the review of income and wealth

Review of Income and Wealth
Series 59, Number 3, September 2013
DOI: 10.1111/roiw.12018

THE PRODUCTION BOUNDARY RECONSIDERED

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Hill and Hawrylyshyn rediscovered a classical contribution made by Margaret Reid as early as 1934, known now as the "third party criterion." The general production boundary in SNA 1993 is defined by using this criterion. They considered that the property of "delegability" was the key to the concept of economic production. That is, an activity is called production in an economic sense if it can be delegated to another economic unit. The author calls due attention to the fact that the SNA includes another criterion, which he tentatively calls "World 1 criterion" meaning that an activity is called economic production only when it is a physical process, where the term World 1 is due to Karl Popper. It is claimed that this criterion can generate a more appropriate general production boundary for the SNA if it is used with "role-exchangeability" criterion, another new criterion.

JEL Codes: A12, E02, E23

Keywords: delegability, Popper's three worlds, production boundary, SNA, third party criterion

INTRODUCTION

The purpose of the present paper is to reconsider the boundary of production in the SNA. In 1970s, some authors in the field of national accounting (Hawrylyshyn, 1977; Hill, 1977, 1979) studied the concept of economic production and reached a widely agreed conclusion, which is considered to be incorporated in SNA 1993.[1]

Actually, they rediscovered a classical contribution made by Margaret Reid in the early 1930s (Reid, 1934). They considered that the property of "delegability" is the key to the concept of economic production. Thus, an activity is called economic production if it can be delegated to another economic unit. This criterion is sometimes referred to as the "third party criterion" in the field of unpaid work or household production in particular because of an additional requirement imposed by her, which will be described below.

However, it is true that in applying their criterion, statisticians have encountered several problems including those found in the field of research in, and the measurement of, unpaid work. For example, it was often questioned whether or not commuting can be delegated. In fact, workers cannot delegate commuting to other persons on their behalf. However, it should be taken into account that

Note: This paper was funded in part by a Senshu University research grant. The author is grateful for comments from Professors Yoshimasa Kurabayashi, Masaaki Kuboniwa, Taichiro Matsukawa, and Satoshi Kanemaru as well as anonymous referees.

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[1]United Nations *et al*. (1993).

activities may be undertaken as part of preparation for some other activities. Commuting should be counted as an example of such preparatory activities.

In addition, it should be noted that Pyatt (1990) pointed out the insufficiency of the criterion, putting it as "Hill's half-way house." For example, a student cannot delegate studying to any other person. However, employers may have many off-the-job training programs for their employees. Thus, for example, they may make their employees go to English conversation schools as part of their work to prepare for transfer to overseas offices. So, delegability or the third party criterion may lead to placing some activities which are regarded as *work* by the people who do them outside the production boundary.

Moreover, there may be a problem about "intellectual property products," a newly coined term in SNA 2008.[2] Thus, it is highly questionable whether Shakespeare could delegate writing *Hamlet* to any other person, leading to the conclusion that authoring a book (or composing a symphony) is *not* within the production boundary of the SNA. This position is the same as that taken in SNA 1968,[3] though it is not consistent with the view taken in SNA 2008 as well as SNA 1993, where authoring and the like is considered to be not only economic production but also (fixed) capital.

Delegability apart, it should be recognized that paragraph 1.20 in SNA 1993 clearly states: "In the System, production is understood to be a physical process."[4] Although *Hamlet* performed in a theater is a physical process and a book containing *Hamlet* is also a physical object that is an output of some physical process, *Hamlet* itself is not physical. In the same way, mental changes that are purported to be brought about by, say, education are clearly not physical either.

Thus, in the very core of the national accounting system, quite fundamental problems remain unsettled. The above mentioned criterion, which is deemed to be included in the current SNA and means that an activity is economic production only if it is a physical process, will be called "World 1 criterion" in what follows, where the term "World 1" is due to Karl Popper, a British philosopher born in Austria, and means essentially the physical world. In the author's view, Popper's consideration on his "three worlds" is very useful for our purpose of delineating the production boundary for the SNA. Here, the other two worlds are World 2 (the mental world), and World 3 (the world of objective knowledge). Popper's insights are useful in avoiding possible confusion among national accountants about the treatment of some borderline cases.

In addition, it is argued that the delegability criterion or the third party criterion should be replaced with another new criterion, tentatively called the "role-exchangeability" criterion, according to which an activity is considered to be economic production only when someone's role in undertaking the activity can be exchanged with someone else's role of undertaking another activity in order for some common purpose of the community to be accomplished. The rationale for

[2]The final version of the 2008 SNA may be found on the United Nation's website, http://unstats.un.org/unsd/nationalaccount/SNA2008.pdf.

[3]See footnote 7.

[4]In SNA 2008 as well, almost the same statement may be found in paragraph 1.40, though the word "System" meaning "central framework" in SNA 1993 is replaced with just "SNA."

the proposed replacement will be explained later, but at this stage it may be pointed out that the possibility of division of labor is not exhausted by the delegability criterion.

In Section 1, the concept of the production boundary will be revisited. In addition to reviewing existing criteria briefly, the focus will be the introduction of newly formulated criteria—the World 1 criterion and the role-exchangeability criterion. To facilitate the discussion, Popper's concept of the three worlds will be introduced in Section 2. Some implications for national accounting will be examined in Section 3. In Section 4, the main conclusions will be recapitulated with some closing remarks.

1. The Production Boundary: Reconsideration and New Criteria

According to Reid (1934, p. 11), "If an activity is of such character that it might be delegated to a paid worker, then that activity shall be deemed productive." Peter Hill rediscovered her contribution when writing "it is inherent in the concept of a service that the opportunity must exist to hire another economic unit to perform it" (Hill, 1979, p. 34), and "Any activity, which is such that it cannot by its very nature be delegated, or contracted out, to another individual or economic unit, must, therefore, be treated as intrinsically a non-service type activity" (Hill, 1977, p. 326).

Clearly, the two authors describe the production boundary in the same fashion. This criterion, which may be described as a delegability criterion, is incorporated in SNA 1993. In fact, paragraph 6.16 states: "Activities that are not productive in an economic sense include basic human activities such as eating, drinking, sleeping, taking exercise, etc., that it is impossible for one person to obtain another person instead."

Here, a remark may be necessary. That is, what Margaret Reid meant was that a possibility to hire or get another economic unit to perform a given activity should be interpreted to mean that anyone *can* perform it for the benefit of the one for whom it is done. In other words, it does not matter who performs it. Thus, if there are activities such that only particular individuals (family members or friends, for example) can do them, they should not be deemed to be productive in her sense. Himmelweit (1995) called this property "separability" (between the activity and the performer). Reid (1934) herself mentioned "impersonal" property of an activity which means that any kind of personal relationship between the one who performs the activity and the one for whom it is performed is *not* required.[5]

However, it may be questioned whether, apart from utility brought about by an activity, does it matter who does it? In fact, in a physical sense, anyone can change diapers. Himmelweit (1995) gave an example of a certain kind of caring, which needs developing a personal relationship between carer and cared for.

[5]"An activity is considered personal if it must be performed by a particular person not because of special ability but because of a personal relationship between the performer and the one whose want is satisfied" (Reid, 1934, p. 11). It may be for this reason that her contribution is called "third party criterion" now rather than "delegability criterion." In fact, this kind of property was not considered in Hill's papers except for self-fulfillment types of activity such as sleeping and studying, which may be regarded as special cases of personal activities.

A further interpretation is due to the author (Sakuma, 1996, p. 220). He thought that if an activity is to be delegable meaningfully, it should be interpreted as meaning in addition that anyone (who has the same technique and materials as the original producer) can re-perform it.[6] This point may be crucially relevant to the area of what the revised SNA calls "intellectual property products." For, while it was not likely that Shakespeare could leave anyone to write *Hamlet* for him, it is almost meaningless for anyone to write the same *Hamlet* again.[7] Because *Hamlet* already exists in Karl Popper's World 3, the world of the products of human minds, no-one can change the world any more by writing it again.

In fact, this type of uniqueness is one of the most salient features of authoring as well as composing. This is the most notable difference between authoring and composing on the one hand and paintings and sculptures on the other. In fact, anyone that has the same technique and materials can reproduce the latter types of artistic products but it is not the case for the former types of artistic works. It should be noted that the treatment in SNA 1968 of authoring and composing is totally different from that of paintings and sculptures.[8] Thus, in the 1968 version of the SNA, the former types of activities are considered to be outside its production boundary while the latter types of artistic products are part of fixed capital formation (not "valuables") if owned by producers.[9]

As already mentioned, SNA 1993 has an implicit criterion to the effect that economic production is understood to be a physical process. So, it seems that "products" belonging to World 3 (changes in, or something added to, World 3), as for those belonging to World 2 (changes in, or something added to, World 2) seem to be excluded from the concept of "products" in the sense of the SNA. Thus, in contrast to *Hamlet* performed in a theater as well as a book containing *Hamlet*, *Hamlet* itself is not physical. In Popper's terminology, *Hamlet* itself resides in World 3, the world of the products of human minds; a performance of *Hamlet* as well as a book containing *Hamlet* is in World 1, the world of physical states and processes; and any emotion provoked by viewing the play or reading the book is in World 2, the world of mental states and processes.

Thus, friendship, affection, inclination and so on[10] may be World 2 products, while literature as well as knowledge creation are World 3 products and are thus excluded from the production boundary as defined in SNA 1993 or SNA 2008 as well as SNA 1968. This criterion will be called "World 1 criterion," which may be formulated as follows:

[6]This property was called "reproducibility" by him.

[7]This kind of uniqueness is characteristic of any World 3 object. See Popper and Bartley (1982, p. 115).

[8]See paragraph 7.52 and table 6.3 in United Nations (1968). The relevant part of the paragraph is given here: "Inventions, creating goodwill, authoring a book and the like, are not included in gross fixed capital formation, or even gross output, in the national accounts." In the next section, a tabular presentation of the treatment of selected art items and Popper's related view will be given.

[9]Producers like museums have to conduct conservation and restoration activities for their collection. This fact shows sculptures and paintings are definitely fixed capital.

[10]Notice that friendship and affection should be regarded as examples of personal relationship, which may be considered to be related with "personalness" of activities.

> *World 1 criterion*: A human-controlled activity is called economic production only when it is a physical process, so that it brings about some changes in World 1 or it is an addition to World 1 and can be described by using World 1 terms only.[11]

Two comments may be necessary. The first comment is about preparatory activities, that is, activities that are necessary preparation for some other activities. For example, commuting is a typical preparatory activity to prepare for regular paid work in the office or factory. To determine whether a preparatory activity is productive or not, it should be combined with the activity or activities for the preparation of which it is undertaken. Certain kinds of voluntary work require the volunteer workers to undertake some preparatory training. It may be noted that preparatory processes as described do not necessarily have perceptible consequences in World 1. For example, a certain research and development process may be needed for a car producing company to meet, say, some environmental regulation in force.

The second comment is that this criterion is too large because consumption as well as production is a physical process anyway. In fact, the roles of the delegability (or third party) criterion include distinguishing between consumption and production.

For this point, it may be claimed that the delegability criterion fails to capture certain possible phases of division of labor within the economy. Thus, studying or learning something is considered to be an activity that cannot be delegated to another person, so they are considered to be consumption rather than production under this criterion. However, there may be very many kinds of work done by employees similar in character to studying or learning, including R&D, so that this criterion may lead to placing activities which are regarded as work by the people who do them outside the production boundary of the system. Also, it may be considered to be contradictory to what is written in paragraph 7.29 in SNA 2008. In fact, according to this paragraph, in order to be classified as employed, the person must be engaged in an activity that falls within the production boundary of the SNA.

It may be proposed that the delegability (or third party) criterion should be replaced with another new criterion, tentatively called the "role-exchangeability" criterion, that may be formulated as follows:

> *Role-exchangeability criterion*: An activity is considered to be economic production only when someone's role of undertaking the activity can be exchanged with someone else's role of undertaking another activity in order for some common purpose of the community to be accomplished.

While consumption activities are neither able to be delegated nor role-exchangeable, receiving education cannot be delegated, but it may be role-exchangeable.

Problems encountered in applying the delegability criterion were described above. Thus, it may be questioned whether the possibility of division of labor is exhausted or not by this criterion. The author's view is that this criterion too

[11]A more detailed introduction of Popper's three worlds will be found in the next section.

focuses on the division of labor through exchange of products (goods or services). Indeed, this focus is valid when one lives in market economies; but if one lives in a pre-market economy, a more direct style of division of labor may be sought.

Taking an example of receiving education, person A may be specialized in a particular area and enrich his/her knowledge in this particular area; and person B may do the same in another particular area. But it is also possible to assume that person A (B) is specialized in the area in which the person B (A) is specialised under the original assumption. Note that there must be some communal goals; at least the group of the two must have some common purpose.

In a sense, role-exchangeability is the possibility of division of labor captured in the widest sense. They exchange time uses.

2. Popper's Three Worlds

The three worlds can be defined easily. As very briefly described earlier, according to Popper,[12] World 1 is the world of physical states and processes including inorganic matter, and the structure and actions of all living beings, plants, and animals and even human brains. It also comprises machines, tools, works of art, films, and computers and other artifacts. Here, "works of art" are to be interpreted to refer to their material bases. It also includes all artifacts that man made for coding information, such as the paper and ink of books. The materialists think that World 1 is the total world and they recognize nothing else.

World 2 is the world of mental states and processes, or states of consciousness.[13] John C. Eccles, an Australian brain scientist and 1963 Nobel Prize laureate who closely collaborated with Sir Karl (Eccles, 1970) distinguished three levels within World 2: outer sense, inner sense, and the self or ego. The first level is the ordinary perceptions provided by all our sense organs. They include vision with light and color, sound with music and harmony, touch with all its qualities and so on. It should be noted that these qualities (*qualia*) do not exist in World 1.[14] On the other hand, emotions, feelings of joy and sadness, fear and anger, memories, imaginings, and intentions are in the inner sensory world. Finally, the ego is at the core of World 2.

World 3 is the world of the products of human minds, more specifically problems, theories, and discussions, as well as architecture, art, literature, and music. In other words, it is the whole world of culture. Ethical values and social institutions (and thus, societies) are also in World 3.

Figure 1 shows a summary presentation of the three worlds by Sir John. This figure first appeared in Eccles (1970) and later in Eccles (1973) and Popper and Eccles (1977), in which it was called "Tabular representation of the three worlds that comprise all existence and all experiences as defined by Popper (1972)." Arrows between the boxes show the interaction between the worlds. It should be noticed that there is no direct interaction between World 1 and World 3.

[12]See Popper (1972), Popper and Bartley (1982), Popper and Notturno (1994), and Popper and Eccles (1977), as well as Eccles (1970, 1973), among others.

[13]For the present purpose, we need not mention some subtle points such as problems of the minds of animals as well as subconscious and unconscious experiences.

[14]Ibid.

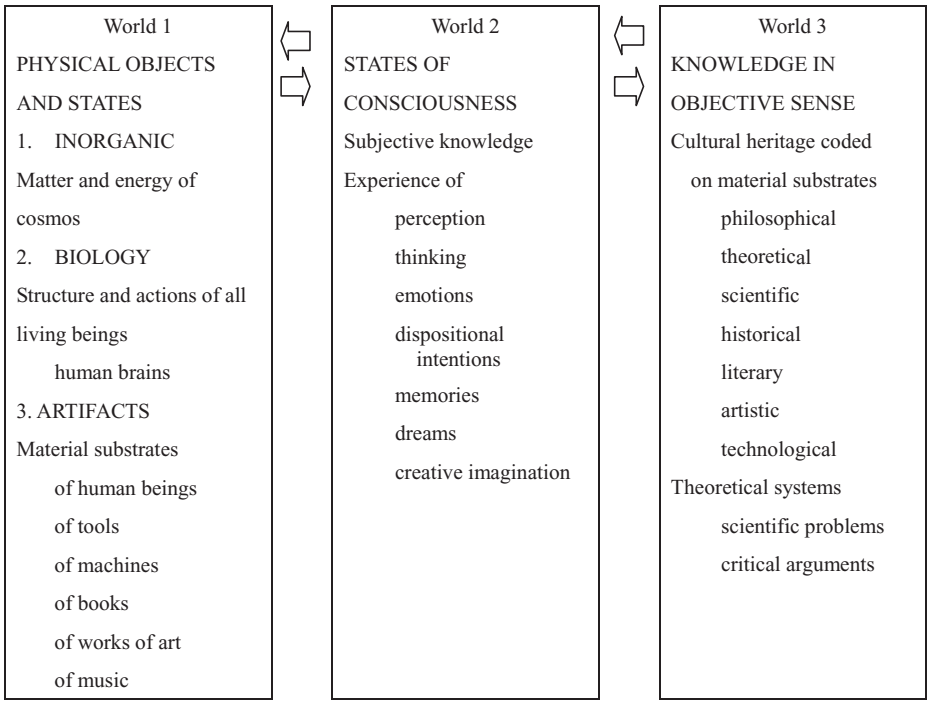

Figure 1. Popper's Three Worlds

From the viewpoint of national accounting, it may be very interesting to know what Popper wrote[15] about artistic and literary works as summarized in Table 1.

> By 'world 3' I mean, roughly, the world of the products of our human minds. These products are sometimes physical things such as the sculptures, paintings, drawings, and buildings of Michelangelo. These are physical things, but they are a very peculiar kind of physical things: in my terminology they belong to both the worlds 1 and 3. Some or other products of our minds are not precisely physical things.
>
> Take a play by Shakespeare. You may say that the written or printed book is a physical thing like, say a drawing. But the performed play is clearly not a physical thing, though perhaps it may be said to be a highly complex sequences of physical events. But now please remember that no single performance of *Hamlet* can be said to be identical with Shakespeare's *Hamlet* itself. Nor is Shakespeare's play the class or set of all of its performances. The play may be said to be represented or reproduced by these performances, in a way similar to that in which a building or a sculpture may be said to be represented by one or several photographs, or in which a painting or a drawing may be said to be reproduced by prints of varying quality. But the original painting

[15]Popper and Notturno (1994, pp. 5–6).

TABLE 1
THE TREATMENT OF SELECTED ART ITEMS IN THE SNA AND POPPER'S VIEW

Items	SNA 1968	SNA 1993	Residence in Popper's Three Worlds
Sculpture	Fixed Capital Formation if purchased by producers	Valuables	World 1 and World 3
Paintings	Fixed Capital Formation if purchased by producers	Valuables	World 1 and World 3
Literary works	Outside of production boundary	Originals should be treated as Intangible Fixed Capital Formation	World 3
Music composing	Outside of production boundary	Originals should be treated as Intangible Fixed Capital Formation	World 3
Music performances	Services; intermediate or final consumption	Master tapes, etc. should be treated as Intangible Fixed Capital Formation	World 1 and World 3

> itself is different from its reproduction. And in a somewhat similar way, Shakespeare's *Hamlet* clearly is not. Although its reproductions may be said to belong both to the world 1 of physical things and to the world 3 of products of human mind, the play, *Hamlet* itself, belongs only to the third world. It is similar with a symphony.

There is a striking correspondence between the treatment of these art items in SNA 1968 (not in SNA 1993) and Popper's philosophical consideration of them.

It may be mentioned that in SNA 1968, sculptures and paintings when purchased by producers (except owner-occupiers) as well as Michelangelo's buildings are fixed capital formation, while in SNA 1993, sculptures and paintings have come to be classified as valuables, the new, third category of capital formation. On the other hand, authoring a book (like *Hamlet*) and composing a piece of music (Symphony in G Minor) are outside the production boundary of SNA 1968, while in SNA 1993 they have come to be regarded as entertainment, literary, or artistic originals—one out of the four categories of "intangible fixed assets" in SNA 1993.

The relation between Shakespeare's *Hamlet* and its performances or that between Mozart's symphony and its performances is somewhat like the relation between a building's plan and the building itself or that between the signifiers and the signified in the theory of semiotics. Of course, there may be a variety of performances of *Hamlet* or Mozart's symphony. In the case of sculptures and paintings, clearly the physical objects belong to World 1. Sculptors and painters had their own plans for the works. But, it is the physical objects themselves that should be deemed to be "authentic" in these cases. It is worth noting that it is a common fact that plans or designs exist for any human products. These plans belong to World 3, so in that sense, any physical product belongs to both World 1 and World 3. Even in the case of works of art which Popper assigns to World 3 only, the signifiers, or more correctly, the media carrying them, are found in the world of physical objects.

It may be worth noting that Popper's World 3 is similar to but not the same as Platonic *ideas* but something that is man-made. Thus, for example, the number

system is a human invention. However, once created, it can cause and has caused various developments which include theories on prime numbers, Mersenne numbers,[16] as well as perfect numbers.[17] Thus, the key characteristic of World 3 is its *autonomy*.[18] In addition, knowledge grows through error elimination by way of systematic rational criticism.[19] The following is Popper's famous schema:

$$P_1 \rightarrow TT \rightarrow EE \rightarrow P_2.$$

Here, P_1 means the problem from which we start. To solve the problem, a tentative theory TT is offered, which may be (partly or wholly) mistaken. EE means a process of error elimination, by way of critical discussion or experimental tests. At any rate, new problems P_2 almost autonomously emerge from the discussions and tests.

Thus, scientific theories are just hypotheses that may be wrong. In what sense, then, can a scientific discovery or a mathematical theorem be ascribed to a particular person or economic unit?

3. Some Implications of New Criteria

Some implications of these new criteria, that is, the "World 1 criterion" as well as the "role-exchangeability criterion" will be discussed in this section. Three topics will be touched upon: computer software and R&D; education; and management and control of corporations.

Computer Software and R&D

Because unlike a human being, a machine *never* belongs in World 2, computer software cannot be intangible because it works inside the machine. It must be treated as a tangible fixed asset in an ordinary sense or intermediate consumption, depending on circumstances.

The genuine problem may be how to treat preparatory expenditures for computer software. They are similar to other R&D type expenditures. Technology and knowledge belongs to World 3, part of the environment within which all human activities are conducted. In a sense, these expenditures are like those incurred for land improvements and land formation. As a *convention* in SNA 1993, they are treated as capital formation only in the accounting period during which they are conducted; in later periods they will come to be treated as part of land. Another convention that may be needed here. Sometimes, they are also like work-in-progress. If preparatory expenditures for developing computer software are not general in character but ad-hoc just for the particular software, the

[16]A Mersenne number is a number of the form $2^p - 1$, where p is a prime number. Such a number which is itself prime is also called a Mersenne prime.

[17]A perfect number is a positive integer that is the sum of its proper positive divisors, that is, the sum of the positive divisors excluding the number itself. The first perfect number is 6 (= 1 + 2 + 3) and the next perfect number is 28 (= 1 + 2 + 4 + 7 + 14).

[18]See Popper and Notturno (1994, pp. 24–46).

[19]See Popper and Notturno (1994, pp. 10–11).

problem is just that of matching costs and revenues. Again, a convention may be required for the treatment of the problem.

In the treatment of intellectual property products in SNA 2008, there is also serious confusion between rights and products. Rights exist in World 3 only. For example, patent rights are rights granted by the authority for some particular policy purposes; they are not documents certifying any exclusive right concerning some entity in World 3. World 3 may be better treated as part of our environment within which our whole economic life is lived.

Education

Just as Hill (1977, p. 322) wrote that doctors' services are not providing cures, teachers' services are not providing mental changes in pupils' World 2. At least, it should be stressed that pupils' or students' own endeavor is needed to cause changes in their World 2, which should not be ignored when education services are described and analyzed. Whether education can bring about mental changes depends on many factors. Endeavour on the part of pupils and students is just one of these many factors. To assume they are immediately brought about by their education is just a common confusion between outputs of the activities and outcomes brought about as their possible or plausible consequences.

Because the production boundary excludes the products of World 2, education services which are purported to bring about mental changes must be described otherwise if they are to be described as productive. Thus, in the author's view, education services might be better described as providing the environment within which pupils and students learn or study something. Teaching itself is rather like music performances or theatrical performances. Instruction in general may be regarded as performance-type services (activities) in which teachers try to inform the pupils and students of something.

Some words should be added here about so-called human capital or human capital formation. Human capital formation must be something that should be regarded as own-account production processes in which education services, above all, are used as intermediate consumption. Although the third party (or delegability) criterion cannot place these self-fulfillment type activities within the production boundary, the newly formulated role-exchangeability criterion can do so. However, in what sense can it be described as capital? It may be a challenge to be met in order to formulate the concept properly.

Management

In paragraph 4.79 of SNA 2008, it is clearly stated that management or control of corporations has two levels: the first level is related to determining general corporate policy, and the second level concerns the direct control of the day-to-day activities or operations of a particular corporation.

This consideration leads to the distinction between two kinds of holding companies in the SNA; head offices and genuine holding companies. However, it is not explicitly mentioned in the text that it is related to the problem of the production boundary.

Thus, whether control or management itself is economic production or not is one of the age-old problems of economics. Reid (1934, p. 13), as early as in the 1930s, gave an answer to this question in the context of household production as follows: "Management is important for satisfactory group life. But can it be delegated? There is evidence that much of it can. Production commences with certain aims and purposes stated. The formation and expression of the basic standards of the members of the group, in regard to the kind of household life and goods to be produced, are not producer but consumer activities since these cannot be delegated. The presence in many homes of a paid housekeeper who assumes much responsibility for management is evidence, however, of the impersonal character of much of the management."

In the context of management and control of corporations, what she regarded as productive may be considered to correspond to activities of head offices (ISIC, Division 70). But there must be decisions concerning the general corporate policy. According to what she considered, these very basic decisions cannot be delegated. In the case of incorporated enterprises, such basic decision making is done collectively by the shareholders.

However, when a financial intermediary holds some equity in another company, its employee who attends the general meeting of stockholders may be able to exercise some control over the latter company's basic decisions. Noting that the financial intermediary is controlled by its own shareholders, the employee is just doing his job on behalf of his employer which is delegable or role-exchangeable. This consideration is totally consistent with the treatment of holding companies on the one hand and that of head offices on the other in SNA 2008.

4. Main Conclusions and Closing Remarks

In this paper, the author reconsidered the production boundary of the SNA and concluded:

(1) The SNA contains an implicit criterion tentatively called "World 1 criterion" which means that an activity is productive only when it is a physical process.
(2) In order to formulate the general production boundary for the system, it is argued that the delegability criterion (Reid, 1934; Hawrylyshyn, 1977; Hill, 1977, 1979) should be replaced with a new criterion (role-exchangeability criterion), and activities of a preparatory nature should be taken into account more appropriately.
(3) Education as a productive activity should be described using World 1 terms only so as to avoid possible confusion between outputs and outcomes.
(4) There are two levels of management and control of corporations, with one being outside the production boundary and the other within it.
(5) Computer software that can be incorporated into computers and similar machines should be treated as physical (tangible) objects.

Finally, two remarks may be added. First, it may be a key step to define intangible assets. The strong impression is that the tangible–intangible distinction

is rather made light of in SNA 1993 (or 2008), bringing serious confusion into the system.[20] It is claimed here that intangible assets should be defined as assets that only exist in World 3 (except for *signifiers*). Typical intangible assets may be financial assets. They are non-produced as well but the concept of non-produced intangible assets in the SNA 1993 is defined excluding financial assets.

The second remark is about preparatory expenditures (activities) mentioned above. In the author's view, some more thought will be needed in order to formulate a more appropriate national accounting treatment (or convention) for these expenditures. Clearly, many problems remain open. For example, preparatory expenditures may be incurred by different types of institutional units (corporations, government units, or non-profit research institutes). It may be questioned whether these similar expenditures should all be treated in the same way.

References

Eccles, John C., *Facing Reality: Philosophical Adventures by a Brain Scientist*, Springer-Verlag, Berlin, 1970.

———, *The Understanding of the Brain*, McGraw-Hill, New York, 1973.

Hawrylyshyn, Oli, "Towards a Definition of Non-Market Activities," *Review of Income and Wealth*, 23(1), 79–96, 1977.

Hill, T. P., "On Goods and Services," *Review of Income and Wealth*, 23(4), 315–38, 1977.

———, "Do-It-Yourself and GDP," *Review of Income and Wealth*, 25(1), 31–9, 1979.

———, "Tangibles, Intangibles and Services: A New Taxonomy for the Classification of Output," *Canadian Journal of Economics*, 32(2), 426–46, 1999.

Himmelweit, Susan, "The Discovery of 'Unpaid Work': The Social Consequences of Expansion of Work," *Feminist Economics*, 1(2), 1–19, 1995.

Popper, Karl R., *Objective Knowledge: An Evolutionary Approach*, Clarendon Press, Oxford, 1972.

Popper, Karl R. and W. W. Bartley, III (eds), *The Open Universe: An Argument for Indeterminism* (From the Postscript to the Logic of Scientific Discovery), Rowman and Littlefield, Totowa, 1982.

Popper, Karl R. and John C. Eccles, *The Self and Its Brain*, Springer International, Berlin, 1977.

Popper, Karl R. and M. A. Notturno (eds), *Knowledge and the Body-Mind Problem: In Defence of Interaction*, Routledge, London, 1994.

Pyatt, Graham, "Accounting for Time Use," *Review of Income and Wealth*, 36(1), 33–52, 1990.

Reid, Margaret, *Economics of Household Production*, John Wiley, New York, 1934.

Sakuma, Itsuo, "National Accounting and the 1993 SNA," *Annual Bulletin of Social Science*, No. 3 (in Japanese), 1996.

United Nations, *A System of National Accounts*, ST/STAT/SER.F/2/Rev.3, Sales No. E. 69. XVII. 3, 1968.

United Nations *et al*., *System of National Accounts 1993*, United Nations document symbol ST/ESA/STAT/SER.F/2/Rev.4, Sales No. E.94. XVII. 4, 1993.

[20]Hill (1999) shared the same view with the author when he wrote that intangibles need to be recognized in their own right (p. 428). Intangibles as defined by Hill belong in Popper's World 3.