Bandwagon Effect, Hirsch’s Positional Economy, and the Rebound Effect

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Abstract

This paper examines the relationship between the social nature of goods and services and the discussion on the rebound effect. First, focusing on the bandwagon effect, the influence of the decline in effective prices on demand following an improvement in resource efficiency is classified into two stages, and its influence is considered. The first stage is the direct effect of the decline in the effective price itself. The second stage is the effect of the changes in the consumption level of individuals in the entire society. The result of the analysis using a simple model indicates that there is a possibility that even if the value of the rebound effect does not exceed one in the first stage, the final rebound effect might exceed one if the second stage is considered. Furthermore, based on the Hirsch hypothesis, this paper also discusses deadweight losses, following competition for securing positional goods. If the improvement in resource efficiency stimulates the positional economy, the wastage of resources should increase instead of decreasing. Focusing on the relationship between the improvement in resource efficiency and wastage of resources, this paper clarifies the conditions under which the improvement in resource efficiency increases the wastage of resources.

Keywords: rebound effect; resource efficiency; bandwagon effect; Hirsch hypothesis; positional goods

1. Introduction

Importance has been placed on improvements in resource efficiency as a strategy for achieving a balance between “the environment and the economy.” In fact, if resource efficiency can be doubled while maintaining GDP at a certain level, resource consumption can be reduced by half. However, in many cases, some or all of the resources that can be saved by improving resource efficiency are eaten away by the growth in the consumption of goods and services. In particular, in some cases, this eating up is attributed to improvements in resource efficiency itself. This phenomenon is known as the rebound effect.

Research on the rebound effect has been carried out since the 1980s mainly by energy economists. Khazzoom (1980, 1987, 1989), a pioneer in the field, focused on the decline in the effective prices of energy services following improvements in the energy efficiency of household appliances, and discussed the relationship between increases in demand attributed to the effective price decline and the rebound effect. Then, Khazzoom (1980, 1987, 1989) showed theoretically that the magnitude of the rebound effect was dependent on the price elasticity value of energy services, and that backfiring (in other words, even if energy efficiency improves, the level of energy consumption becomes greater than the original level of energy consumption) could occur depending on the magnitude.

Focusing mainly on energy-consuming durable goods, the magnitude of the rebound effect has been estimated empirically. Although these estimates vary, the popular opinion is that, as a whole, the level
of the rebound effect is not so serious as to eat away all the gains of improvements in energy efficiency (Greene, 1992; Berkhout et al., 2000; Greening et al., 2000; Laitner, 2000; Schipper and Grubb, 2000). However, few empirical analyses have been conducted so far on the rebound effect of resources other than energy. Therefore, it is too early to generalize this view for all resources. In addition, the mechanism of the rebound effect includes not only its own rebound but also the change in the level of resource consumption because of increases in demand for other goods and services (in other words, secondary rebound effects), which have an economy-wide ripple effect. Studies on these types of rebound effects have not been carried out sufficiently. Existing estimates of the size of economy-wide rebound effects vary from insignificant (4CMR, 2006) to backfiring (Hanley et al., 2006).

Moreover, Greening et al. (2000) proposed a fourth type of rebound effect, the transformational effect, which has not been studied at all. This type of rebound effect considers the impact of technological changes on people’s preferences. It is not surprising that this study is not related to standard economics, because, in the framework of standard economics, i.e., neoclassical economics, the preferences of economic entities have been dealt with as a given exogenous element (Hodgson, 1988, 1999a, 1999b, 2004; O’Neill, 2007).

Nonetheless, it is extremely difficult to set up an economic model that perfectly incorporates an individual’s preferences as an endogenous factor. Hence, to simplify the discussion, this paper attempts to examine the rebound effect from the viewpoint of the relationship between the social nature of goods and services. For some goods and services, the satisfaction obtained through their consumption is influenced by the level of consumption by others. The existence of such goods and services has been recognized for a long time (e.g., Smith (1776) pointed out the necessity of owning goods without which people felt ashamed when they met other people). Needs satisfied by such “social goods” have strong symbolic meanings. Therefore, such goods are always in demand (Keynes, 1930). If competition to obtain social goods becomes fiercer, resources that could be saved through resource efficiency improvement will be swallowed up completely. Hence, it is not wise to ignore the social nature of goods and services and to admire environment-friendly technologies too much. Unfortunately, the social nature of goods and services has not been extensively examined by neoclassical economists (Mason, 1998). Thus, there are no studies about how the social characteristics of goods and services are associated with the rebound effect.

In this paper, a study is performed from the following two perspectives. First, in Section 2, which focuses on the bandwagon effect, it is indicated that even if the effect of the (own) rebound effect is small in the short term, it can be substantial in the long term. In Section 3, based on the Hirsch positional economy hypothesis, we consider resources used to produce positional goods as waste, to clarify the relationship between the level of resource wastage and resource efficiency. Finally, the conclusion is presented in Section 4.

2. Rebound effect of bandwagon goods

The bandwagon effect means that demands for goods and services are positively affected by the level of consumption of other people (Leibenstein, 1950). This consumption behavior is derived from the social desire of people not to lag behind other people, and it is an important aspect of status seeking. With respect to the demands for bandwagon goods, individuals react to information about the amount of goods others consume. Therefore, the mechanism is phased. First, consumers react to the decline in effective prices (the first stage). Then, each consumer compares the level of his/her consumption with
that of others and accordingly readjusts his/her demands for bandwagon goods (the second stage). Therefore, it is natural to consider that there is a time lag between the first stage and the second stage.

The time lag between the first and second stages is supposed to be influenced by the nature of bandwagon goods, customs, general rules, trends, and other factors. It might range from several days to months or even several years. Irrespective of the lag, it is important that even if the rebound effect is small in the first stage, it does not always mean that the overall rebound effect including the second stage will also be small. In fact, empirical analyses exist to prove such concerns. For example, empirical research on the price elasticity of car gasoline consumption indicates that in the long term of 10 to 20 years, the rebound effect is two to three times that of the one-year short-term rebound effect (Berkhout et al., 2000; Greening et al., 2000). Considering intervals of 10 years, it can be seen that fuel price changes can influence the ownership of cars, which is not surprising. However, the short and long terms mentioned here simply refer to the length of the time period. This result is not based on research conducted with strong awareness of the social nature of automotive goods. The nature of cars as bandwagon goods cannot be denied. Furthermore, the hypothesis that this nature partially influences the long-term car ownership trend is plausible. However, it is difficult to gauge the extent to which it contributes to the rebound effect. Although a relatively large number of empirical studies have been performed on the rebound effect related to the energy efficiency of cars and household appliances, it is difficult to determine the point in time when indirect demand readjustment is “completed.” Existing data are not sufficient to discuss empirically the trend in the long-term rebound effect. Therefore, in this section, I perform a theoretical analysis based on the following simple model.

Let us assume that an individual’s demand for bandwagon good, $B$, depends on not only the effective price, $P$, but also the average level of bandwagon goods consumption in the society as a whole, $B^a$. 

$$B = f(P, B^a) \quad \text{with} \quad f_P < 0, 0 < f_{B^a} < 1.$$  \hspace{1cm} (1)

The subscripts represent partial derivatives. Although this demand function does not express time explicitly, the second stage of demand change following price change further consists of numerous stages. Initially, each individual recognizes the total consumption level of bandwagon goods in society. Based on this, each individual determines the consumption level of the bandwagon goods, and this further influences the overall consumption level. Thus, the average consumption level of bandwagon goods in society and individuals’ consumption level influence each other. When this interaction gradually converges and the consumption level of the bandwagon goods settles at a certain level, the second stage ends (in this paper the possibility of divergence is excluded).

It is assumed that the resource required for the production of the bandwagon goods, $R$, is expressed by the following simple relation:

$$R = B/e,$$ \hspace{1cm} (2)

where $e$ is energy efficiency. The price of the bandwagon goods is given by a reduction function related to energy efficiency. The price of the resource is supposed to be constant:

$$P = p(e), \quad p’ < 0.$$ \hspace{1cm} (3)

The impact of improvement in energy efficiency on resource consumption is generally expressed as the elasticity:

$$\eta = \frac{\partial \ln R}{\partial \ln e} = \frac{e}{R} \frac{\partial R}{\partial e}.$$ \hspace{1cm} (4)

If the consumption level of the bandwagon goods remains unchanged but resource efficiency im-
proves, a 1% improvement in resource efficiency results in a 1% reduction in resource consumption, and the resulting elasticity is \(-1\). However, if the rebound effect occurs, i.e., energy efficiency improvement increases demand for bandwagon goods, the degree of reduction in resource consumption, which is supposed to be reduced by 1%, will be partially weakened. Using Eq. (2) and Eq. (4), the magnitude of the rebound effect \(r^e\) is:

\[
r^e = \eta + 1 = \frac{-B}{eR} + \frac{1}{R} \frac{\partial B}{\partial e} + 1 = \frac{1}{R} \frac{\partial B}{\partial e}.
\]

If energy efficiency improvement does not change resource consumption at all, then the rebound effect is one. On the contrary, if a 1% improvement in resource efficiency leads to a 1% reduction of resource consumption, the rebound effect is zero.

Based on the definition, the rebound effect at the first stage corresponds to demand change, which reacts only to price changes:

\[
r^e_{1st} = \frac{B'}{R} f_p.
\]

On the other hand, at the end of the second stage, not only is the rebound effect affected by the price changes of bandwagon goods but it also reflects individual consumers’ reactions to a rise in the average consumption level in society. To simplify the discussion, assume that the same demand function is applicable to all individuals and all individuals always consume equivalent amounts of bandwagon goods, that is, \(B_0 = B\). Using Eq. (1) and Eq. (5), the following equation is obtained:

\[
r^e_{2nd} = \frac{B'}{R} \frac{f_p}{1 - f_{y_0}}.
\]

Based on Eqs (6) and (7), the ratio of the rebound effect at the end of the second stage and the rebound effect at the first stage, \(r^r\), is expressed as follows:

\[
r^r = \frac{r^e_{2nd}}{r^e_{1st}} = \frac{1}{1 - f_{y_0}}.
\]

Because the cases in which demands diverge are excluded by assumption, the denominator of Eq. (8) is greater than zero. The rebound effect at the end of the second stage can be many times larger than the rebound effect in the first stage. In other words, even if the rebound effect is 0.1 in the first stage, as long as \(f_{S_0}\) exceeds 0.9, the final rebound effect exceeds one.

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1. Eq. (7) is obtained as following: Differentiating Eq. (1) with respect to energy efficiency yields:

\[
\frac{dB}{dc} = f_y \frac{B'}{R} + f_{y_0} \frac{dB^o}{dc}.
\]

Assuming \(B = B^o\), we get:

\[
\frac{dB}{dc} = f_y \frac{B'}{R} \frac{1}{1 - f_{y_0}}.
\]

Inserting this equation into Eq. (5) yields Eq. (7).

2. On the condition that the marginal demand of the average consumption level of bandwagon goods \(f_{y^o}\) is greater than one, each consumer mutually tries to exceed the average level of bandwagon goods, and, therefore, consumption competition for bandwagon goods continues endlessly. It is obvious that such diverging situations are not compatible with a sustainable society.
3. **Rebound effect of resource wastage**

The desire to maintain or enhance social status is a part of the basic human desire to obtain social approval. Veblen (1899) believed that, as productivity and social anonymity increase, people try to inform others of their social status through conspicuous consumption of goods and services. In particular, it is worth noting that Veblen clearly recognized that show-off consumption is “wasteful” behavior. As pointed out by Veblen, individuals’ consumption behavior to catch up with and get ahead of surrounding people is reasonable for individuals and hence is not recognized by them as being wasteful. However, such behavior brings about a fallacy of composition, and does not contribute to any enhancement or promotion of welfare in the society. In this sense, Veblen called this behavior wasteful.

A similar idea also appeared in Hirsch’s (1976) discussion on the positional economy. However, not only do the positional goods defined by Hirsch include goods to be used to show off individuals’ status, but also include all goods and services that produce negative effects if other people consume the goods and services. For instance, a car is a tool to maintain status. At the same time, if everyone in a society owns a car, roads will be congested and this will impair the convenience of having a car. In addition, the atmosphere becomes polluted and public transportation becomes impoverished. This also harms people who do not own cars. To avoid in any way the disadvantage of not owning a car, people cannot help having a car. A negative spiral occurs. As Hirsch pointed out, scarcity of positional goods is never resolved by improvements in productivity. Hence, competition for obtaining positional goods causes a deadweight loss. This idea is consistent with Veblen’s stance, but more importantly, both Hirsh and Veblen believed that it is not possible for the masses to escape from competition for acquiring social goods and services. Veblen assumed that achievement of social position is a basic desire of humans. In addition, even a person who can regard this type of show-off competition as “garbage” cannot avoid getting involved in a competition to obtain positional goods. Hirsch pointed out the tragedy of the positional economy with regard to this point. Congleton (1989) showed that social competition among a limited number of people (e.g., feats of athletes, etc.) can generate positive externalities (even if this type of competition is a zero-sum game, it can enhance social welfare as a whole). However, this conclusion presumes that each individual can arbitrarily decide whether he/she should participate in the competition. Without this presumption, deadweight losses cannot be avoided in a society.

A consumption tax is required to correct deadweight losses following social competition as discussed by Howarth (1996). It is also possible to regard the tax rate as one of the indicators that represent the degree of deadweight losses. However, this paper’s interest is still wastage of material resources. There is almost no doubt that a sustainable society is equipped with a mechanism to minimize resources wasted as deadweight losses. If this is the case, there is no justification for avoiding a discussion on the issue of whether resource efficiency improvements decrease wastage or not.

In this section, using a simple static model, I examine the influence of the improvement in resource efficiency of goods and services on the wastage level. First, based on Hirsch’s discussion, I consider two types of goods, normal and positional goods. The utility obtained from the consumption of normal goods is only dependent on the absolute level of consumption, and it has no relation with other people’s consumption level. On the other hand, the utility obtained by each individual through consumption of positional goods is determined only by the relative difference to other people’s consumption level.

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3 Positional goods in this model are different from bandwagon goods in Section 2 in the following sense. In this mod-

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Moreover, following the model of Brekke et al. (2003), I assume that all individuals are identical. In other words, all individuals maximize the same utility function under the same constraint condition. This always creates a situation in which all individuals “stand on tiptoes”, and as a result, “no one sees better” (Hirsch, 1976). This means that consuming positional goods becomes futile. Every individual cannot simultaneously improve his or her social status.

In addition, the model in which all individuals are identical is useful for the following reason. By using this model, we can avoid the issue of how to judge the overall social desirability when there is a gap in the consumption level of positional goods among individuals. For example, can we determine the degree of desirability (or undesirability) of the situation in which A’s consumption of positional goods greatly exceeds that of B’s? Can we evaluate it simply by summing up the benefits to both individuals? Supposing that this is the case, if A’s satisfaction attributed to his/her superiority to B rises much above B’s envy of A, this situation is determined as a desirable situation as a whole. Is this right? To be sure, these issues must be considered as important, but a detailed discussion of these issues is beyond the scope of this paper.

Assume that each individual uses a certain amount of resources \( R \) to produce normal goods \( X \) and positional goods \( S \), and consumes the goods immediately. In other words, increases and decreases in the society-wide resource consumption level are not considered. Hence, resources used in the production of positional goods are all wasted. The resource efficiency of normal and positional goods are \( e_x \) and \( e_s \), respectively. Each individual utilizes all resources, and the overall resource consumption is always constant.

Given available technologies (resource efficiency of positional goods is \( e_s \), and that of normal goods is \( e_x \)), each individual maximizes utility determined by the level of the position and the consumption level of normal goods. The utility function is given by the following CES formulation. Then, each individual faces the problem:

\[
\max_{x, s} U = u(X, L) = (a_1 X^{-b} + a_2 L^{-b})^{-\frac{1}{b}}
\]

subject to \( \frac{S}{e_s} + \frac{X}{e_x} = R \) with \( a_1 > 0, a_2 < 0, b > -1 \),

where \( L \) is the level of each individual’s position, which is dependent on his or her consumption level of positional goods and the average consumption level of positional goods as a whole, \( S^a \):

\[
L = g(S ; S^a) \text{ with } g_s > 0, g_{ss} < 0.
\]

Note that each individual regards \( S^a \) as given and beyond his or her control. The first-order condition is given by Eq. (11). The positional economy referred to by Hirsch is the prisoner’s dilemma problem in game theory. In the Nash equilibrium, the consumption level of positional goods is equal for all individuals (\( = S^a \)):

\[
\frac{ut_x g_s}{ut_x} = \frac{1/e_s}{1/e_x}.
\]

Regarding the formulation of the status function following Brekke et al. (2003), I consider two types, which are formulations based on the “ratio” and “difference” as follows. The positional function defined
by the ratio $g^r$ is represented by Eq. (12).

$$g^r(S; S^a) = S/S^a. \tag{12}$$

In this function, as the overall average consumption level of positional goods rises, the rise in the marginal position related to positional goods becomes smaller. On the other hand, in the positional function $g^a$ defined by the difference in Eq. (13), the marginal position of positional goods is constant:

$$g^a(S; S^a) = S - S^a + C, \tag{13}$$

where $C$ is a constant.

Table 1 shows the direction of changes in the resource waste level when resource efficiency increases. Here, wasted resources refer to resources used for positional goods in the Nash equilibrium, and are defined by Eq. (14):

$$Rs^N = \frac{S^N}{e_s}. \tag{14}$$

The effect of the resource efficiency improvement in positional goods on wastage depends on how the positional function is formulated. However, it does not depend on substitutability between positional and normal goods ($\hat{b}$). It is not surprising that the consumption level of positional goods increases because the resource efficiency improvement in positional goods induces the same effect as the price decline of positional goods. However, an increase in the demand for positional goods does not mean an immediate increase in resource wastage. The balance between the increase in demand for positional goods and resource efficiency improvement in positional goods determines whether resource wastage increases or not. In the case of the positional function represented by a ratio, the two factors balance out. Thus, there is no change in resource usage. On the other hand, if the positional function is defined by the difference, the increase in demand for positional goods is large, and, hence, the improvement in resource efficiency significantly increases resource wastage. This difference derives from the difference in the marginal positions of positional goods. While the marginal position decreases in the positional function defined by the ratio, it is constant in the positional function defined by the difference. Therefore, if the consumption level of positional goods increases, the degree of marginal utility decreases in the positional function defined by the ratio.

We next turn to the improvement in resource efficiency of normal goods. In this case, the resource efficiency of positional goods is unchanged. Hence, a rise in the consumption level of positional goods immediately means a rise in the resource waste level. However, unlike the improvement in resource efficiency of positional goods, when the resource efficiency of normal goods improves, the effects that re-
press the consumption of positional goods (substitution effect) also act together with the effects that boost the consumption of positional goods (income effect). Therefore, if the effects that repress the consumption of positional goods are greater, the consumption level of positional goods declines (in other words, resource wastage decreases). After all, if the utility function is defined as a CES type, the direction of changes in the resource waste level coincides with the sign of $b$. If $b$ is greater than zero (Cobb-Douglas utility function), the resource efficiency of normal goods reduces resource wastage irrespective of the form of the positional function. This result is consistent with the view of Brekke et al. (2003) that if substitutability between normal and positional goods is high, economic growth leads to a decrease in the expenditure ratio of positional goods.

If the substitutability between normal and positional goods is high, the competition for obtaining positional goods is not so tough (because normal goods can be substituted for positional goods). However, if Hirsch’s hypothesis is followed, as income increases and demand for normal goods is met, people’s interests must be directed to positional goods. Hirsch’s concern is that because of their nature, positional goods cannot be replaced with normal goods, and, hence, there is a pessimistic scenario in which people irresistibly get involved in the competition of obtaining positional goods. If positional and normal goods can be used to satisfy distinctive needs in different dimensions, it is natural to consider that, basically, the two types of goods are complementary to each other. If this is the case, the improvement in the resource efficiency of normal goods results in increasing resource wastage.

To determine whether a social situation is good or bad based only on utility, we only have to consider changes in the consumption level of normal goods. With no regard to the value of the parameter $b$, improvement in the resource efficiency of normal goods raises the consumption level of normal goods. However, note that our present interest is in the degree of resource wastage.

Despite this, some points are clear. Although the issue of whether utility and resource wastage are commensurable or not is avoided, it is obviously undesirable that resource wastage increases together with a decline in the utility level. In addition, it is obviously desirable that, together with a rise in the utility level, resource wastage decreases. Hence, if the value of $b$ is negative (in other words, if the two types of goods are in a substitutable relationship), it is desirable to enhance the resource efficiency of normal goods. On the other hand, it is undesirable to enhance the resource efficiency of positional goods. This is obvious in the case of the positional function defined by the difference. Furthermore, in the case of the positional function defined by the ratio, the improvement in the resource efficiency of positional goods realizes neither wastage reduction nor utility enhancement. We should acknowledge this as another problem. This is because, in reality, it is necessary to use a large amount of resources to enhance resource efficiency. Hence, if these efforts are useless, resources used to improve resource efficiency are wasted.

4. Conclusion

Empirical analysis on the rebound effect is still insufficient. Moreover, in previous studies, a disproportionate interest was put on goods and services related to energy. However, if we consider natural resources in a broad sense, then not only fossil resources but also various kinds of renewable and nonrenewable resources and water resources must also be included. In addition, as an integrated indicator, we can assume that the level of resources used in the economic system is also expressed in ecological footprints and ecological rucksacks. In the future, we can expect long-term empirical analyses on resource efficiency related to resources in a broad sense. At the same time, it will take a considerably lon-
ger time to obtain universal knowledge and views related to the rebound effect through empirical analyses.

Instead of an empirical analysis, a deductive theoretical analysis based on a simple model was used in this paper. I primarily focused on the social aspects of goods and services and discussed the implications of this for research on the rebound effect. In particular, to study the sociality of goods and services, I focused on the bandwagon effect and Hirsch’s positional economy hypothesis. When goods and services are subject to the bandwagon effect, the demands for them are influenced not only by price but also by how much other people consume the goods and services. An effective decline in prices because of the improvement in resource efficiency itself increases demand. However, increased total demands in society themselves stimulate individuals’ demands. In this paper, I called the former the first stage and the latter the second stage to clarify the difference in rebound at both stages. As a result, it has been indicated that even if the rebound effect at the first stage is less than one, the greater the bandwagon effect of the goods, the more likely it is that the rebound effect exceeds one at the end of the second stage. In the past, several empirical analyses have been conducted on the rebound effect. According to these results, as a whole, the rebound effect fell short of one, but there is no study that explicitly considered the bandwagon effect.

Moreover, in this paper, based on Hirsch’s positional economy hypothesis, I examined the rebound effect. Traditional research on the rebound effect only focuses on increases and decreases in overall resource consumption and does not consider the usage of resources. Hirsch’s hypothesis was concerned with wastage of resources in a broad sense attributed to competition in acquiring positional goods. This paper clarified the relationship between resource efficiency and resource wastage. As a result, it was indicated that substitutability between positional and normal goods is lower, and there is a higher tendency for resource efficiency improvement to lead to resource wastage. If both goods are substitutable, resource efficiency improvement tends to reduce wastage. However, as suggested by Hirsch, positional and normal goods correspond to incommensurable multidimensional human needs. Hence, we should consider them to be complementary to each other. It might be possible to keep the economy-wide resource consumption level at a certain level through control programs such as tradable permits. Nevertheless, this study has indicated that resource efficiency improvement can still create an undesirable situation from the standpoint of resource wastage.

References

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