THE STATUS QUO AND ISSUES OF R&D STATISTICS IN CHINA

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Note

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ABSTRACT

This paper discusses four issues about China's R&D statistics. (1) After a brief account of the history of China's R&D statistics, it is clarified that China's R&D statistics have progressed rapidly and kept high consistency with international guidelines although it started late. (2) It describes the status quo, including the framework, organizations, core indicators, data production and release of China's R&D statistics. (3) It makes a systematic comparison between the R&D statistics and the enterprise R&D accounting and assesses the feasibility of establishing the R&D statistics directly on the basis of enterprise accounting. (4) It discusses the importance of R&D expenditure data for R&D capitalization in SNA and explains how R&D statistics should be improved in the future in order to meet SNA's data needs.

Keywords: R&D Statistics; Enterprise R&D accounting; R&D expenditure; R&D capitalization

0. Introduction

China's R&D statistics started late but developed fast. Compared with other government statistics, R&D statistics based on science and technology statistics have a shorter history of only more than 30 years, but developed more rapidly and kept higher consistency with international norms. The data from R&D statistics are highly focused and comprehensively analyzed.

During 2015 to 2016, the National Bureau of Statistics of China (NBS for short) commissioned experts from the School of Statistics, Renmin University of China to study the revision of the *Code for Science and Technology Input Statistics (2000) (Code-2000 for short)*. The *Code-2000* has been in operation for fifteen years. During this period, R&D statistics have become the center of science and technology input statistics, and its scope and procedures have been generally shaped. It is high time to develop a standard to guide subsequent R&D statistics.

On one hand, the research team carefully studied the OECD's Frascati Manual and followed up on its latest developments. On the other hand, the team investigated domestic experts from wide ranges including the NBS, Ministry of Science and Technology, Ministry of Education, State Administration of Science, Technology and Industry for National Defence, National Development and Reform Commission, Ministry of Finance and several scientific and technological enterprises. The draft of the "China R&D Statistics Standard (2017)" was formed, expected to be formally implemented in 2018.

At the same time, the team has studied two further issues. First, we scrutinized the data source of R&D statistics, and explored the feasibility of directly using enterprise accounting records as the basis for R&D statistics; Secondly, in response to SNA-2008's avocation of R&D capitalization, we carefully examined the transformation of R&D expenditure to R&D capitalization and considered how to improve R&D input statistics in the future.

The above researches provided a complete case for government statistics through mode of government-academic cooperation. The following is the brief introduction of research findings of the team, including (1) a brief account of the history of China's R&D statistics, (2) the status quo of China's R&D statistics. (3) a discussion of the reason that the enterprise accounting records of the R&D should not be directly used as the R&D statistics, and (4) some suggestions on the development of the R&D statistics in order to meet SNA's data needs.

1. The brief history of China's R&D statistics

Research and development (R&D in short) is the inherent driving force of economic development and social progress. In order to make effective use of the power of science and technology and to scientifically

formulate and evaluate science and technology policies, the Chinese government statistics departments have recognized the need to establish a systematic R&D statistics system at the national level and conduct a comprehensive investigation of R&D information, especially R&D statistics. The following is a brief introduction of the development of China's R&D statistics.

China's R&D statistics developed gradually on the base of science and technology statistics, experiencing the stages of exploration, establishment, improvement and innovation.

(1) Stage of exploration (1985-1990). China started the science and technology statistics(S&T statistics for short) in the mid 1980s. The first Census of Science and Technology was implemented in 1985 and the annual report system of science and technology was established in 1986 with the scope of investigation gradually covering scientific research institutes, colleges and universities and enterprises. However, there is still a lack of comprehensive R&D statistics, and it still could not provide the data of expenditure on science and technology activities and R&D expenditure.

(2) Stage of establishment (1991-2000). In 1991, it was proposed to pay close attention to the calculation of the total amount of science and technology expenditures and related parameters. In 1992, the NBS completed the calculation of the national R&D expenditure in 1988-1991 for the first time and accordingly promoted the follow-up survey and data calculation, which marked that R&D statistics entered into the practice. In 1996, it was clarified that S&T statistics should take into account the special needs of China's economy and science and technology management as well as the international standards. In 2000, China carried out the first nationwide R&D resource check-up, which was the most extensive scientific and technological survey at that time and provided important data support for correctly understanding the status quo and international status of China's R&D expenditure. Also in 2000, based on practices of China's S&T statistics and international norms of R&D statistics from the United Nations and the OECD, the NBS formulated *Code for Science and Technology Input Statistics* (*Trial Implementation*). This is the first code for scientific and technical statistics in China that specified the statistical definition of science and technology activities and stipulated the statistical scope, statistical standards, calculation methods and data evaluation of scientific and technological indicators. The *Code-2000* became the guiding document of China's S&T statistics.

(3) Stage of improvement (2001-2008). During this stage, the *Code-2000* was implemented, and the implementation of the *Code-2000* was gradually improved and standardized with the statistical investigation system being generally stable. It is worth noting that the calculation of R&D expenditures was computerized and the whole process of measuring R&D expenditures was established.

(4) Stage of Innovation (2009-). In 2009, the second nationwide R&D resource check-up was conducted, which not only obtained comprehensive data on R&D expenditure but also improved the design of survey. R&D expenditures were no longer directly reported by the enterprises, but instead were produced from the

corresponding indicators. The statistical indicator system of science and technology has been greatly revised, weakening the concept of the "science and technology expenditure" and strengthening the concept of "R&D expenditure" to emphasize independent innovation. From this year on, publications about science and technology ceased to release the indicator of scientific and technological activities expenditure, and instead turned to R&D expenditure.

Since then, the NBS has implemented a series of reforms on the survey system of enterprises' R&D expenditure. In 2011, the annual reports on the scientific and technological activities of oversized industrial enterprises were formally incorporated into "Integrated Questionnaire for Enterprises". The data began to be directly reported on the Internet instead of e-mail or magnetic media, thereby statistical production methods was significantly changed. In 2015, the S&T statistical reporting system for oversized industrial enterprises was greatly reformed and the S&T activities were revised as R&D activities to achieve a fundamental shift from S&T statistics to R&D statistics. In 2016, the coverage of investigated enterprises was expanded to oversized construction enterprises and key service enterprises besides industrial enterprises.

On the basis of these reforms, the NBS in cooperation with other relevant departments commissioned relevant research institutes to begin the revision of the *Code-2000*. After comprehensive investigations and studies, *Code for R&D Statistics* (2017) (Code-2017 for short) has been formed to provide guidance for R&D statistics in the future. The Code-2017 has the following features: (1) R&D expenditure is directly surveyed; (2) it is more consistent with the sixth edition of the OECD's Frascati Manual, with due consideration given to the seventh edition; (3) It integrates the experience from the previous practice of China's R&D statistics and sets the goal for the next stage.

2. The status quo of China's R&D statistics

After more than 30 years of implementation, China's R&D statistics have formed a relatively complete system consisting of "Data Resources – Data Collection - Data Processing and Estimation - Information Release". The following will give some brief introduction of the system.

2.1. Concept system of R&D statistics. China's R&D statistics directly follow the definition of R&D in OECD Frascati Manual that comprises creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge. R&D covers three types of activity: basic research, applied research and experimental development.

2.2. Indicators system of R&D statistics. China's R&D statistics have set up a set of indicators system that includes both personnel and expenditure. The names, definitions and classifications of indicators are all in line with the international norms. The R&D personnel refer to those engaged in basic research, applied

research and experimental development in the R&D activity units during the reporting period. Indicators on R&D personnel are compiled as both head counts (HC) and as full-time equivalents (FTEs). R&D expenditure is defined as the total expenditure (current and capital) incurred for the implementation of R&D activities during the reporting period. The indicators can be classified in two ways, one based on the nature of R&D units and the other on the nature of R&D activities.

2.3. The organizational system of R&D statistics. Since the beginning of the establishment of S&T statistics, China has been adopting an organization system in which the NBS is chiefly responsible with multiple departments in cooperation, and the data are collected from the bottom up. Ministry of Education, State Administration of Science, Technology and Industry for National Defence, Ministry of Science and Technology, and NBS are responsible for the R&D statistics in colleges and universities, military research institutions, the public civilian research institutions, large and medium-sized industries and other enterprises and institutions respectively. According to the assigned duties, all departments, on the one hand, take advantage of the system of statistical reporting to carry out regular statistical surveys and data processing within their scopes, and on the other hand, they work together to carry out various one-off or specialized investigations such as national R&D resource check-up. Finally, the NBS summarizes all the data, and releases the aggregates and related information.

2.4. Survey system of R&D statistics. China's R&D statistics survey has generally formed a system, and comprehensively use a variety of survey methods. The first part is that each department has set up an annual statistical system for S&T statistics with the objective to obtain annual data on the R&D activities. The second part is a nationwide R&D resources check-up conducted every other longer cycle. Previously, two check-ups were conducted in 2000 and 2009, which were focused on all the legal entities with relatively intensive R&D activities in order to find out the basis of R&D activities and expenditures. In addition, a special scientific and technological activity module is included in the national economic census every five years to conduct a full investigation of the scientific and technological activities of oversized industrial enterprises. The investigation takes R&D projects as the basic investigation units and the legal entity units that conduct R&D activities as reporting units. That is, information of each R&D project shall be reported by the legal entity that is responsible for the R&D activities.

2.5 Calculation of R&D indicators. We will take R&D expenditure as an example to explain the calculation method and data processing. (1) Set target. R&D expenditure is the current year's expenditures for R&D activities recorded according to the principle of cash receipt and payment, including current and capital expenditures. (2) According to the assigned duties, each department is responsible for the calculation of R&D expenditures within its own scope. There will be some differences in calculation methods between different departments due to different respondents and reporting items. (3) In term of items, current expenditures can generally be obtained directly or processed from the survey data, while capital expenditures are estimated based on some proportion parameters since a large amount of

investments are shared with other non-R&D activities. (4) Each department will evaluate the quality of the data obtained from the survey. On the one hand, it is necessary to identify whether the activities reported belong to the R&D activities, and on the other hand, reported data will be evaluated by the departments. (5) The R&D expenditures estimated by various departments should be submitted to the NBS and be consolidated by the NBS. The aggregated data will be evaluated by all departments together to form the R&D expenditures data.

2.6. Submission and release of R&D data. The NBS sets up the Social Science and Technology and Cultural Industry Statistics Division to take charge of S&T statistics. Since the establishment of S&T statistics system, the R&D statistics can be roughly divided into vertical and horizontal directions: in vertical direction, data is the submitted by investigation units to the department in charge, that is, data of civilian research institutions is submitted to Ministry of Science and Technology level by level, data of military research institutions is submitted by the Military Groups to the State Administration of Science, Technology and Industry for National Defence, data of colleges and universities and affiliated hospitals is submitted by the Provincial Department of Education (Education Commission) to the Ministry of Education, The data of enterprises and other institutions will be submitted to the NBS level by level. The horizontal direction involves the submission of the aggregated data, that is, the aggregated data of the Provincial Science and Technology Department (Commission of Science and Technology) and the Provincial Department of Education (Education Commission) shall be submitted to the Provincial Bureau of Statistics; aggregated data of Ministry of Science and Technology, Ministry of Education and State Administration of Science, Technology and Industry for National Defence shall be submitted to the NBS; all the data will be consolidated by the NBS. The data submission process is shown in Figure 1.

China first released R&D statistics in 1992. Since then, the data have been released on an annual basis. At present, the channels of release mainly include the statistical bulletin, statistical yearbook, statistical abstract, statistical summary, China Development Report, official website, national statistical database and mobile client, WeChat and Weibo. Relevant publications mainly include the *Statistical Bulletin of the People's Republic of China on National Economic and Social Development*, the *Statistical Bulletin of National Science and Technology Funding*, the *China Statistical Yearbook*, the *China Science and Technology Yearbook*, the *Statistical Yearbook of China's High-tech Industry*, *Statistics of Enterprise R&D Activities*（in-house publication）.

3. Enterprise R&D expenditures: whether the accounting records can be used directly to form R&D statistics

In China, R&D expenditures incurred by enterprises have accounted for a large proportion of R&D expenditures in the whole society (78% in 2016). Obviously, it is of great significance to strengthen the data foundation of enterprises.

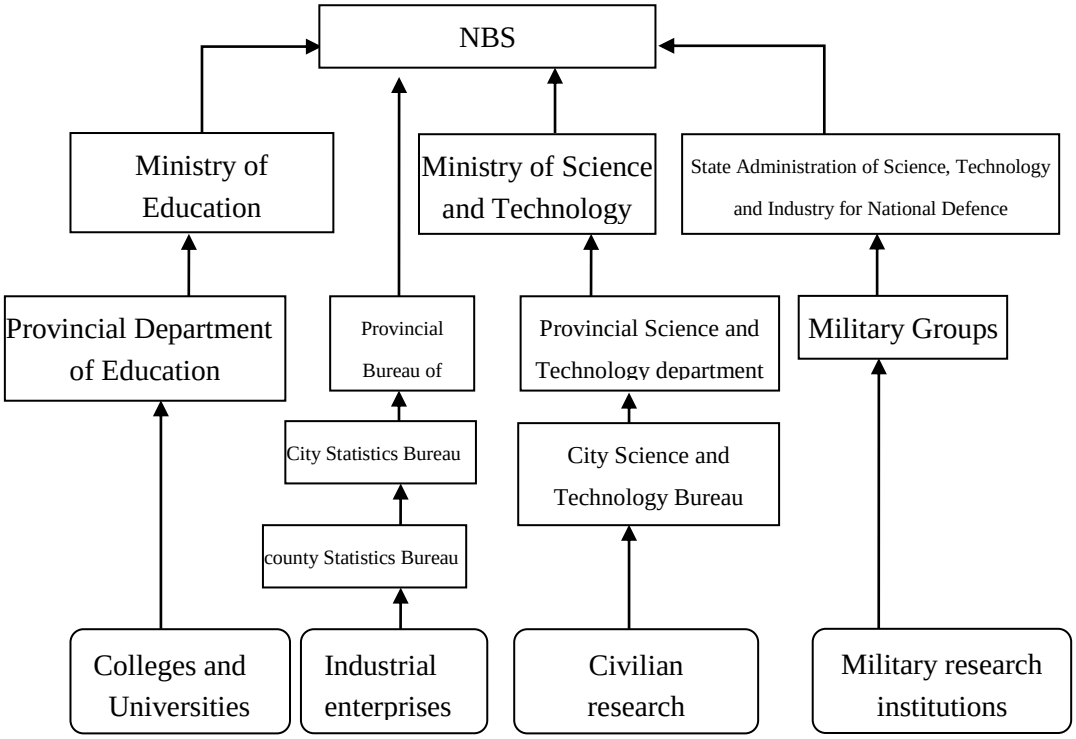

Figure 1 R&D statistics submission process

In the current R&D survey conducted by the NBS, the reporting units are legal entity enterprises, and the basic investigation units are the scientific and technological activities (or projects) implemented within the enterprises. The basic data are from the records of the activities by the enterprise's science and technology management departments. Based on the data reported by the enterprises, the statistical department identifies the research projects that belong to the R&D activities and sum up the relevant data to get the R&D expenditures of the enterprises. This procedure is called “aggregation by items”.

In order to encourage enterprises to implement R&D and innovation, the Chinese government has promulgated a lot of incentive policies to provide financial and policy support to eligible enterprises, including tax relief and investment subsidy. Those policies are based on the scale of the R&D expenditure of enterprises. In order to meet the policy requirements, enterprise accounting needs to conduct a special accounting for R&D expenditure and disclose relevant information. To this end, the "Accounting Standards for Business Enterprises" specifies in detail how to set up corresponding accounts for collecting R&D costs and the intangible assets formed, and the "Tax Law" and "Measures for the Identification and Management of High-tech Enterprises " provide in detail the definitions and expense items of enterprises R&D expenditure

The enterprise accounting provides another data source for R&D statistics. The question is: Can the investigation by the NBS be based on the enterprise accounting records? Put it another way, To answer this question, we have done the following research.

At first, by systematically reading the various rules and regulations, we have conducted a detailed comparison of the definitions of the concepts, the scope of the accounting, the structure of the accounting framework, the design of the basic indicators in the two sets of systems. The main findings are shown as the following.

(1) Definition of R&D activities. The theoretical definitions of R&D activities in both systems are originated from the OECD's Frascati Manual. Specifically, the accounting standards are mainly aimed at the R&D activities of enterprises, and R&D statistics cover R&D activities of the whole society. Therefore, the two differ in their specific statements. For example, the accounting divides the R&D activities into research and development, and R&D statistics include basic research, applied research, and experimental development. Since the enterprises' R&D activities are mainly concentrated in applied research and experimental development and rarely in basic research in reality, therefore, we can conclude that, at the enterprise level, the definition of R&D activities in the accounting are essentially the same with that in R&D statistics.

(2) Scope of R&D activity. We focus on the following questions.

The first question is the industry coverage. R&D statistics cover the Industry and other "R&D intensive industries", while corporate accounting regulations do not make a clear description of the industries involved. However, according to the intensity of actual R&D activities, there is no significant difference between the two systems. That is, industries that are statistically regarded as R&D intensive industries generally fall into the category of industries that may be included in high-tech enterprises because of R&D expenditures and are exempt from income tax.

Next to consider whether the enterprises in R&D intensive industries are all covered. R&D statistics cover all the eligible businesses. However, from an accounting point of view, R&D expenditure is only a special accounting for the disclosure of relevant information and is not directly related to the core contents of enterprise accounting (such as balance sheet, income statement, and cash flow statement). Therefore, those enterprises that do not care about the impact of R&D activities on the overall corporate image and do not intend to benefit from the preferential policies (or far from the requirements of these preferential policies) have no motivation to record and R&D expenditure in a special account and release relevant information. As a result, not all the eligible enterprises will provide information R&D expenditure in accounting system.

Finally, we pay attention to how the R&D activities are identified at the enterprise level. Both R&D statistics and enterprise accounting need to identify at a single enterprise level which activities belong to

R&D activities. We find that different responsible departments take similar processes: the relevant departments enumerate the categories of R&D activities that should be included in the scope of survey based on the R&D projects, then the enterprises submit data according to the categories, and external experts (those from the statistics department, or those invited by the auditing and tax department) will judge whether the activities should be included at last. In practice, the problems lie in that enterprises usually have a broader understanding of R&D activities, which leads to over estimation of R&D activities. Therefore, it is necessary to scrutinize the reports f from enterprise accountings.

(3) The indicator of R&D expenditure. Although "R&D expenditure" is the core indicator in both systems, it has different content in the two systems.

R&D expenditures statistics at the national level do make statistics on actual "expenditures" incurred by an enterprise for R&D purposes, and are statistics of cash flow based on the principle of cash receipts and payments. These expenditures are divided into current expenditures and capital expenditures. Current expenditures are expenditures on materials, services and personnel incurred by enterprises for the implementation of R&D activities, and capital expenditures are expenditure on the acquisition of various fixed assets for R&D activities.

Accounting sets up "R&D expenditure" account under the "intangible assets", collecting the events occurred in the R&D activities and providing relevant accounting information. First, expenditures recorded are costs on the accrual basis instead of cash flow based on the principle of cash receipts and payments. As a result, expenditures on labor, materials and services purchased and used in the current period are recorded, while expenditures incurred for the acquisition of fixed assets for R&D activities (i.e. capital expenditures) are not included, but depreciation of fixed assets and amortization of intangible assets used by current R&D activities are included. Secondly, all expenditures (that is, costs and expenses) shall be accounted for in detail according to "Cost Expenditure" and "Capitalized Expenditure". The former refers to those expenditures that are not eligible for capitalization and enter the current profit or loss through "administrative expenses"; the latter refers to expenditures that meet the capitalization requirements and is carried forward to "intangible assets" when the intangible assets are ready for its intended use, having nothing to do with current profit or loss.

The differences are shown in Figure 2. It can be seen that the first difference is reflected in the total expenditures for the current period because the capital expenditures for the purchase of fixed assets for the current period do not equal the depreciation of fixed assets for the current period. Secondly, the grouped data is not comparable, i.e., current expenditures do not correspond to cost expenditures, and capital expenditures do not correspond to capitalized expenditures. The current expenditures and capital expenditures in R&D statistics are "forward purchase", that means expenditures on durable goods and service can only be treated as capital expenditures (which can be recorded as a fixed asset), otherwise,

expenditures (for instance, non-durable goods and services and the payment of labor costs) should be recorded as current expenditures. The criteria to classify cost expenditures and capitalized expenditures by enterprise accounting is the post-outcome corresponding to the expenditure, i.e., only R&D expenditures that result in intangible assets can be treated as capitalized expenditures, otherwise, the expenses should be treated as cost expenditures.

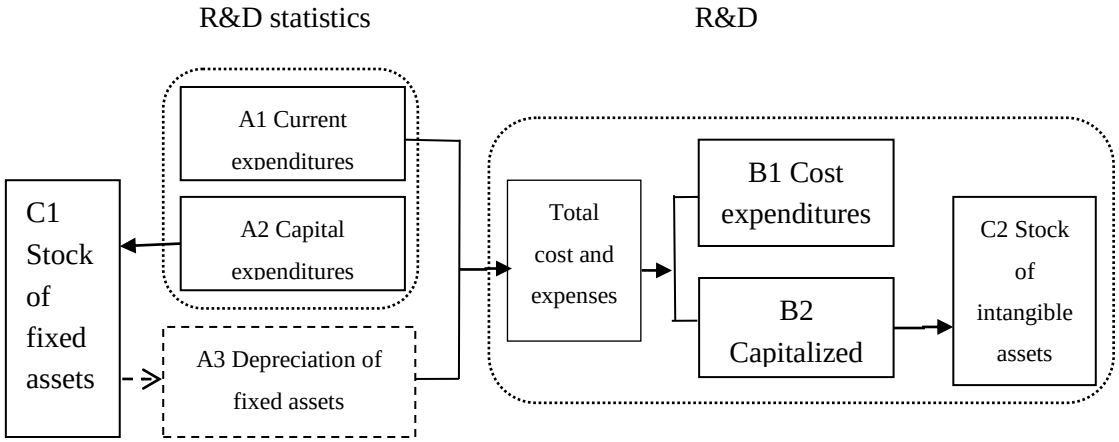

Figure 2 R&D expenditure: the difference between statistics and accounting

The above comparison is based on the texts of regulations. If practices are taken into account, there will be even greater differences between the two systems.

An important principle of the government statistics is to keep the stability of the scope so that the data can be comparable either in different time or different regions. To achieve this goal, once the statistical scope is confirmed, the implementation will show "rigidity" to a large extent. The same is the R&D statistics for the identification standard of R&D activity and R&D expenditure. To this end, the statistical department on the one hand gives detailed case guidance and trains personnel related in the enterprise; on the other hand, supervises and audits the results reported by enterprises, including R&D projects and R&D expenditures and their categories in case that the quality of data would be affected by overreporting or underreporting due to misidentification during the reporting process.

Accounting is different. One of its functions is accounting for investors; therefore, it has a distinct motive of "profit-seeking", i.e., to provide a basis for maximizing the interests of investors through operation and management. Utilizing such characteristics of enterprise accounting, relevant government departments launch appropriate policies to affect the enterprise accounting and to achieve the goal of guiding the conducts of enterprises. Subject to government goals and specific policies, the range of industries that conduct R&D expenditure accounting, the enterprises that conduct R&D expenditures accounting in the industries, the R&D activities that are included in the scope of enterprises accounting, and the types of

expenditures that are included in the scope of R&D expenditures may change. To some extent, it can be said that in certain periods, the R&D cost of accounting is not necessarily the total R&D cost, and is not necessarily the R&D cost in perspectives of accounting. Instead, it is R&D costs stated in the policy documents. Hence, the scope of R&D activities and costs involved are not a matter of scientific cognition to some extent but rather a means of regulation, which is of great flexibility.

To sum up, we have come to the conclusion that although there is no fundamental difference between R&D statistics and enterprise accounting in the basic definition of R&D activities, there are inherent differences between the two in practices that not all the enterprises conduct R&D expenditure accounting, which does not meet the requirement by R&D expenditure statistics. Therefore, although R&D statistics should be based on enterprise R&D expenditure accounting in the long run, it is infeasible in the short run. The NBS is doing a pilot study on this issue, and it has been found that the gradual integration of R&D expenditure accounting data into the R&D statistics is of feasibility, but need some special adjustments. These reforms have yet to be explored further.

4. R&D expenditures data: how to serve the accounting of R&D capitalization

SNA-2008 formally incorporated R&D into IPR products and formally proposed the R&D capitalization approach. Many countries, including China, have already capitalized R&D in the GDP accounting framework to adjust their GDP, and generated data series of R&D investment and R&D stock. China implemented the reform in 2016 and published data of revised GDP.

What is R&D capitalization? Why should R&D be capitalized? How to capitalize R&D expenditures? Answering these questions involves three areas: analysis of economic growth, R&D statistics, and adjustments of GDP in national accounts. The analysis of economic growth is the ultimate goal of R&D capitalization, with R&D investment and R&D assets being the focus of attention; GDP accounting is the platform to capitalize R&D, which provide the data of the two indicators that analysis of economic growth focuses; R&D statistics is the data sources of R&D capitalization and the starting point of accounting of R&D investment and R&D assets in the GDP accounting framework. Therefore, all the three areas are indispensable.

4.1. Definition of R&D capitalization

There is broad consensus about the contribution of science and technology to economic growth. To measure the contribution of science and technology to economic growth, one basic approach is to estimate R&D capital stock based on R&D expenditures through certain concept conversion and data estimation process, and then use R&D capital stock as a proxy for science and technology in economic growth econometric models and estimate its contribution to economic growth. The concept conversion and data estimation process in estimating R&D capital stock is the so-called "R&D capitalization".

4.2. Platform of implementing R&D capitalization

Normalized R&D capitalization needs to be achieved by means of the GDP accounting framework of the SNA. In the framework of GDP accounting, R&D capitalization generally includes the following steps: (1) Identify R&D activities as independent production activities. In the previous versions of SNA, a considerable portion of own-account R&D activities could not be identified individually because of their ancillary activities within the production unit. (2) Calculate the output of R&D activities respectively for market and non-market R&D activities. The market output are valued at market price, and the non-market ones (own-account or conducted by the government affiliates) are valued at costs. Both market output and non-market output are part of the output of intellectual property products. In previous versions of SNA, only the output of individually identified R&D activities are calculated, while that of self-account activities are not separately calculated and are consolidated with the primary or secondary economic activities of the enterprises. (3) Classify R&D output from the users' point of view. R&D products are classified as those acquired by the enterprises, including purchased parts and self-produced parts, and those acquired by non-enterprise institutions such as government that are mainly obtained by the government on behalf of the whole society. The reason for this distinction is that the previous versions of SNA treated these two types of output differently: R&D products acquired by the enterprises were treated as the intermediate consumption, while R&D products acquired by the government sector were treated as the government final consumption. (4) Record the R&D products acquired by all institutions as fixed capital formation. At this step, R&D investment is generated, which represent the increase of R&D assets in the current period. Unlike previous versions of SNA, R&D products acquired by the enterprise are no longer recorded as intermediate consumption, and R&D products acquired by the government are no longer recorded as final consumption. (5) Based on R&D investments, the stock of R&D capital can be estimated through perpetual inventory method. Therefore, the data can be used to analyze economic growth and the contribution of science and technology to economic growth can be estimated.

4.3. Data sources for R&D capitalization

Calculating the output of R&D is a key node in the R&D capitalization accounting under the GDP accounting framework. The existing industrial data is not enough to separately calculate the output, intermediate inputs and value-added of the R&D activities, while R&D statistics have irreplaceable advantages. First, it covers all R&D activities - no matter who conduct them and under what background they are conducted, which addresses the issue of identification. Secondly, it includes sum data and disaggregated data in the R&D activities. Although the sum of expenditures is different from the output, the disaggregated data provide the possibility of converting expenditures into outputs. To this end, precisely because of the R&D statistics, it is feasible to achieve R&D capitalization under the framework of GDP accounting.

The data conversion from R&D expenditures to R&D output involves two steps. The first step is to convert the R&D expenditures under the principle of cash receipts and payments into the R&D input under the principle of accruals. For this purpose, we need to substitute capital expenditures (expenditures on acquisition of fixed assets in the current period) by the depreciation of fixed assets (representing the value of fixed assets consumed by the R&D activities of the current period). Combining the depreciation of fixed assets with current expenditures gives the total cost of R&D activities, which is the R&D output (shown in Figure 2 above). In addition, other adjustments should be made to satisfy accounting principles of the SNA, such as deductions of software development costs and deductions of land values. The second step is to allocate the R&D output to different users (purchasers) and grouping data according to the type of acquirer (i.e., purchaser) can be provided, so that it can be shown "who" use the R&D output and R&D investment (and R&D asset stock) can be recorded for different sectors.

To sum up, in terms of the status quo of R&D accounting, in order to show the contribution of science and technology to economic growth, the starting point for R&D capitalization under the GDP accounting framework is R&D statistics. This is not only the case when capitalizing R&D for the first time, but also in the long run, because R&D data in the enterprise accounting cannot be directly used as the data source for GDP accounting, and subsequent R&D capitalization still requires special adjustments. This requires R&D statistics to improve in the future in order to meet the data needs of R&D capitalization. The Frascati Manual (7th Edition) has given many discussions about this issue. Here, we put forward some suggestions based on the status quo of China's R&D statistics.

First, pay more attention to institutional units and differentiate market and non-market activities in sectoral classification. In the course of the conversion from "expenditure" to " output," market producers and non-market producers should use different conversion methods due to different accounting methods and components.

Secondly, strengthen the statistics on the sources of R&D funds. On the one hand, it is necessary to consolidate the data base of funding sources and, on the other hand, to distinguish between the source of funds in exchange and the source of funds in transfer, so as to match the sectoral classification of funding sources with that of SNA. Statistics at present mainly focus on "who" implement R&D activities and bear expenditures, but the statistics on funding sources have been relatively neglected. From the perspective of R&D capitalization, it is funds in exchange that should be used to determine which sector purchase the R&D output and then record the capital formation (investment), whereas funds in transfer are not directly relevant.

Thirdly, supplement data of external R&D funds. Statistics at present are mainly based on data of internal funds, which is necessary for avoiding double counting in deriving the total expenditure on R&D activities. However, the information contained in external funds should not be neglected because it represents

expenditures paid for the purchase of R&D products and is important for allocating R&D output to users (purchasers) during R&D capitalization.

Fourthly, expand and refine R&D capital expenditure statistics. On the one hand, we should refine the disaggregated data on capital expenditures, such as separately listing expenditures on acquisition of land and acquisition of computer software, etc., and providing expenditures on machinery and equipment in detailed type such as information and communications equipments, transportation equipments and other machinery and equipments for research and development. The disaggregated data will facilitate the deduction of corresponding assets and estimation of depreciation for different assets in the accounting of R&D capitalization. On the other hand, we should not only include statistics of flows, but also include the statistics of stocks. If there is no data of assets stock accumulated from expenditures in the past years, it is impossible to display the fixed assets used by R&D activities, and more importantly, it's impossible to estimate its depreciation and thus to realize the conversion from the R&D expenditures to R&D costs (output).

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