state, the term \((s_w^D + s_w^R)k\) is added to \( \Delta \). This is because the change in the interest rate affects the wages through the change in factor demands by firms and this brings about the long-run effect through the change in capital accumulation. By totally differentiating (14), we can obtain the effect of the transfer on the interest rate, as follows:

\[
\Gamma dr = s^D_T dT^D + s^R_T dT^R = (s^R_T - s^D_T)dt,
\]

where \( s^i_T = \frac{\partial s^i}{\partial r} \) and \( dT^R = -dT^D = dt > 0 \).

By totally differentiating the indirect utility functions of the donor and the recipient in the steady state, \( V^i, i = D, R \), and noting (6’)-(10’) and \( dw = -kdr \), we obtain the following equations:

\[
dV^D = (1 + \beta^{D,i})(dw + \frac{s^D}{r} dr - dT) = (1 + \beta^{D,i}) \left[ (-k + \frac{s^D}{r}) \frac{s^R_T - s^D_T}{\Gamma} - 1 \right] dt, \tag{17}
\]

\[
dV^R = (1 + \beta^{R,i})(dw + \frac{s^R}{r} dr + dT) = (1 + \beta^{R,i}) \left[ (-k + \frac{s^R}{r}) \frac{s^R_T - s^D_T}{\Gamma} + 1 \right] dt. \tag{18}
\]

From (17) and (18), the condition for the transfer paradox can be stated as follows: (i) The strong paradox occurs if \( dV^D > 0 \) and \( dV^R < 0 \); (ii) The weak paradox occurs either if \( dV^D > 0 \) and \( dV^R > 0 \), or if \( dV^D < 0 \) and \( dV^R < 0 \). In any case, we can immediately obtain the following proposition.

\[5\) Hereafter, variables with no time subscript indicate the ones in the steady state.\]
**Proposition 1.** Intergenerational altruism has no effect on the likelihood of the occurrence of the transfer paradox.

When individuals have no intergenerational altruism, the effect of the transfer is equivalent to the terms in the squared brackets of (17) and (18), which can be obtained by substituting $\beta^{i,j} = 0$ into (17) and (18).\(^6\) This implies that although the existence of intergenerational altruism amplifies the effect on the welfare of the donor and the recipient, it does not at all affect whether the transfer paradox occurs. In fact, both these conditions are independent of the degree of intergenerational altruism, $\beta^{i,j}$. Moreover, the result of Proposition 1 holds even when $\beta^{i,j} > 1$, although such a situation is unrealistic because it implies that a generation places greater priority on the other generation than on itself.

The reason why Proposition 1 holds is easy to appreciate. At first glance, because intergenerational altruism works as a type of utility externality, it might seem that the introduction of intergenerational altruism into the model would affect the likelihood of the occurrence of the transfer paradox. However, because intergenerational altruism is, by definition, a utility externality that arises only between the generations within a donor or recipient country, such a domestic externality has no effect on the welfare of other countries. This is consistent with the result of Hamada and Yanagihara (2013), who examined the transfer paradox in the context of altruism between a donor country and a recipient country. These results show that the condition under which the paradox occurs changes if the type of altruism differs.

### 4 Concluding remarks

In this paper, we have demonstrated that the condition under which the transfer paradox occurs in the steady state is not affected by the degree of intergenerational altruism. This result is in sharp contrast to the results of previous research, such as Hamada and Yanagihara (2013), who found that, when both a donor and a recipient country have altruism towards each other, the condition under which the paradox occurs changes.

It seems at first glance that the introduction of the intergenerational altruism raises the likelihood of the transfer paradox, in particular, the likelihood of the donor’s enrichment by the transfer. However, our paper concludes that, in a dynamic framework, although the intergenerational altruism within a country amplifies the effect of the transfer, it does not change the condition under which the transfer paradox occurs. This implies that the intergenerational altruism does not contribute to explaining the motivation for the donor’s voluntary transfer. Combining the result obtained in our paper, which is based

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\(^6\) The welfare effect without intergenerational altruism has been shown in Galor and Polemarchakis (1987) and Yanagihara (2006).

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on intergenerational altruism, with the results obtained in previous papers involving altruism between two countries, including our previous paper (Hamada and Yanagihara, 2013), suggests that the likelihood of the transfer paradox occurring depends crucially on the characteristics of altruism assumed. Therefore, it can be inferred from our conclusion that, even if another externality is added to the model, the externality itself will not cause any change in the condition influencing the likelihood of the paradox, unless the interdependency is between a donor and a recipient. A further extension of our research is to actually investigate whether this inferred conclusion is correct; that is, whether the condition for the occurrence of the transfer paradox is changed when there is another externality.

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