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Innovation Enhancement and International Technology Transfer in the Economy of the People's Republic of China

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SUMMARY

Research justification

Transformations in the modern world economy are taking place not only under the influence of technological revolution and global economic processes, but also events and economic changes in the countries that form those perceived as global economic powers. One of the most significant of such transformations at the beginning of the 21st century was the People's Republic of China (henceforth referred to as PRC or China) – a country of great economic and technological achievement – joining the leading group of developed countries – previously called the Triad (United States, European Union, Japan).

In 1978, after much political and economic discussion, the PRC authorities initiated the reformulation of the country's economic system by implementing major reforms that transformed the centrally planned economy to a market-based economy. This transformation of the economic system was carried out in a gradual, balanced and pragmatic way, introducing fundamental institutional changes and market-oriented instruments in four successive stages from 1978 to 2019. The goal of the implemented reforms was dynamic economic growth, an ambitious plan to be achieved not only through creating a well-functioning market but modernizing the economy through the liberalization of foreign exchange. The Chinese authorities recognized that the realization of economic reforms and social goals largely depended on the development of an open market, competitive enterprises (public and private), and their ability to create and apply new technologies and innovations.

Under the conditions of an economically and technologically underdeveloped country such as China in the 1970s and 1980s, accelerated technological development of enterprises and the economy was possible through the transfer (import) of technology from abroad, mainly from developed countries. In foreign exchange, the supply of various kinds of technology to the country are realized through the import of industrial goods, services, technical licenses, the inflow of foreign direct investment (FDI), international cooperation, information and knowledge flows in networks. Starting in the 1980s with the removal of restrictions on the import of machinery and equipment, the PRC authorities gradually opened the Chinese economy to the transfer of foreign technologies, which enabled the acquisition, subsequent absorption and effective use of these technologies in Chinese enterprises. Of key importance was the ability to move quickly from implementing foreign technologies to conducting their own in country research and development (R&D), ultimately leading to the creation of their own innovations

and launching of new, competitive products. The role of foreign technology transfer in enhancing the innovation of Chinese enterprises and the PRC economy have been of particular interest to me as a doctoral student in this area of research, especially the major changes in this area occurring during the economic transition. Thanks to readings and first-hand observations in China, I formed three main threads of scientific interest and research that guide my project: systemic transformation and economic growth, development of technological and innovative capabilities, and international technology transfer (ITT) involving China.

The policy of transformation, reconstruction and development of China's economy was undertaken about ten years earlier than in Central and Eastern Europe, making it a unique and experimental historical case study. As such this period has become the subject of much research and scholarly publication, among the most notable scholarly works in this area are those by: L. Brandt and T. G. Rawski, R. P. Appelbaum et al., X. Fu, B. Naughton, W. M. Morrison, B. Góralczyk, K. Starzyk, S. Dai and M. Taube, G. S. Yip and B. McKern, Z. Li et al. The analysis of changes in China's economy focused on two streams: economic policy and economic changes (institutional, market, resources and productive capacity, industry, foreign exchange and enterprises). At the same time, interactions, linkages and interdependencies were developing in various areas of the modernizing Chinese economy. Importantly, economic processes and phenomena in the PRC are significantly influenced by international policies, agreements, organizations (both global and regional) and the state of global economic activity.

The study of literature derived from the work of J. A. Schumpeter contributed to the knowledge of innovation and innovation models, processes, and systems. His concepts were developed, among others, by C. Freeman, H. Chesbrough, M. E. Porter, Oslo Manual (OECD) and other researchers of strategic management and international business. Among Polish researchers, whose publications proved most notable are A. Pomykalski, L. Bialoń, M. A. Weresa, A. H. Jasiński, A. Zorska. However, the scientific literature has not found a suitable research method that could be applied to an in-depth analysis of the process of fostering innovation in China's transforming, developing and opening economy.

Theoretical foundations of technology and technology transfer have been presented in publications by UNCTAD, J. H. Dunning, J. Tidd, J. Bessant, and Polish authors: S. Kubielas, W. M. Grudzewski and I. K. Hejduk, M.-J. Radło et al. ITT has been analysed by S. Umiński, and also recently in a book written by R. Ciborowski. In the literature on the subject (e.g. in publications by A. Zorska), technology transfer between countries is analysed in connection with foreign expansion of multinational corporations (MNCs) and the flow of their FDI (in the so-called "investment package"), as well as with the operation of global supply chains. Researchers

have established the difficulty of measuring ITT and determining its effects on a country's economy.

My research intention was not only to present the connections and interactions of three processes in China's economy – reforming and developing the Chinese economy, improving its innovation capacity and international technology flows – but also to develop a methodology to study the growing innovation and ITT under the conditions of active innovation policy.

Research objective and thesis of the dissertation, research framework and methods

The purpose of this dissertation is to study the process of increasing innovation in China's economy and the changes taking place in ITT under the conditions of the state's systemic transformation of the economy and active implementation of innovation policy since 1978. Based on the reading of major publications (books and articles), reflections and discussions, the following thesis of my dissertation was developed:

"Innovation enhancement in the economy of China is a state-led, long-term, complex and evolutionary process of increasing innovation capabilities. Being initiated under the systemic transformation, the process has been developing with institutional, economic, technological advances and is directed towards indigenous innovation. The innovation enhancement proceeds with a contribution and influence of international technology transfer being itself a subject to crucial changes which gradually decrease the significance of foreign technology inflow in the indigenous innovation enhancement."

In order to verify the thesis of this dissertation, I set seven research tasks (briefly presented below) that consist of, or concern, the following: (1) to develop my own account of the process of rising innovation in China's economy; (2) to develop my own concept of studying ITT; (3) to make an in-depth analysis of the processes of transformation and external liberalization in China and their significance for the development of innovation; (4) to discuss broadly the state's innovation policy, including institutional changes, instruments, directions and inputs; (5) to provide a characterization of China's national innovation system (NIS) and the activities of four groups of innovative actors; (6) to develop a research concept of ITT in China's economy; and (7) to make a comparative analysis of transfer activity in five ITT channels and the impact on the development of technological and innovation capacity in China.

This research covers the systemic economic transformations taking place in China and the state's innovation policy, which are the fundamental determinants of the process of increasing the economy's innovation and ITT. The dominant, empirical character of the research conducted in

this dissertation stems from this framing. Extensive use of various statistical data (verified, compiled) is essential in empirical and comparative analysis, and in the case of China, this requires special care and skill in their verification. Logical inference based on the results of the research methods allows for confirmation or rejection of the adopted thesis of the dissertation. The bibliography of this dissertation includes over 300 items, including scientific books and selected book chapters, articles, academic and consulting studies, and reports.

The research scope of the dissertation is limited to the field of economics and incorporates a time frame of 1978 to 2019 which accounts for the four stage economic transition. The research accounts for the collective development of China's economy with special focus being given to the changes occurring in high-tech industries.

Dissertation structure

The dissertation consists of an introduction, four main chapters with between three and four subchapters each, a conclusion, and an appendix section consisting of figures, charts, tables, and the research bibliography.

Chapter 1 outlines the theoretical background of the research, which refers to two important and broad issues: innovation, technology and technology transfer. Various definitions and concepts of innovation, innovation capacity and position, as well as NIS, are discussed. Different approaches to technology and technology transfer are presented, followed by an inter- and external country analysis of the mechanisms, forms, and channels of technology transfer. Next, the activities of foreign MNCs in technology transfer to countries hosting their direct investments and global supply chains are presented. The literature review revealed a lack of an adequate conceptualization to study the process of increasing innovation in the Chinese economy. This prompted me to develop my own concept of domestic innovation upgrading with foreign technology transfer, to study China's transforming, opening and changing economy.

Chapter 2 is devoted to presenting the processes of systemic transformation and external liberalization in the PRC economy, in the period 1978 to 2019. In it, I present the process of transition from a formerly centrally-planned economy to the development of a market economy. This chapter will include the characteristics and course of the four stages of economic reform, with attention paid to the long-term trends of development, dynamics and changes in the structure of the PRC economy. The development of resources and production capacity during the transformation of the economy and the current economic problems of the country are discussed against the background of the policies pursued by the Chinese authorities. This chapter then

presents the opening of the PRC economy to international flows of goods and factors, including efforts to become a member of the World Trade Organization (WTO), and the entry of foreign MNCs into the Chinese market. A detailed analysis of changes in the value and structure of foreign trade, FDI flows and the involvement of foreign corporations in the Chinese economy follows. The final section of this chapter discusses the state of China's economic ties in the world (and problems in the international arena), as well as international science and technology (S&T) cooperation, with a focus on the Triad countries.

Chapter 3 deals broadly with the innovation policies pursued by Chinese authorities during the transformation of the national economy. S&T and innovation policies are broadly presented, including their institutional foundations, directions, programs and instruments. This discussion is supported by the compilation and analysis of statistical data documenting the development of investment in R&D and the supply of qualified human resources, as well as the development of modern economic infrastructure. A thorough presentation of the activities of four innovative groups (enterprises, R&D centres, technology and innovation transfer intermediaries, and universities) serves as the analytical framework to discuss the changes, functioning and general characteristics of the Chinese NIS. This is followed by a comparative analysis of corporate innovation and the economy in China – demonstrating its uniqueness and the great progress achieved, against the achievements of other BRICS (Brazil, Russia, India, China, and South Africa) group countries. This study considers the international aspects of the growing innovation and competitiveness of major Chinese companies, using the expansion of several Chinese MNCs as examples.

Chapter 4 is devoted to the study of the changes in the course, characteristics and impact of ITT in the context of rising innovation in the Chinese economy. I present my concept of studying the changes of technology transfer to/from China and the impact and significance of ITT in enhancing national innovation. This concept consists of six elements: (1) establishing the scope of fundamental concepts; (2) a detailed study of the flows of tangible and intangible technology carriers in the five ITT channels, against the backdrop of China's economic transition; (3) identifying the factors of change in transfer activity in ITT channels; (4) determining the functions performed by ITT at a given stage of economic transition; (5) comparing transfer activity within and across channels; and (6) assessing the significance and impact of changes in ITT on the development of technological capabilities in China, and consequently also on rising the innovation of the Chinese economy.

The core of this concept is the analysis of technology flows to/from China through five transfer channels. This is followed by a discussion of the shifting factors of change and the

functions of ITT against the background of China's reforms and stages of economic transition. Important to the research herein conducted is the analysis of the development of the inflow of foreign technology into China and the outflow of domestic technology from China abroad (against the backdrop of economic transition) through five ITT channels: (1) trade, (2) investment, (3) licensing, (4) cooperation and (5) people. This is followed by a comparison of transfer activity across channels (inflow versus outflow) of Chinese ITT and an assessment of the gradual shifts in technology transfer occurring during the PRC's economic transition. This assessment is complemented by an indication of the direction of change in the evolution of China's dependence on foreign technology supplies in recent years

My dissertation concludes with a discussion of the collection of findings and results from the conducted analyses, followed by an assessment of the implementation of the research objective and verification of the thesis. In the concluding summary, the most important findings and conclusions which have been supported by extensive, verified statistical material, will be presented in a concise form.

Contributions of research tasks

The realization of the first research task, thanks to the extensive review of the scientific literature, made it possible for me to develop my own method of studying the process of rising innovation in a national economy. It is assumed that rising innovation is a long-term process of developing capabilities with consideration of technology transfer in an open economy, carried out at all levels of economic activity. My conceptualization assumes that innovation on a national level occurs as a result of four groups of factors, which are: (1) state policy (economic, innovation and other types); (2) activities of innovative entities (including foreign ones); (3) technological capabilities and technology transfer (including foreign ones); and (4) conditions in the domestic and global environment. This concept differs from other approaches in that it includes the policy of transforming and opening the economy, takes into account foreign entities and internationalization of NIS, exposes the development of technological capabilities and transfer of foreign technologies, as well as takes into account the impact of external conditions and factors on the country's economy (such as international agreements).

In the results of the second research task, the theoretical issues of technology and technology transfer are highlighted by discussing transfer mechanisms (commercial and non-commercial), the form of transferred knowledge and technology (embodied and disembodied), and forms and

channels of technology transfer in international business. Microeconomic aspects of foreign technology transfer are important. The adoption of transferred technology by an enterprise can trigger its absorption into a given organization, its effective use in production and the development of technological capabilities, followed by the enhancement of its own innovative capabilities. The main suppliers of foreign technology are MNCs from developed countries that use trade, investment, cooperation and licensing methods to transfer technology and penetrate host markets. While FDI inflows have traditionally been considered a positive form of engagement for foreign corporations, including in the transfer of their technology to host countries, global supply chains are now more widely used and well-regarded.

The results of the third research task showed that during the implementation of the four stages of economic reforms and market development, there was also a gradual opening of the PRC economy to international flows of goods, and then to the influx of FDI (along with capital and technology) and tightly controlled activities of foreign companies. This allowed China's economy to be injected with a significant transfer of foreign technology and stimulated the development of private business, as well as sharpened competition in the emerging market. At the same time, the state supported and shaped the development of domestic manufacturing resources and capabilities, which were directed at the expansion of technological capabilities of developing enterprises (private, public) and other innovative entities. Systemic transformation, external liberalization and the emergence of many new institutions laid the foundation for exchange mechanisms in the great Chinese market (goods and technologies) and for fierce competition of domestic enterprises, their determination to acquire foreign technologies and learn methods of competitive business. As a consequence of the fundamental economic changes in China, market factors (on both the demand and supply sides) were activated to spur the development of domestic technological capabilities, with the participation of foreign technologies and innovative capabilities.

The fourth research task is focused on the PRC authorities' innovation policies that responded to the conditions of the emerging market and the needs of the rapidly growing economy. This policy included a number of evolving institutional, transformational, ownership-related, and organizational measures, mainly in the public enterprise and R&D sectors. Actions leading to reindustrialization, i.e. the rebuilding of the industrial structure and the development of new industries, were also undertaken in the form of planning, programming (i.e. "Made in China 2025"), and promotion. Restrictions on the inflow of FDI were eased, and the creation of Sino-foreign joint ventures was supported as an effective way to quickly absorb foreign technology (and learn competitive business), which contributed to the technological development

of Chinese companies. The conditions for this development were created by increasing and supporting investment in R&D (public and private), developing a pool of highly qualified staff and modern economic infrastructure, as well as creating legal instruments to protect the intellectual property of companies. At the beginning of the 21st century, changes were introduced in innovation policy, aimed at intensive development of the most innovative areas of research and production with their own resources and by domestic entities, which was termed "improvement of national innovation" by the PRC authorities.

The fifth research task, which relates to the functioning of the NIS in China, is also partially related to the state innovation policy. It was assumed that in the Chinese NIS there are four groups of innovative entities of national origin – enterprises (with private and public capital), R&D centres (including scientific institutes) and universities, and of foreign origin – corporate subsidiaries and R&D centres. The group distinguished by the dynamic development of research and innovation activities are Chinese private companies that experiment and quickly implement the results of R&D work, created in their own laboratories or in cooperation with other entities, as well as apply technologies transferred from abroad. China's state-supported universities and R&D centres are playing an increasingly important role in creating new technologies and developing innovation linkages with other entities. As a result of the dynamic development of the innovation activities of domestic players, there has been a relative reduction in the importance of the "contribution" of R&D centres and subsidiaries of foreign MNCs to rising innovation in China.

The comparative analysis of the changes in innovation of the BRICS countries showed that China strongly outpaced other countries in all indicators of the development of innovation capabilities and in the achievements of this development. It was found that China – especially since 2007 – pursued its own specific path of technological development, which resulted in high intensity technological progress, changes in the industrial structure for the growth of high-tech industries, the development of global business and ITT links (from the side of the expansion of Chinese MNCs and technology outflow). In addition, it was found that in China there has been a strong reduction in the share of foreign players in the creation of cutting-edge technology. At the same time, Chinese companies – emerging MNCs – were rapidly increasing their innovation and international competitiveness, also becoming suppliers of the latest technologies acquired (e.g. through company acquisitions or R&D centres) and/or jointly developed technologies abroad.

The sixth research task in my dissertation required the development of a proprietary ITT study concept. My concept of studying Chinese ITT consists of six elements (as listed above in the section dedicated to chapter 4). In accordance with the findings in the literature on this

subject, five channels of technology transfer in foreign exchange are adopted: (1) trade, (2) investment, (3) licensing, (4) cooperation and (5) people. A detailed empirical analysis of the inflow/outflow of technology to/from China was carried out, and then the trends of changes in transfer activity on both sides of the ITT compared, with an assessment of changes in China's technological dependence on foreign countries presented.

Technology transfer to/from China was intertwined with policies and changes in the domestic economy, and was an important and evolving part of the modernization process. The inflow of foreign technology was strongly accelerated at the second stage of reforms (at the turn of the 20th and 21st centuries) and continued at later stages, while the use of different channels and characteristics of transfer activity changed. These changes were driven by institutional and then economic and technological factors. Initially, the inflow of technology fulfilled the function of supplying the economy with new technologies, then a function complementary to domestic resources developed, and more recently a function complementary to R&D work in China. Extensive technology transfer – along with rapidly growing imports of high-tech products, FDI inflows and license purchases – has significantly contributed to the development of technological capabilities of Chinese enterprises during more than two decades of economic transition. However, according to the PRC authorities, foreign companies and their technologies have not significantly supported the development of domestic innovative capabilities in modern industries. For this reason, since 2007, Chinese state innovation policy has been strongly oriented to the development of domestic innovation, and the inflow, role and function of foreign technology transfer have gradually decreased.

Completion of the seventh research task showed that the long-term development of China's ITT was characterized by evolving dynamics (including accelerated growth phases) and changing characteristics of activity in all channels. In the inflow of foreign technology, the most significant changes were the shifting of transfer activity from the trade channel, through the investment and cooperation channels to the licensing channel. These changes were to some extent of a small sequential and substitutional nature, and partly also complementary. In the outflow of Chinese technology, similar changes took place, but they were delayed by about ten to twelve years. The evolution of technology inflows and outflows to/from China proceeded asynchronously, due to the time lag needed for absorption of foreign technologies, development of their own innovations (or imitation of them), and business development and overseas expansion of Chinese companies. Today, Chinese MNCs are already significant suppliers of technology to other countries. The existing differences in the intensity of technology inflows and outflows to/from China resulted in changes in the value balance of technology carrier flows,

which evolved from an import surplus to an export surplus in the trade and investment channels by the end of the second decade of the 21st century. This indicates a trend toward increased balance in China's ITT, the decreased importance of foreign technology inflows, and a partial decrease in the technological dependence of China on foreign countries.

Final conclusions

This dissertation has examined the long-term and broadly defined process of increasing innovation in China's economy and changes in ITT, taking into account the evolving conditions created by the transformation, innovation, opening and other policies of the PRC authorities. The implementation of the research and the findings from this research confirm the validity of the thesis of my dissertation. I have found that rising innovation in China's economy is a state-led, long-term and evolving process of institutional, economic and technological transformation, which has been directed at the development of national innovation. The process of rising innovation was initiated in the conditions of a transforming and increasingly open economy, and carried out with adaptation to the conditions (domestic and international) and needs of enterprises developing competitive business. It was carried out with the use and influence of ITT, which is undergoing important, gradual changes, which reduce the importance of the inflow of foreign technologies for rising national innovation.