

# Characteristics and Development of Information Industry and Its Impact on the Economy

Shan Chen

**Abstract** The information industry has gradually become a pillar of national economic development in various countries, but there has been disagreement about its definition and its categorical measure at home and abroad. As a constantly changing complex system, the information industry has its own law of development as well as internal characteristics. The information industry features the intellectualization of high technology and regards universality as the main goal. Another feature of the information industry is that it penetrates into and integrates with traditional industries by means of information technology and service, which makes its development have a “multiplier” effect on the economy.

**Keywords** Information industry • Intelligence • Universality • Infiltration and integration • Industrial measurement systems • Spillover effect

## 1 Introduction

The 21st century is one of communication as the information industry increases rapidly in the international context and has an increasingly high contribution to economic growth. From an international perspective, the information industry has become the largest pillar of American economics and one of the world’s fastest growing industries. Since the 1990s, a strong push from the information technology revolution has led the information industry into a period of rapid development. In 2009, the scale of China’s information economy topped \$900 billion for the first time, \$633.4 billion more than that in Britain. In 2013, the scale of China’s information economy even reached \$2.18 trillion, \$1.58 trillion more than Japan, making it the world’s no. 2 industry following the United States, whose scale of information economy was \$7.49 trillion. Data show that the growth rates of the information economy in China, the United States, Japan, and Britain are significantly higher than

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S. Chen (✉)

School of Economics and Management, Beijing Jiaotong University, Beijing 100044, China  
e-mail: 125029529@qq.com

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those countries' GDP growth rate, which are, respectively, 1.6, 1.5, 4.1, and 1.6 times the country's GDP growth rate. Furthermore, the information industry is playing an increasingly remarkable role in driving economic growth.

However, the information industry is an evolving complex system, and its unique internal and development characteristics differentiate it from other industries in terms of the basic law of development. How do we define the current rapid development of the information industry? How do we accurately classify and measure the size and extent of its development? Research on the characteristics of the information industry may reveal its mechanisms and rules of development, which will be conducive to clarifying the current status of the information industry as well as its advantages and disadvantages and its impact on the economy. Finally, it will be possible for us to put forward scientific suggestions and specific strategies regarding the developmental direction of the information industry.

## **2 What Is Information—Its Evolution and Development**

The concept of information is always changing, but it evolves slowly with the development of society. Information in ancient China was known as the “news,” whereas in English it was known as “information” and in Japan as “intelligence”. C.E. Shannon explicitly pointed out the following: “Information is a thing used to eliminate the uncertainty of a random thing,” and this definition is now widely accepted. Economic management scientists believe that “information is used to provide effective decision-making data.” Our information expert, Zhong Yixin, stated that “information is the way things exist or a state of motion, and is expressed through this way or state in a direct or indirect manner.” United States information management specialist F.W. Horton defined information as “processed data used to help users making decisions.”

With the development of human society and the advancement of science and technology, information changes in its content, its form, and the manner in which it is conveyed. Means of transferring information evolved from oral message to letters, the telegraph, and the telephone. Today, information is transferred in huge amounts through communication networks and the Internet, which features much higher speed, larger scope, more diversified information content, and more intensified directivity. This scientific trend of information “bitization” will last until a new era, the “Internet of Everything,” begins.

## **3 The Definition and Classification of Information Industry**

Based on the theory of “knowledge industry” proposed by F. Machlup in 1962, American economist M. Porat separated out all the information and information activities included in the first, second, and third industries (based on the

industry-classification method proposed by C. Clark) and labeled them as an independent industry, namely, the information industry. In his opinion, information industry has already penetrated into every sphere of the national economy; thus, information activities—in terms of production, procession, circulation, and service—cannot be simply classified into certain departments. Departments performing information activities shall be divided into explicit ones, which directly provide information products and service to the market and implicit ones, which provide information service and capital only for internal consumption but without entering the market [1]. Economic scientists at home and abroad have begun to conduct relevant research on this basis.

The American Information Industry Association believes that information is a combination of production activities that produce and provide information products and services by utilizing new technologies and innovative information processing methods.

In the opinion of our country's information expert, Wu Jiawei, the information industry is a new industry engaged in information and technology equipment manufacturing and information production, processing, storage, distribution, and service: It is composed of the information equipment manufacturing industry (hardware industry) and the information services industry (i.e., the software industry) [2].

In 1997, the United States, Canada, and Mexico jointly developed the North American Industry Classification System (NAICS) [3]. For the first time, this classification system considered the information industry as a separate industry sector and defined it in terms of statistical classification [4]. The NAICS divided the information industry into three categories: (1) production and distribution of information and cultural goods; (2) provision of methods to deliver or distribute those products, data, or communications; and (3) processing of data. In 2002, the NAICS re-divided these into four categories: (1) the publishing industry; (2) the film and recording industry; (3) the broadcasting and communications industry; and (4) the information and data-processing services industry. This standard of classification was used in a survey of these three countries [5].

Expert Si Youhe divided the information industry into three departments: (1) the IT equipment manufacturing department; (2) the information commercialization department; and (3) the quasi-information department. This classification of the information industry is regarded as reasonable and has become the three major components of China's information industry [6] as follows:

- The IT equipment manufacturing department includes microelectronic, electronic, computer, communications and network-equipment manufacturing, and information technology infrastructure construction
- The information-commercialization department includes the information-production sector, the information-communication sector, and the information-service sector.
- Quasi-information departments (information department affiliated with non-information industry).

Meiyun considered that some sectors in the implicit-information departments, which provide paid information services, should be classified into the information-service sector, whereas information products provided only on a self-service basis or provided free of charge should not be regarded as part of the information industry [7]. The definition of the information industry should also be expanded in part at different stages of historical development. Domestic information—industry development was integrated into traditional industries to create new production organization method in all aspects: production, sales, distribution, and service. The formation of a new organization and production should also be part of the information department in the information industry.

## 4 Characteristics of Information Industry

I. The information industry is closely related to scientific and technological development, and its intellectualization has become an increasingly prominent feature. The information industry is called a “3C” industry in foreign countries (i.e., computer, communication, and content) and features much technological content. From this perspective, it not only includes the manufacturing of information equipment and the communication, it also includes the even larger information-service industry with information resource development and utilization as its content. Information and communication technology is the product of organically combining telecommunications services, information services, and IT services and applications. It does a better job in fully and accurately reflecting the new forms by which information technology supports and promotes the “informatization” of a society.

Computers, electronics, communication equipment, and high-speed information networks all belong to the “hardware” side of the information industry, whereas the publication of news and books, posts and telecommunications, advertising, software development, and systems integration all belong to the “software” side of the information industry. If the information industry was thought of as a human being, then the hardware is like the bones supporting the body, whereas the software is like the blood circulating through the body. However, the most important part of a human being is the brain. ICT is a kind of information service industry that is based on information resources using intelligent methods and innovative approaches (i.e., the brain) to developing and utilizing various types of hardware and software resources to create new products and value.

The information industry is closely related to the development of science and technology, its development can be divided into the following three distinctive stages:

1. Television and telephone, especially the increasingly popular personal computer, is the first big step of information industry in promoting social progress. At this point in the information-transfer phase, information is mostly transmitted

directly; its form and content are very simple. During this period, the information industry is still focusing on the hardware side.

2. In the early 1980s, Internet technology developed rapidly; its rise led to the rapid development of the information industry and attained the first apex. Portals, search engines, and instant messaging appeared quickly, one after another, and it can be seen that this was the information-acquisition stage. The scope of information acquisition expanded exponentially; information content became diversified; and the information form gradually became bitization. At this point, the development of the information industry focused on the software side.
3. The recent developmental cycle of the information industry is directed at the treatment and reuse of information: big data mining, OTT applications, Cloud storage, e-commerce, and Internet finance. Information service based on ICT is no longer just the role of disseminator of information, it uses the hardware and software information resource production and creates new products and new values of the “brain.”

Thus, it can be observed that the information industry is closely related to the development of science and technology, but the focus of development—whether “hardware,” “software,” or “brain”—has turned in an intellectual direction. The electronics and communication equipment manufacturing industry generally has a high degree of intelligence, [8] and information transfer gradually changed to intellectual development. The content and object of delivery became more selective and targeted. Information service is the best intelligent comment, either information processing or storage, and either mining or application, these cannot leave the mainline: intellectualization. The higher level of the intelligent information industry, the faster it develops and the larger it becomes the industrial standard.

The developmental element of information industry is people, and popularity (i.e., demand) is the fundamental purpose of its development. The information industry exists to develop human beings’ spiritual wealth; the object of industrial activity is information; and the content is for information research, development, dissemination, and use. Information industry is high-tech and knowledge-intensive. Because information technology industry requires more sophisticated, senior, and complex labor, knowledge, technical capabilities, and the higher power requirements of scientific research have become necessary for the employee. Although the fixed-asset investment is also important for the industry, the characteristics of the information industry make the intellectual assets more critical.

Popularity is the fundamental purpose of the information industry. Whether it is information delivery or information production and service, the main purpose is to benefit people. According to CNNIC statistics, as early as 2008 the number of China’s Internet users had surpassed that of the United States and become no. 1 in the world; in December 2014 the number of users reached 649 million and the Internet penetration rate was 47.9 %, which fully reflects the universality of the information industry [9].

Human society tends to be more equitable and open because of the power of information; as such this should foster more inclusive sharing and collaboration.

The popularity of information is closely related to the development of the information industry according to human needs. The desire for information transmission resulted in the emergence of the telegraph and telephone telecommunications networks. The need for long-distance information broadcasting led to the advent of television and television networks. The high-speed broadband network has reached a perfect purpose of the free and equal exchange of information. There are a variety of information services to meet the needs of individuals in all aspects of spiritual and material basic necessities. Development of the information industry should offer more opportunities for all people to enjoy more freedom and happiness. This is also in line with the goals of the World Summit on the Information Society (WSIS) for the information industry to be “people-centered, inclusive and development-oriented” [10].

The information industry has a strong capability to penetrate and integrate society. It uses information technology as a foundation and information equipment as the carrier; through the spread and digging of information resources, it gradually permeates traditional primary, secondary, and tertiary industries. Its permeability is shown by its application of rich processed information resources and service in traditional industries through advanced information technologies to promote technical innovation (often referred to as “informatization”) of the industrial production or organization modes. This resembles the concept of industrialization. Most economists hold that industrialization is a process during which the proportion of the total output value and employed population of the secondary industry (i.e., industry) in the whole society’s total output value and employed population is increasing continually, whereas that of the primary industry continually decreases. Our country’s economist, Peigang, believes that “the national economy in a series of strategic production function process keeping change, is the process of industrialization” [11]. It is a field including two aspects of industrial and agricultural modernization and mechanization: “social productivity change”, which is a series of changes caused by the significant symbol of productivity, and change in social-production tools.

Informatization is a process during which the proportion of the total output value and employed population of the information industry (i.e., the fourth industry) in the whole society’s total output value and employed population continually increases. The information industry will become the leading industry of the national economy, e.g., information resources have become a new factor of production inputs to various industrial production activities as well as the process of national economic operation.

The information fuses the traditional industry, which smears fusion boundary and has new contents and forms. It is a paradigm of breakthrough in traditional industrial innovation. The development of this integration is an inevitable trend and also leads to social and economic acceleration. Many new products and services created by industrial innovation lends the traditional industry a complementary, alternative, or restructured relationship [12]. The complementary information industry, which occurred during the first industry fusion, produced modern agricultural production, and the sales service system produced the food safety

traceability system. The recombination of the secondary industry fusion spawned the industrial intelligent-control production line, the industrial robot, and the customized industrial manufacturing system. Fusion of the alternative third industry resulted in electronic commerce, Internet finance, and mobile payment. To generate fusion inside the information industry's own OTT service, etc. Generating fusion inside the information industry's own OTT service, etc. has fully proved that all kinds of production factors constitute the productivity of the information industry including "information equipment," "information technology," "information service," and "information resources." The productivity of information becomes a "multiplier" and promotes the development of the productive forces within other industries. From the previous analysis, it can be seen that the penetration of the information industry into traditional industries exhibits a characteristic of "mixture," whereas the fusion of products and services serve as "compound" traits.

## **5 The Main Method to Measure the Existing Information Industry and Its Application Analysis**

The main methods to measure information industry include the following: Porat information economic measurement method, the input-output method [13], the Japanese informatization index model method [14], the Engel-Bray-Hitt multiplier method, the Hayes-Erickson logarithmic model, and the comprehensive information-industry dynamics method. [15]. Porat's method, the Engel-Bray-Hitt multiplier method and the comprehensive information industry dynamics method, etc., are a measure of the level of the information industry from the perspective of economics. Thus we can achieve the purpose of linking the information industry to the social productive forces as well as the industrial structure and labor force change. The social informatization-measurement method, such as the Japanese informatization index model method, comes from the perspective of sociology, i.e., measurement of the degree of social informatization of a country or region. The main characteristic of indexation measurement is correlation is the ability to perform longitudinal comparison of the time vector as well as compare the area vector. These two types of methods have their advantages and disadvantages, but both of them attempt to construct a comprehensive evaluation system that can completely and accurately reflect the situation of social information industry. However, they have problems as follows:

1. There are differences or overlap about the definition and scope of the information industry. Researchers have various definitions for the information industry and its range with both regional and time limitations. Today's information industry development and innovation have gradually expanded their scope, which can no longer use the old standard definitions. Original measurement system indicators may also no longer apply; thus, they must be readjusted.

2. The universality of the information industry is also an important index. The development of the information industry shows a trend to close to that of individuals, e.g. the E-mailbox number used, the number and type of APP that are used frequently, and the information services of the government and social service department. Such improvement of people's living standards and quality indicators also must be reflected in the measurement system.
3. The information industry continues to promote industrial upgrading in traditional industries, and some industries promote innovative integration such as mobile payments. That such emerging new departments continue to appear confers new problems in existed measurement method and index.

## **6 Development of Information Industry and the Impact on the Economy**

The rapid increase of the information industry caused great changes in industrial and employment structures and has also led to a dramatic change in the quality of economic growth in each respective country. Information has become one angle of the "resource triangle" in the process of economic operation and thus is on an equal position with materials and energy. The development of information technology shifts the consumption resources by economic growth from energy and materials to information and technology. Therefore, the development of the information industry has become an important symbol of a region's, or even a country's, level of economic development and degree of social progress [16]. Because of the characteristics of information technology, its impact on the economy lies not only in its output growth, which brings direct economic growth, but also in its permeability, which may improve traditional industries' efficiency by (1) dramatically enhancing their output and remarkably reducing production costs; and (2) as well as integration, which may promote the optimization and upgrading of traditional industries and even the formation of new industries. By such reasoning, the direct economic impact and indirect economic benefits of the information industry to the national economy are diffused; however, it plays a key role in national economic development. The impact of the development of the information industry of the given economy has been the focus of academic attention, but in view of its development process, a long-term, in-depth study is required.

Neoclassical economists believed that capital, labor, and technology are the three main causes of economic growth. Specialized knowledge, technological progress, and human capital can promote economic growth, technological development, and progress and, as such, are important factors in economic growth. However, now IT and technology are the main components. Robert Solow, who considered economic growth, capital, and labor technology established a new economic-growth model. However, he did not have a clear explanation about how technology affects economic growth.

Chinese scholars Xianhua and Ji used cointegration and Granger the causality test to analyze the relationship between the information industry and economic growth. Further theoretical calculations used gray relational information industry and the national economy in the correlation between the three industries [17].

The role of information industry development in other industries has increased the productivity generated, which is known as the “spillover effect” [18]; there is no doubt that there is also overall economic growth. This spillover effect of the information industry is multifaceted; It improves the working environment and workers’ productivity and it improves the quality of production factors of social production, thus contributing to economic activity in terms of more efficient, more rapid economic growth. Xinling and Li drew contributions from the two-sector model by Feder [19] to measure the information industry on economic growth [20]. Jinjin employed the GDP in 2004–2010 and the information industry output value of the panel data model to explore the impact of China’s information industry on China’s three major economic regions [21].

However, most scholars did not include the new information economic scale produced by the permeability and integration of information technology into traditional industries in the measurement systems. That makes the current-factors measurement of the economic impact of the information industry obviously flawed and does not conform to the development trend of the information industry. The estimation deviation of influence social and economic factors may lead to many economic-, industrial-, and policy-related issues.

## 7 Conclusion

Based on the characteristics of the information industry and its development, its effect on the economy should be studied from three perspectives as follows:

1. The existing information industry is at the core using current industry classification and statistic system directly to calculate the economic size and growth rate.
2. The information industry continually self-integrates into the production section of traditional industries with advanced equipment and technology. In production, sales, and service, the improvement and innovation of the method of production organization brings economic benefits and improves production efficiency. This point consists of the information industry promoting the economic growth scale while also belonging to the system. The input–output method should be used here.
3. New technology integrates with original traditional industries to bring about new products and departments in the continuous development of the information industry, which will also contribute to the development of the national economy. However, the marginal part of the new department is still fuzzy, and the definition is not clear, either, thus leading to inadequate research of the size of the economy and the growth rate as well as the impact on the economy

The sum of the three parts is the entire content of the information industry's impact on the national economy. Their development speed and scale, as well as a single part of the proportion of the GDP and the promotion of improved function, are the focus of subsequent quantitative research.

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