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Research article

SNA Under the framework of global public goods

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Abstract: ISWGN (Inter-Secretariat Working Group on National Accounts) is revising 2008 SNA and is expected to publish the latest version of SNA in 2025. In this context, this paper observes SNA (System of National Accounts) from a new perspective of global public goods and further understands the public goods attributes of national accounts. The global public good is developed from the theory of public goods. According to its definition, classification, and supply rule, SNA is considered a global public good in essence. In terms of characteristics, SNA belongs to means-oriented and best shot supply-oriented global public goods. It has network effect and belongs to network global public goods. And it is also global institutional knowledge, belonging to knowledge-based global public goods. Although SNA serves as a global standard of national accounts, it is not mandatory for consumption. As a global public good, SNA can enhance a country's statistical ability, avoid and reduce the cost of developing the system of national accounts, and reduce transaction costs. At the same time, SNA has the problem of underprovision and underuse, which requires global cooperation in the revision process of SNA. The evolution of SNA demand determines the evolution of SNA supply. Therefore, even if SNA is a global public good, it does not mean that countries should copy SNA, but need to "localize" SNA and transform it from a global public good to a national or regional public good.

Keywords: SNA; public goods; global public goods; national accounts

JEL Codes: E01, F02

1. Introduction

With the increasing demand for macroeconomic data by the government and the deepening of economic globalization, the comparison of macroeconomic indicators of various economies is increasing. There is an increasing need for a general national accounting system and international statistical standards. In 1947, under the leadership of Richard Stone, the Sub-Committee on National Income Statistics of the League of Nations Committee of Statistical Experts published the *Measurement of National Income and the Construction of Social Accounts*. In the same year, at its first session, the United Nations Statistical Commission (UNSC) emphasized the need for international statistical standards to compile and update comparable statistics in support of a large array of policy needs. On this basis, the United Nations published the first version of the System of National Accounts in 1953 or 1953 SNA. The SNA describes a coherent, consistent and integrated set of macroeconomic accounts in the context of a set of internationally agreed concepts, definitions, classifications and accounting rules. This was followed by two revisions of 1953 SNA: the second edition in 1960 and the third edition in 1964. Four years later, 1968 SNA was published as a significant revision of the 1953 SNA. From 1953 SNA to 1968 SNA, the content and methods of SNA have been greatly expanded and improved. However, 1968 SNA focuses on the delicacy of the system and pays insufficient attention to the feasibility of its application (Qiu, 1997). After ten years of effort, the United Nations and other international organizations published the revised SNA or 1993 SNA. From 1968 SNA to 1993 SNA, the content of basic accounting did not expand significantly, but mainly updated, clarified, simplified and coordinated the principles of national accounts (Gao, 2013). During the 15 years following the publication of the 1993 SNA, a series of significant changes took place in the socio-economic environment, such as non-financial corporations directly carrying out many traditional financial services. Moreover, the research on national economic accounting methods has made meaningful progress. For example, the research on the measurement method of R&D expenditure has made great progress, no longer regarded as intermediate consumption but included in GDP. At its thirty-fourth Session in 2003, the United Nations Statistical Commission decided to revise 1993 SNA in a centralized manner and officially adopted 2008 SNA at its fortieth session in 2009. Compared with 1993 SNA, the basic accounting framework of 2008 SNA has not changed fundamentally. It mainly improves the accounting content and methods, optimizes the content arrangement, and shows the central framework and satellite account of SNA. With the continuous change of economic environment and new problems, the equilibrium state of 2008 SNA has been gradually broken. At its 51st session, the United Nations Statistical Commission requested the ISWGNA to develop a roadmap for the revision of the 2008 SNA and plans to launch the latest version of SNA in 2025. Seen from the historical development of SNA, SNA is designed for use by all countries and to meet the needs of countries at different stages of economic development. It is one of the building blocks of macroeconomic statistics forming a basis for economic analysis and policy formulation.

Based on the global public goods theory, this paper comprehensively analyzes the public goods attribute of SNA from their nature, classification and supply law. In essence, SNA is a global public good. Therefore, we should clarify the characteristics of SNA before we can study the role of SNA as a global public good and the supply and demand mechanism of SNA.

2. The level of public goods and global public goods

2.1. Look at the level of public goods from the scope of the benefit

The public goods we usually talk about and the theory of public goods in economic textbooks are generally from a country or a certain part of the country. Public goods can't only be inspected from a country or a certain part of a country but also be further extended beyond a country's borders. According to the range of benefits, public goods can be divided into four levels: local public goods, national public goods, regional public goods, and global public goods. Among them, regional public goods and global public goods are called international public goods. In general, the benefits of local public goods and national public goods are limited to the borders of one country, and the benefits of regional public goods and global public goods are beyond the borders of the country. The regional public goods can benefit many countries in a region. The benefit of global public goods is far more than other public goods, and it can benefit many countries in different parts of the world and even all countries in the world. Because of this, the supply and financing of global public goods will be more complex, and the "free rider" phenomenon will be more prominent. Global public goods are more prone to shortages. International cooperation is needed to provide global public goods.

Like other levels of public goods, global public goods are characterized by publicity, nonrivalry, non-exclusiveness, and zero marginal cost of production. Global public goods are also linked to other levels of public goods. On the one hand, with the acceleration of globalization and the increase of international exchanges, the benefits of some public goods have spilled over the borders of national boundaries or national groups. Therefore, some public goods originally belong to a country or some countries can be called global public goods and regional public goods. On the other hand, some public goods are provided initially at a global level. Moreover, a country must transform them into national public goods in order to benefit from them. The size of its benefits depends not only on the country's policy options but also on the size and preference of its capacity.

2.2. Definition of global public goods

The theory of global public goods develops from the theory of public goods. Before 1999, the concept of global public goods had not received much attention. The research about it was also scattered. American economist Charles P. Kindleberger (1986) thinks various international public goods have been identified: an open trading system, international money, capital flows, consistent macroeconomic policies in periods of tranquility, and a source of crisis management when needed. Stiglitz (1995) identifies five global public goods: international economic stability, international security (political stability), the international environment, international humanitarian assistance, and knowledge. Charles P. Kindleberger and Joseph E. Stiglitz define global public goods from the perspective of extension. The scope of global public goods is very specific, and other essential global public goods are not included.

In 1999, the United Nations Development Programme (UNDP) published *Global Public Goods: International cooperation in the 21st Century*, edited by Kaul et al. (1999). Since then, the theory of global public goods has attracted attention and has gradually become a research hotspot in the economic field (Sandler, 2001, 2006; Joyce, 2008). However, there is not a widely accepted definition of global public goods until now. Kaul (1999) define that global public goods are marked

by universality—that is, it benefits all countries, people, and generations. This definition defines global public goods from the benefit scope, the beneficiary, and the benefit time.

For the World Bank's purposes, global public goods are commodities, resources and services—and also systems of rules or policy regimes—with substantial cross-border externalities that are important for development and poverty reduction, and that can be produced in sufficient supply only through cooperation and collective action by developed and developing countries (World Bank, 2000). This definition of the World Bank emphasizes the property, extension, function and source of global public goods.

The International Task Force on Global Public Goods[1] (2006) has defined global public goods as issues that are broadly conceived as important to the international community, that for the most part cannot or will not be adequately addressed by individual countries acting alone and that are defined through a broad international consensus or a legitimate process of decision-making. This definition defines global public goods from the perspective of importance and supply.

In terms of the above definitions, we define global public goods as the goods, services, resources, environment, rules, and systems that have strong externalities, which can benefit many countries in different regions or all countries of the world and need global cooperation. In addition to covering several global public goods defined by Charles P. Kindleberger and Joseph E. Stiglitz, this definition also includes many other global public goods, such as global health, the global Internet, biodiversity, the high seas fisheries resources, basic research, standards, principles and so on.

It is necessary to explain that the goods of public goods are different from the goods defined in 2008 SNA. In 2008 SNA, "goods are physical, produced objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets." In the theory of public goods, the scope of goods is far beyond the scope of goods in 2008 SNA. It includes not only goods but also services, resources, environment, rules, and systems. In other words, it includes all the things that can bring benefits. It is clear that goods in the theory of public product are also beyond the concept of product in 2008 SNA.

2.3. The classifications of global public goods

There are many kinds of global public goods. According to the classification of existing literature, we can summarize from multiple perspectives and select some cases to distinguish categories more clearly, as shown in Table 1.

(a) According to the property of the global public goods, they can be divided into pure global public goods and impure global public goods (Sandler, 1999). Pure global public goods are nonrival and nonexcludable. Impure global public goods only meet one of the two properties. The global public goods with nonrivalry and non-excludability are club goods. The global public goods with nonrivalry and non-excludability are the common-pool resource.

[1]The International Task Force on Global Public Goods was created in 2003 by France and Sweden with a mandate to assess and prioritize global public goods and make recommendations to policy-makers and other stakeholders on how to improve and expand their provision. Co-Chair Ernesto Zedillo and members Kemal Dervis and Trevor Manuel presented the final report of the Task Force, *Meeting Global Challenges: International Cooperation in the National Interest*, during the Annual Meeting of the IMF and the World Bank Group on 18 September 2006.

(b) According to the nature of the global public goods, they can be divided into natural global commons, human-made commons, and policy outcomes (Kaul et al., 1999). Natural global commons are the natural existence. Human-made global commons and global conditions are generated by the existence and development of human beings. The main difference between human-made global commons and global conditions is that the former is a stock that requires the proper consumption of human beings to ensure their full utility; the latter is a flow, which requires adequate efforts to ensure its provision.

(c) According to the place of the global public goods in the production cycle, they can be divided into final global public goods and intermediate global public goods (Kaul et al., 2003). Final global public goods are outcomes rather than "goods" in the standard sense. They may be tangible (such as the environment or the common heritage of mankind) or intangible (such as peace or financial stability). Intermediate global public goods, such as international regimes, contribute to providing final global public goods.

(d) According to the different forms of expression, the global public goods can be divided into goal-oriented global public goods and means-oriented global public goods (Kaul et al., 1999). The former is the pursuit of human goals, and the latter is a means to achieve the goal.

(e) According to the different sectors, the global public goods can be divided into environment, health, knowledge, security, and governance (Oliver et al., 2002).

(f) According to the compulsion of consumption, the global public goods can be divided into mandatory consumer global public goods and non-mandatory consumer global public goods (Kaul et al., 2003).

As for the classification of global public goods, it is necessary to make two points. Firstly, it is different to classify global public goods in terms of production cycle and form, but the classification results correspond. The final global public goods correspond to the goal-oriented global public goods, and the intermediate global public goods correspond to the means-oriented global public goods. Secondly, there is a kind of network public goods among the global public goods. They form a global network that needs to maintain the integrity of the network to make full use of its effectiveness, such as international communications satellite, international transportation, international postal services, international internet, international weather information, and so on.

Table 1. The classification of global public goods.

Category basis	Category		Example
Property	Pure global public goods		Disease containment
			Fundamental research
			Protect ozone layer
	Impure global public goods	Club goods	International communications satellite
			International postal services
			International meteorological information
		Common pool resource	Public nuisance fisheries resources
			Tropical rain forests
Nature	Natural global commons		Ozone layer
			Climate stability
	Human-made commons		Global networks
			Knowledge
			International regimes and norms
	Global conditions		Peace
			Health
			Financial stability
			Open trade regimes
			Environmental sustainability
Production cycle	Final global public goods		Environment
			Common heritage of mankind
			International financial stability
	Intermediate global public goods		International order
Form	Goal-oriented global public goods		World peace
			Eliminate poverty
			Financial stability
			Prevention of global warming
	Means-oriented global public goods		Regime
			Policy
			International cooperation
			Data
			Knowledge
			Harmonization of standards
Sector	Environment		Reduce emissions
			Conserve biodiversity
	Health		Control the spread of infectious diseases
			Research on disease
	Knowledge		Access and use knowledge
			Internet services
	Security		Peace-keeping
			Fight international terrorism and transnational crime
	Governance		International financial stability
			Global trade regime
Consumption	Mandatory consumer global public goods		Climate stability
			Global security
			International financial stability
	Non-mandatory consumer global public goods		Internet services
			Knowledge
			International communications satellite

2.4. The forms of global public goods benefits

The benefits of global public goods can be summed up in three forms:

(a) Reducing risk. Many public goods arise by providing a benefit that is in the form of reducing or eliminating risk, where the risk is a disutility (or, in general, a public bad) (Oliver et al., 2002). For example, fighting international terrorism and transnational crime can enable everyone to have a peaceful living environment.

(b) Enhance capacity. Some global public goods can enhance the production capacity of products, improve stability and reduce uncertainty, such as knowledge and governance.

(c) Provide utility directly. A final set of benefits gives rise to public goods because they provide utility directly. Reducing environmental degradation of a common property resource, such as ocean or forest, improves the quality of the natural resource (Oliver et al., 2002).

Obviously, these three sources of benefit can be inter-linked and mutually reinforcing. For example, reducing global warming may provide benefits of all three forms.

2.5. The general rule of global public goods supply and demand

There are four supply strategies according to the different roles and contribution of actors in the supply of global public goods (Kaul et al., 1999, 2003), as shown in Table 2:

(a) Summation. The total supply of global public goods is equal to the sum of the supply of each actor. The contribution of each actor is equal so that they can be substituted by each other.

(b) Weighted sum. This kind of supply is somewhat similar to the way of summation supply but assigned a weight to each actor before summation, and the role of each actor is different. Each actor can't wholly substitute.

(c) Best shot. The supply quantity of dominant actors determines the total supply quantity of global public goods, while the non-dominant participants do not affect the supply of global public goods. For example, the research and development of disease treatment technology (such as AIDS) need to be provided by developed countries. It is difficult for backward countries to play a role.

(d) Weakest Link. The provision of the public good is limited by the effort of the weakest member. Many global regimes, from the prevention of marine pollution to prudential financial supervision, are only as strong as their weakest link (Kaul et al., 1999).

There are several difficulties in the supply of global public goods. First, the scope of global public goods is wide, and the demand for various categories of global public goods varies from country to country. Many conflicts of interest need to be coordinated. Second, even if consensus is reached on the provision of global public goods, it isn't easy to monitor the implementation of various countries. Third, the lack of a powerful supranational authority.

Due to a jurisdictional gap, a participation gap, and an incentive gap (Kaul et al., 1999), there are two problems in the supply and demand of global public goods. One is the undersupply. The other is the coexistence of overuse and underuse. The main challenge for these global public goods is under-provision, such as world peace, health, financial stability, free trade, environmental sustainability, equity, and justice. The main challenge of the ozone layer and the atmosphere is overuse. The main challenge of the Internet and knowledge is underuse. Because of this, the provision of global public goods requires global cooperation and collective action of various subjects (countries, corporations, and individuals). Global public goods provide an important rationalization for international collective action (Stiglitz, 1999).

Table 2. Four supply strategies of global public goods.

Supply strategies	Characteristics	Example
Summation	Total supply is equal to the sum of the supply of each actor, and the contribution of each actor is the same.	Reduce air pollution Curb global warming
Weighted sum	Total supply is obtained by the sum of the supply of each actor, and each actor has different contributions.	Reduce sulfur deposits Control diseases and pests
Best shot	Maximum effort determines the total supply of public goods.	AIDS treatment research Research and development of drugs to prevent and cure diseases and pests Plan the next green revolution
Weakest link	Minimal effort determines the total supply of public goods.	Maintain the integrity of the network Eradicate infectious diseases Reduce violent conflict

3. The features of SNA as global public goods

Firstly, SNA is analyzed from its attribute characteristics according to the definition of global public goods. As an international standard of the statistical system, SNA can be used by any country for free, and no country is excluded from the scope of benefits. At the same time, the use of SNA in one country does not affect the use of SNA in any other country, and its use cost does not increase. Because SNA is both non-exclusive and non-rival, SNA is a special pure public good. Secondly, in terms of the scope of benefits, each country can find and implement the valuable parts closely related to their reality from the SNA according to their own needs and statistical capacity, no matter the economic structure, institutional arrangement, or development level. At present, SNA is a global public good used by more than 200 countries and regions in the world. Therefore, we can make an essential judgment: SNA is a global public good. Its scope of use is usually worldwide. Furthermore, it is a non-physical product with no upper limit on the number of users and strong transnational externality. It can benefit all countries and requires global cooperation to provide products and systems.

To observe SNA from the perspective of global public goods, we should first understand the characteristics of SNA so that we can study the role of SNA as global public goods and the mechanism of SNA supply and demand. As global public goods, SNA has these features.

3.1. SNA belongs to means-oriented global public goods

As an international standard in national accounts, SNA is the basis of national accounts work in the world. However, in terms of the ultimate social demand, whether for the government, corporations, or the general public, the ultimate need is not SNA itself but macroeconomic statistics provided by national accounts. Macroeconomic statistical information is the product of statistical departments and also needs a production process. Of course, the process of production requires the support of various inputs and basic statistical structures. SNA provides guidance for national accounts almost universally (SNA, 1993), and it is the role of the infrastructure. That is to say, statistical departments of each country get all kinds of macroeconomic statistical information by

means of the specific national accounts system of each country based on SNA. Therefore, to obtain various macroeconomic statistics is the purpose, and SNA is the means to achieve this purpose.

3.2. SNA belongs to best shot supply-oriented global public goods

SNA is a universal system of knowledge, but the status and role of each country in the supply of SNA are different. As the level and knowledge stock of national accounts are different in various countries, a breakthrough in a certain field of national accounts is often achieved in the country with the highest level of national accounts. Moreover, other countries tend to learn after the fact, draw lessons from developed countries, and improve their level of national accounts. Countries with a low level of national accounts generally have little effect on the increase of knowledge stock of national accounts. In most cases, even some basic requirements in the SNA may not be met, let alone contribute to increasing the knowledge stock of the SNA. Here, the weakest link is a free rider with the best shot.

Since 1992, China's System of National Accounts (CSNA) has issued three versions (1992, 2002, 2016). CSNA-2002 has been fully integrated with the 1993 SNA, and CSNA-2016 has been revised according to 2008 SNA. However, the level of China's national accounts is still not balanced, generally between the 1953 edition and 1993 edition. Some items have reached the level of 2008 SNA, such as research and development (R&D) items. There is still a big gap between China and countries with a more developed level of national accounts. For example, the statistical frequency of GDP is insufficient, and the classification of items is not detailed enough. Input-output tables also have defects in department classification, tabulation price, survey object, scheme design, tabulation method, and so on. The balance sheet in China has always been an internal trial compilation, has not yet formed routine statistics. Overall, China is still in the introduction, learning, digestion, and absorption of SNA and belongs to "the weakest link" in national accounts, making little contribution to the further revision of SNA. And some countries with a long history and high level of national accounts continue to conduct research and experiments on some recent problems still unresolved in SNA. Some advanced methods are adopted in national accounts practice, which improves the quality of national accounts and provides examples for the revision of SNA.

3.3. SNA has network effect and belongs to network global public goods

We can think of e-mail users as a network in which everyone can send e-mails to each other. The more E-mail users there are, the more potential utility each user can derive from the network. Consumers join a network by purchasing a specific product, and utility depends on the number of people using the same product in the same network. This phenomenon is called the network effect. From the perspective of consumption, countries that use SNA can be regarded as users or consumers of SNA, and each country that uses SNA forms a network. Each country that uses SNA can get utility from SNA, and the size of utility depends on the number of countries that use SNA. With the increase of countries using SNA, the harmonization and consistency of national accounts among countries will become more significant and robust. Accordingly, the comparability will become stronger. Each country will get more and more utility from it. In fact, the network effect of SNA has formed a self-enhancement mechanism, attracting more countries that did not previously adopt SNA to adopt SNA and share its benefits.

The purpose of implementing SNA in the United Nations can also be explained from the perspective of the network effect. The international comparability of economic statistics is an essential aspect of official statistics. The history of SNA includes two main lines—the development of national accounts and the internationalization of statistical operations. The history of internationalization includes two crucial aspects of SNA—comparability of economic statistics and the development of international standards and norms (SNA, 1993). To achieve the requirement of comparability, as network public goods, SNA must be used by enough countries to give full play to the network effect of SNA in the international scope. The network effect of SNA provides a dynamic mechanism for the United Nations to implement SNA.

As SNA belongs to network global public goods, if one of the countries using SNA has a poor level of national accounts, it will affect the overall level of the global national accounts and is not conducive to the play of the SNA network effect. Therefore, although SNA belongs to the best shot supply public goods, the level of the global national accounts belongs to the weakest link supply. In order to improve the level of the global national accounts and promote the integration of the global national accounts, we should also pay attention to the weak links.

3.4. SNA belongs to knowledge-based global public goods and is the global institutional knowledge

Joseph E. Stiglitz, a Nobel laureate in economics, regards knowledge as global public goods (Stiglitz, 1995, 1999). SNA is the general summation of people's understanding of national accounts and the accumulation of knowledge and experience of national accounts. It belongs to knowledge-based global public goods. Institutional knowledge refers to the part of knowledge that people share about language, religion, beliefs, codes of conduct, ideology, history, law, and the principles of natural knowledge that involve interpersonal communication (Wang, 2000). It is clear that SNA is the global institutional knowledge that guides the interaction among governments, corporations and individuals, as well as the interaction between a government and an international organization.

Characteristics of knowledge-based global public goods make SNA have significant economies of scale. Producing the first product requires enormous sunk costs, and the cost of the second product is negligible. It's like compiling an Encyclopedia of Great Britain, which initial cost includes more than 100 years of research, massive information collection costs, and the author's life. And the cost of copying it on a set of CDs is less than $5. The production of SNA is the same as the Encyclopedia of Great Britain, and its initial cost is also huge. For example, at its 33rd session in 2003, the United Nations Statistical Commission decided to update the 1993 SNA, and ISWGNA which consists of five organizations, completed the revision work and successfully published the 2008 SNA. Currently, the 2008 SNA is being revised, and the latest version is planned to be released in 2025. Since the revised budget of 2008 SNA has not been given, the revised budget of SNA1993 is presented in Table3. According to ISWGNA's estimate, the budge of revising 1993 SNA was US$2.1 million in 2004–2008 years. A new SNA can be produced with an initial cost of over US$2 million. Once SNA is produced, the cost of replication and propagation of SNA is minimal, showing strong economies of scale. In economic terms, SNA production has a high initial sunk cost, and marginal cost is almost negligible.

Table 3. Budget for Activities to be Financed by Joint Funds in U.S. Dollars.

Budget items	2004	2005	2006	2007	2008	Total
AEG meetings (expenses of developing country members)	75000	120000	62500	65000	-	322500
Remuneration of Project staff	7500	309081	338668	347348	50000	1052597
Travel for Project staff	11000	65000	45000	47000	10000	178000
Consultancies	-	40000	40000	140000	100000	160000
Contingencies	-	-	-	-	100000	100000
Consultations in developing countries	-	200000	200000	200000	-	300000
Total	93500	614081	566168	629348	210000	2113097

Source: "Update of the 1993 SNA Progress Report by the Project Manager to ISWGNA", https://unstats.un.org/unsd/statcom/doc05/SNA-ProjectManager.pdf, February 28, 2005.

3.5. As global public goods, SNA is not mandatory for consumption

SNA is not a legal text but a national accounting standard recommended by the United Nations. As global public goods, SNA does not require every country to adopt SNA. Each country can make a choice according to its situation. Even if a country has adopted SNA, it does not have to follow the recommendations and practices of SNA entirely. Countries can modify or selectively adopt SNA according to their actual conditions. The 2008 SNA also recognizes the need for flexibility. For example, the National Income and Product Accounts (NIPA's) used by the United States is consistent with SNA in function, nature, basic method, and basic concept. However, there are some differences in concrete content structure, classification, and concept definition. In this regard, SNA differs from some other international statistical standards, such as General Data Dissemination System (GDDS) and Special Data Dissemination Standards (SDDS) of the International Monetary Fund (IMF). If a country wants to join GDDS or SDDS, it must meet certain conditions and make the necessary commitments. Although GDDS and SDDS are not mandatory for consumption, countries must release data in accordance with IMF requirements after joining. SNA is also different from the micro field of accounting standards. Accounting standards belong to another special class. Each corporation and sector must be forced to consume it.

4. The role of SNA as global public goods

The SNA provides guidance for national accounts almost universally. The United Nations Statistical Commission recommended to the United Nations Economic and Social Council that the 2008 SNA be adopted as the new international standard for compiling national accounts statistics at its thirty-ninth session. As a global public good, SNA has the following roles.

4.1. As means-oriented global public goods, SNA can enhance a country's statistical capacity and improve the completeness of the information

The emergence and development of national accounts come from the need for the government's macro-management. As means-oriented global public goods, the ultimate goal of SNA is to provide accurate and reliable macroeconomic statistics. Within the framework of SNA, economic data can be programmed and expressed in accordance with the requirements of economic analysis and policy formulation. Just as satellites in space can detect the weather on Earth's continents, the SNA presents

in a condensed way a great mass of detailed information, organized according to economic principles and perceptions, about the working of an economy (SNA, 2008). With the guidance of SNA, countries can design their own national accounts system on this basis and enhance their statistical capacity. Through macroeconomic statistics provided by SNA, people can timely grasp the overall picture and internal structure of economic operation, reducing the incompleteness of information. Most macroeconomic statistics used by economists and economic analysts also come from SNA, and their research work is based on SNA. With accurate and reliable statistical information, the government can formulate various macroeconomic policies and carry out the economic macro-control, thus significantly reducing the uncertainty of economic operation.

4.2. To avoid and reduce the cost of developing the system of national accounts in various countries

Development and revision of SNA are massive projects that require a lot of human resources, material, and financial resources. Once SNA is produced, the marginal cost of reproducing SNA is meager. Each country will pay a high cost if it develops its system of national accounts. In other words, the nature of high initial cost and low marginal cost induce each country to stop dispersing the development of the system of national accounts. If SNA is developed and revised by international organizations, plenty of initial costs can be saved. Countries can design their own system of national accounts directly based on SNA produced by international organizations and apply it to their own national accounts practice. Undoubtedly, this will greatly benefit the cost savings. ISWGNA was also aware that the statistical capacity of certain countries was insufficient to support the implementation of international statistical standards. So there will be complementary measures to support these countries. Moreover, SNA2008 stresses that even though Some countries may be able, at least initially, to calculate only a small number of accounts and tables for the total economy, a reduced set of accounts or tables does not constitute an alternative system.

4.3. SNA as global public goods can reduce transaction costs

As global public goods, SNA provides a unified national accounting standard for all countries in the world and reduces the transaction costs of economic operation[2]. As the framework and standard of a statistical system in developing and developed countries, SNA has been recognized more and more. All countries in the world use the same national accounts framework and international standards, which will undoubtedly enhance the comparability of national statistical data, which is also one of the critical purposes of the United Nations to promote SNA. In this regard, we can also analyze the two characteristics of SNA as a global public good.

(a) SNA belongs to network global public goods. Countries that implement SNA, just like joining the same network, can share network benefits. For example, most computer users use the Windows Operating system, while UNIX and Macintosh are rarely used. The reason is that most computers use Windows. If a person has mastered Windows, he/she can use any computer with Windows System without obstacles, reducing conversion and learning costs. For the same reason, the word processing software used by most people is Word instead of WPS. Language and money also

[2]According to the transaction cost concept used by Arrow (1970), the transaction cost of economic operation refers to the operation cost of the economic system, including information cost, exclusivity cost, and the cost of designing and implementing public policy.

have a network effect. We can make another analogy. If all countries in the world use the same language and currency, it will significantly facilitate exchanges between countries, greatly reducing transaction costs. SNA, as the standard "language" in the field of global national accounts, also plays this role. Each country's national accounts and macroeconomic indicators use the same method and caliber of compilation and have the same meaning in each country. They can be directly compared without adjustment, which dramatically reduces the cost of information.

The system of national accounts has undergone a long-term development process. At first, MPS (System of Material Product Balance) and SNA coexist, and then SNA becomes the only system of national accounts. During the coexistence of MPS and SNA, MPS was adopted in the former Comecon (The Council for Mutual Economic Assistance) countries and China. SNA is not yet global public goods. MPS and SNA form two interconnected network systems. With the disintegration of the Soviet Union and the transition of Eastern European countries, MPS eventually withdrew from the historical stage, and the countries that used MPS began to transition to SNA. SNA eventually gained the status of global public goods. The two separated networks are unified, allowing countries and international organizations to share the benefits of the network. It is as Arrow quotes Lardner's views: "many observations can be transmitted as two numbers, a statistic and an indicator of its reliability. Thus, the costs of transmission are much lower than those of acquisition, and it is possible that joining the observers into a signal organization can represent a net economy" (Arrow, 1984). SNA plays the role of combining different observations into a signal organization.

(b) SNA belongs to knowledge-based global public goods, which is conducive to saving communication costs. SNA is the institutional knowledge accumulated by the whole world. The accumulation of institutional knowledge among the population is the fundamental reason for the continuous decrease of coordination costs (Wang, 2000). SNA also has shared knowledge worldwide, and shared knowledge helps reduce communication costs (Wang, 2000).

5. Supply and demand of SNA as a global public good

5.1. Supply and demand mechanism of SNA as a global public good

Research on methodology of foreign national economic statistics is mainly "exogenous" (Qiu, 2003). SNA's research and supply are also very exogenous. The mechanism can be represented in Figure1. In fact, the demand for SNA is induced demand, and the supply of SNA is triggered by demand. First, the demand for SNA comes from the problems raised by real economic life. The Great Depression in the 1930s told us that the market was not omnipotent, and the government needed to participate in economic management. The government needed to have comprehensive economic information as the basis of decision-making for macroeconomic management. The systematic collection of macroeconomic information required the establishment and improvement of the system of national accounts. Governments need accounting data, but corporations, institutions, and other sectors of the national economy also need macroeconomic data for research and analysis. Secondly, the practical needs have induced scholars to carry out relevant research. In the early stage of SNA, it was not systematic, and the accounting information was not comprehensive, which mainly depended on the voluntary contribution of economists from developed countries. Later, the Great Depression, the mobilization of the war and post-war reconstruction, and other significant events directly promoted the breakthrough development of the national economic accounting. The strengthening of macroeconomic

management requires the government to engage in the national economic accounting work systematically. Third, international organizations coordinate the promulgation of SNA. With the deepening of international economic and political exchanges, the international comparability of macroeconomic data is increasingly required, which requires international organizations to formulate a unified accounting system to meet the needs of a higher level. Finally, the supply of SNA is realized.

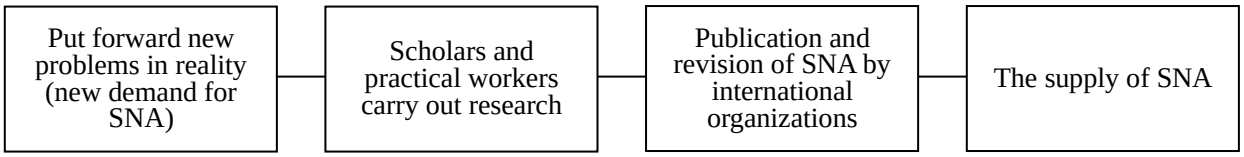

Figure 1. The supply and demand mechanism of SNA.

Similarly, for the SNA revision process, the supply and demand mechanism is the same. As the economic environment of many countries has undergone significant changes, new requirements and changes need to be put forward for SNA. Scholars and government sectors will research relevant issues, and ISWGN is responsible for promoting the research progress of these issues and integrating them into SNA. It seems that significant revisions to SNA occur every 15–20 years, but identifying the required updates to the SNA is a continuous process. Moreover, each change was based on the original accounting system and methods. International organizations did not intend to carry out fundamental or comprehensive changes because it would bring difficulties to those countries that implemented national accounts based on earlier versions.

5.2. As a global public good, SNA is coexistence of underprovision and underuse

Underprovision and underuse of SNA appear to be contradictory, but they coexist.

(a) There is underprovision of SNA. Most public goods tend to underprovision, which is also suitable for SNA. The main reason for the underprovision of SNA is that SNA is a knowledge-based global public good. The supply of SNA mainly depends on the progress of research on national economic accounting and the accumulation of knowledge. Of course, it also depends on the public decision-making process of international organizations such as the United Nations because the revision of SNA is a costly process. We can make an analogy. In the field of private goods, there is a "surplus" state, and the system of national accounts is generally in a "shortage" state. The underprovision of SNA mainly manifests in three aspects.

First, SNA did not pay enough attention to some critical issues, such as treatment of product quality change, non-observed economy accounting and measuring regional accounting, quarterly accounting, etc. These issues were briefly introduced in 2008 SNA and lacked specific guidance.

Second, many old problems raised in the practice of national accounts have not been well solved for a long time, such as capital cost, consumer subsidy, output of financial institutions, statistics of service industry, treatment of intangible assets, matrix representation and so on. In the process of SNA revision, the same issues are often debated for a long time and become the so-called "challenges". Part of the reason for these phenomena is that we do not sort out the problems, do not clarify the key of the challenge, and the supply of in-depth research is insufficient (Qiu, 2015).

Third, with the continuous development of economic globalization and constant change of economic environment, many new problems have been raised in reality and need to be reflected or better solved in national accounts, such as non-market service output accounting, resource and environment valuation, knowledge economy measurement, global value chain, digital economy satellite account and so on.

These three aspects also constitute the main reason for revision of 2008 SNA by international organizations such as the United Nations. At present, there are 55 revised topics in seven areas listed by ISWGN, including framework for a satellite account on the digital economy, unpaid household activities, statistical units, informal economy, non-bank financial intermediation and so on. Therefore, the underprovision of national accounts also provides a driving mechanism for continuous development of SNA.

(b)There is underuse of SNA. SNA, as a global public good provided to all countries free of charge, does not lead to "tragedy of the commons" like some global public goods such as the atmosphere and the high seas. On the contrary, although SNA is free, it will be underused, mainly due to the regulation of learning ability and learning cost. Underuse of SNA is manifested in two aspects.

First, some of the 2008 SNA recommendations have not been implemented in some countries. Alternatively, some countries did not adopt the better practices recommended by SNA and still used relatively backward methods because of the weak accounting basis. For example, some essential contents of SNA have not been adopted in accounting practice in the transition countries that previously adopted MPS. At present, the concept of actual final consumption has not been introduced into China's GDP accounting, social accounting matrix (SAM) is rarely used, and industrial and agricultural value added is calculated at constant prices. Only a few developed countries, such as the United States, Canada, The United Kingdom, Australia, and New Zealand, adopt 1993 SNA recommended Chain Fisher's Ideal Index or Chain Laspeyres Indices to calculate GDP growth rate. Most countries still use the Fixed Base Laspeyres Indices to calculate the GDP growth rate. The underuse of SNA also reflects the imbalanced level of national accounts.

Second, the user range of SNA is still relatively narrow, and its popularity is still relatively low. Many people, especially some economists and economic workers, still do not understand SNA. The purpose of SNA is for economic analysis, decision-making, and policy formulation (SNA, 2008). However, SNA cannot only meet the demand of government departments for national accounts data. It is a multi-purpose system designed to meet the needs of different types of users: government, business, research institutes, universities, the press, and the general public (SNA, 1993). The public is the final owner of government statistics (Qiu, 2002), the final owner of SNA. Nevertheless, it seems that only government statistics departments, some university statistics departments, and some academic research institutions use SNA in China. In addition, many economists may not even know what SNA is. Some so-called economists can't even know the primary connotation of GDP, let alone use SNA. Here's another typical example. "GNP can tell us everything about America except why we are proud that we are Americans," Robert Kennedy said in a 1968 campaign speech at the University of Kansas[3]. At that time in the US, GNP (gross national product) was the core indicator of national economic statistics, rather than GDP (gross domestic product). The purpose of Kennedy's speech may have been to warn of the limitations of GNP, which cannot be used as an indicator of the overall well-being of Americans. There is no denying that Robert Kennedy is a good politician, but

[3]For a complete speech, see https://images2.americanprogress.org/campus/email/RobertFKennedyUniversityofKansas.pdf.

his speech shows that he does not understand the GNP indicators and lacks the common sense of economic statistics.

5.3. Although SNA belongs to best shot supply-oriented global public goods, it needs global cooperation in the revision process of SNA

SNA belongs to knowledge-based global public goods. The degree to which SNA can be perfected depends on the research progress of national accounts and the summary of practical experience of national accounts. Although the "best shot" mainly creates knowledge of national accounts, the stock of knowledge in national accounts mainly comes from the contribution of the "best shot", this does not mean that SNA revision only needs the participation of the "best shot". Because SNA is a global public good and an international statistical standard, it requires multi-party coordination and international cooperation to integrate the knowledge progress on national accounts into SNA.

First, we need coordination between the best shot and the weakest link. Considering the different abilities and needs of the best shot and the weakest link, we mustn't blindly "pursue high levels", nor "compromise on low levels". SNA was initially established based on the accounting system of developed countries, which more satisfied the economic analysis requirements of developed countries. The 1953 SNA and 1968 SNA were mainly written under the direction of Richard Stone and reflected the experience of developed countries. In the process of revising the 1968 SNA, the expert group meeting proposed that there should not be two sets of accounting systems applicable to different countries and that the concerns of developing countries should be reflected in the SNA. When MPS is not available, SNA wants to merge the MPS content to make it applicable to all types of countries. Later, after 14 expert group meetings and regional meetings, the 1993SNA was successfully published by incorporating the views of experts from all types of economies in the revision process (Gerald Berk et al., 2013).

Second, coordination among various international organizations is needed. International organizations are significant users of SNA. The revision of SNA also needs to consider their needs. Only the United Nations was responsible for the compilation and revision of 1953 SNA and 1969 SNA, while 1993 SNA was jointly revised by the United Nations, World Bank, International Monetary Fund, OECD, Commission of the European Communities. ISWGNA manages and coordinates the entire revision process of 2008 SNA. ISWGNA has also established The Advisory Expert Group on National Accounts (AEG) and several Task Forces. The members of AEG mainly come from senior experts of various countries on national accounts. The evolution of the SNA supply body embodies this requirement.

Third, SNA needs to be coordinated with other international statistical standards. 2008 SNA is an international statistical standard led by the United Nations. In addition, IMF has also taken the lead in formulating several international statistical standards and guidelines, such as Government Finance Statistics Manual (GFSM2001), Monetary and Financial Statistics Manual (MFSM), Balance of Payments, and International Investment Position Manual (BPM6), etc. SNA, BPM, GFSM and MFSM are all part of the international statistical standard system. The links to balance of payments and the international accounts as presented in BPM6, government finance statistics as in GFSM2001 or MFSM could all be seen as a form of satellite account (SNA, 2008).

Four, division of labor and cost-sharing in SNA revision also requires cooperation between countries and international organizations. All these internally require revision of SNA to require global cooperation.

5.4. SNA, as a global public good, is the result of global public choice and is evolutionary in supply and demand

Placing public goods back in the public domain and reintroducing a notion of policy choice raises the question of how well publicness in consumption is matched by publicness in decisionmaking and in the distribution of net benefits across various parts of the global public (Kaul et al., 2003). Kaul and Mendoza proposed an analytical tool, namely the triangle of publicness which makes it possible to examine how various public goods fare along these three dimensions. As a global public good, SNA is a global public contract on national accounts reached by all countries in the world. According to the definition of the triangle of publicness, SNA has threefold publicness, shown in Figure 2. The vertical axis represents SNA's publicness in consumption, the left axis represents SNA's publicness in decisionmaking, and the right axis represents SNA publicness in the distribution of benefits. The length of the axis denotes the magnitude of publicity.

First, SNA has publicness in consumption. Every country, organization, and individual possibly use SNA after learning and understanding. Second, SNA has publicness in the distribution of benefits. Every country, organization, and individual possibly benefit from SNA. Third, SNA has publicness in decisionmaking. All stakeholders of SNA should have a dialogue to reach a consensus on what aspects of SNA need to be revised and how to revise it. Only then, would SNA result from global public choice.

The ideal triangle of publicness is that the publicness in consumption, the distribution of benefits, and decisionmaking are all complete. But the ideal triangle of publicness of some public goods is different from the actual triangle. Based on the above analysis, we believe that the publicness of SNA is complete and symmetric in three dimensions. However, the publicness of many global public goods in three dimensions of many global public goods is incomplete and asymmetric. For example, International financial stability has complete publicness in consumption and the distribution of benefits, but the publicity in decisionmaking is incomplete. Another example is that the WTO-based international trade system is also a global public good. As "One member country has one vote" in voting, it has complete publicness in decisionmaking and consumption. However, due to the limited influence of developing countries in WTO, many rules in WTO are in favor of developed countries, so it does not have complete publicness in the distribution of benefits. In this regard, SNA is different from some other global public goods.

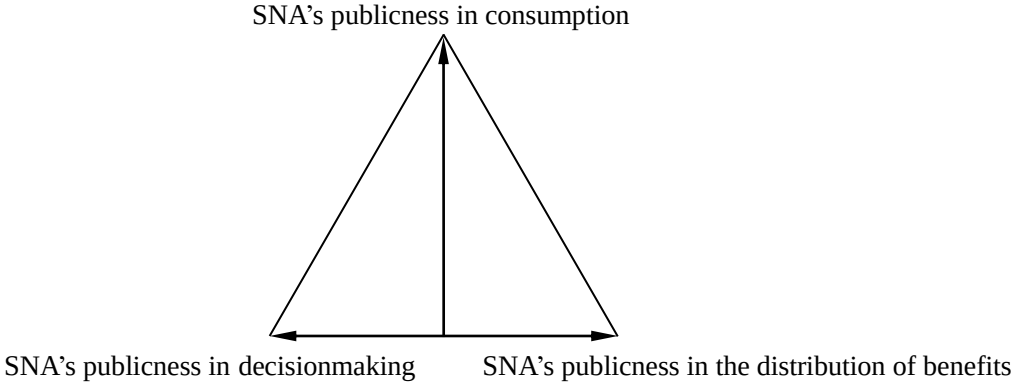

Figure 2. Triangle of publicness on SNA.

Because SNA is the result of global public choice, the formulation and revision of SNA is the social game process of stakeholders' arrangement on the system of national accounts. After the completion of a game process, SNA, as a global public good, temporarily achieves Nash equilibrium, and all stakeholders share the benefits brought by the improvement of the national economic accounting system. Under the same external conditions, the stakeholders do not improve the motivation of SNA. Nevertheless, this state of equilibrium will not remain forever. After the changes in external conditions and the emergence of recent problems, the new processing methods are constantly proposed, and SNA is required to follow up. The potential benefits of the changes in SNA will lead to the motivation to revise SNA. All stakeholders will launch a new round of social games, make a new revision of SNA, and temporarily achieve a new Nash equilibrium. Generally speaking, the revision of each issue of SNA should form a unique solution. That is to say, consensus must be reached to the maximum extent possible, and if consensus cannot be reached, a vote shall be taken. Thus, when the revision is finished, the new Nash equilibrium is reached. But now, in the context of Beyond GDP, the core position of SNA is facing new challenges, and a large number of alternative indexes and indicators have emerged, such as OECD's Better Life Index and the Sustainable Development Goals of the United Nations. SNA embodies evolution.

As a global public good, SNA should meet the needs of countries all over the world and provide theoretical and methodological guidance for countries to establish and improve their national accounts. This inherently stipulates that SNA should "move along the general trend of the world". In essence, the evolution of SNA demand determines the evolution of SNA supply.

6. Several revelations and conclusions

6.1. Other international statistical standards can also be observed from the perspective of global public goods

Although SNA is at the core of official statistics, there are many international statistical standards besides SNA, such as Balance of Payments Statistics(BOP), Government Finance Statistics(GFS), Monetary and Financial Statistics (MFS), System of Integrated Environment and Economic Accounting (SEEA), Handbook Quarterly National Accounts (QNA), General Data Dissemination System (GDDS), Special Data Dissemination Standards (SDDS), Indexes to the International Standard Industrial Classification of All Economic Activities (ISIC), Agricultural Accounts Manual, Consumer Price Index (CPI) Manual, Producer Price Index (PPI) Manual, etc. These international statistical standards also belong to global public goods. Our previous analysis of SNA can also be extended to these international statistical standards. These international statistical standards also belong to means-oriented and best shot supply-oriented public goods. They have network effect and belong to network global public goods. And they belong to knowledge-based public goods. As global public goods in the field of statistics, inherent requirements of the various statistical standards are coordinated and consistent with each other. For example, BOP, GFS, MFS are all revised by IMF, and IMF also participated in SNA revision, making SNA and BOP, GFS, MFS coordination greatly enhanced. For example, CPI Manual and PPI Manual use the same concepts and symbols, and some of the chapters are the same. The harmonization of international statistical standards makes them constitute the global public good in the field of statistics.

6.2. All countries are faced with the problem of transforming SNA from global public goods to national public goods

As a global public good, SNA has macro-directiveness and is too "textual" in its expression. It needs to be "localized", that is, specific and operable according to the actual situation of each country or group of countries. This process is essentially the process of transforming SNA from global public goods to national public goods or regional public goods. For example, when China formulates its system of national accounts with reference to SNA, China's public goods will be formed. ESA 2010 (The European System of National and Regional Accounts) formulated by the Statistical Office of the European Community with reference to SNA is the regional public goods of the European Union. Whether SNA can be successfully transformed from global public goods into national public goods depends on a country's learning ability, learning cost, and implementation cost.

6.3. SNA belongs to global public goods, which does not mean that all countries should copy SNA

Different countries have different national conditions, industrial structures, and bases of national accounts, which determines that countries can not copy SNA. They must choose to absorb and adapt according to their actual situation. This is also the embodiment of the flexibility of using SNA. For example, Canada, Australia, and Germany began to implement 1993 SNA in 1997, 1998, and 1999 respectively. In the implementation process, the original system of national accounts was systematically revised to be consistent with 1993 SNA as far as possible. But there are still many inconsistencies with 1993 SNA, including GDP accounting. ESA 1995 is much more specific in terms of regional accounting than 1993 SNA. It sets up a separate chapter on regional accounts, which describes the territory, units and residence, accounting methods, and household accounts.

6.4. China should keep consistent with the dynamics of SNA and benefit from SNA more comprehensively

There are four implications:

First, China should actively take the free ride of SNA, further localize SNA, and make China's System of National Accounts in line with international standards.

Second, SNA, as a global public good, is evolving. With the revision of SNA, it is necessary to make appropriate adjustments to China's System of National Accounts (2002).

Third, although SNA belongs to the best shot supply-oriented global public goods, China should also strengthen theoretical research and accounting practice of national accounts and contribute to the development of SNA.

Fourth, strengthen the publicity and education of SNA so that more economic workers, economists, and the public understand and apply SNA, share the benefits of SNA as a global public good.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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