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Innovative Development of the Countries of the Asia-Pacific Region

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***Abstract*—The country's economic growth is largely determined by the development of innovations in the country. The development of an innovative economy is not just the result of the adaptation of the subjects of the economic system, but their radical transformations, and this requires the active participation of the state. To transition to an innovative development model of the country, the state needs to develop a national innovation strategy, prepare a legislative framework, form an innovative and institutional infrastructure. Today, Asian countries are one of the innovative regions of the world; their regional economy is growing faster than the developed Western economies because of the competent innovation policy of the state. This article describes the process of developing an innovative economy in the countries of the Asia-Pacific region, as well as features of the national innovation policy of states.**

Keywords—innovative development, innovation policy, world economy, R&D financing, Pacific Rim, China, Japan, South Korea, Taiwan, Singapore

I. Introduction

At the end of the 20th century, Europe lost its leading position in the field of innovation. Asia's financial market got out of the crisis, as well as increased economic potential. New players have entered the global innovation market, such as China, Japan, South Korea, Singapore, Thailand, Taiwan, Malaysia and others.

Today, China and Japan have the largest economies in the Asia-Pacific region. People's Republic of China is often called in the press as the main contender for superpower status. South Korea, Hong Kong and Taiwan are the so-called Asian tigers [1]. Since the 1960s and up to the Asian financial crisis, these regions have demonstrated very high rates of economic development. The economic success of the Asian region led to the fact that the World Bank in 2007 called it the "East Asian Renaissance".

II. Results

China. China's economy is the second largest in the world in nominal GDP (13.457 trillion dollars for 2018).

After a long isolation from the world economy, China's economy turned into a socialist market economy in the 1970s. The “openness policy”, launched in 1978, actively supported foreign direct investment. In order to study foreign technologies, Special Economic Zones and National Economic and Technological Development Zones were created [1].

Science and innovation developed especially intensively in China between 1990 and 2010. In December 2001, China was accepted as a member of the World Trade Organization (WTO), which accelerated the opening of the Chinese economy, providing access to the world market and attracting more investment.

The Chinese economy, which was accused of releasing low-quality products and copying technologies, is now increasingly focused on local innovations and seeks to reform the remaining weaknesses (in particular, copyright protection). The Chinese government pays special attention to financing innovation as a fundamental part of the country's socio-economic development, as well as national prestige [2].

Thus, in the 21st century, a series of government programs were carried out in China aimed at promoting local innovation and innovative development. These include the national medium-term and long-term program for the development of science and technology (2006–2020), the Strategic Developing Industries initiative, the Internet Plus initiative, the program “Made in China until 2025”, the research program of Zhang Jiang, aimed to attract outstanding professors, the Thousand Talents plan, aimed at attracting the best Chinese researchers from abroad and others. Nationalism and nationalist achievements are viewed as the main ideologies of the Chinese regime, because Marxism loses influence.

The Chinese government also played a direct role in technological development in sectors such as space exploration, defense and supercomputers. All over the world, the state is often the only or dominant consumer in these industries. Thus, technological innovations, as a rule, are financed by the government and carried out inside state and quasi-state laboratories.

Innovation clusters that are part of China's innovation strategy have become centers of local technological development, which bring a huge amount of foreign investment to the regions. Foreign companies also receive an incentive to transfer technological innovation and promote research and development in China.

Today, the PRC has developed 1,300 industrial and innovative clusters. More than 560 thousand scientific and engineering workers (including more than 52,000 masters, more than 9,000 PhDs), as well as a third of all college graduates (1.33 million out of 4 million) are currently employed in the system of innovation clusters. In this system, more than 250 business incubators of innovative and high technologies are functioning, and also powerful research centers (R&D) have been created, which exceed eight times the average national investment volume and six times their specific values.

The success of Chinese industrial and innovation clusters is due to the financial support that the state provides to small and medium-sized enterprises, gross expenses on R&D (2% of GDP in 2016), as well as close cooperation between research centers and local universities.

However, from 2010 to 2015, the share of Chinese patents issued by the United States Patent and Trademark Office (USPTO) was only 2.2%. Over the same period, the share of patents granted by the USPTO for inventions originating from Japan and South Korea was 18.8% and 5.5%, respectively. According to the latest report from the OECD, not a single Chinese university is in the world top 30 in the number of cited scientific publications. In addition, China has a small share in the most popular publications [3].

This can be explained by the fact that the bulk of government research and development funds in China allocate money based on political connections. This practice increases the risk that part of the money will be spent on specific buildings and equipment, and not on research.

Secondly, China spends relatively few resources (only 4% of the total) on basic research as compared to OECD economies (17% of the total). As a result, Chinese R&D focuses on existing knowledge to adapt products and services for the Chinese market; not enough research efforts are directed towards the development of new scientific ideas and technologies.

Another reason for the relatively small number of patents is China's Great Firewall, which makes it difficult for Chinese researchers to access global information.

China is also taking steps to share innovations, it wants to receive innovations from other countries and create global innovation networks. However, foreign companies are at a disadvantage because of litigation involving intellectual property (IP). As a result, almost all Western technological giants have research laboratories in China, but the majority is local adaptation, and not the development of technologies and products of the next generation. They do not want to risk the transfer of the latest technological developments to Chinese competitors. As a direct result, China lags behind the advanced research and development of the world's leading developers, and this is a key factor in the emergence of innovative ecosystems, such as Silicon Valley.

Despite the flaws in the innovation system, China is on the verge of a new wave of innovation business model, which combines three advantages, namely, a system of production clusters, inexpensive skilled workers and an extensive domestic market to offer high-tech, high-quality and low-cost products.

Japan. The Japanese economy is the third largest in the world in nominal GDP (5,632 trillion US dollars for 2018). Japan has been a member of the G7 since 1979.

For three decades of economic development after 1960, there was a rapid economic growth called the post-war economic miracle of Japan. Under the leadership of the Ministry of Economy, Trade and Industry and with an average growth rate of 10% in the 1960s, 5% in the 1970s, and 4% in the 1980s, the Japanese economy was the second largest in the world from 1978 to 2010. It was later surpassed by the People's Republic of China.

As the economy developed in the 1970s and 1980s, Japan gradually became independent from foreign research and development. Japan's ability to conduct independent research was a decisive factor in improving the country's competitiveness. Back in 1980, the Japanese Science and Technology Agency, which is part of Kantei (the office of the Prime Minister), announced the beginning of the "era of technological independence of Japan"[4].

In 2017, 1% of Japan's GDP was in the agricultural sector, 29.7% in the industrial sector and 69.3% in the service sector. Most Japanese innovations occur in the industrial sector. Japan is home to many technological innovations, mainly in the automotive, pharmaceutical and electronics industries.

In 2010, the Japanese government formulated a long-term innovation strategy for the development of the country, the main sectors of which were alternative energy and energy conservation. However, according to Japanese experts, the country's leadership has limited this strategy only to technological innovations, disregarding the development of venture, small and medium-sized companies. At the moment, the support of such enterprises is insufficient and does not contribute to the development of the country's R&D.

In recent years, Japan has been the leader among the economically developed in terms of gross domestic expenditure on research and development (3.14% of GDP). The state part of financing is 19–20%. It can be concluded that innovations are mainly funded by the private sector.

Also, it should be noted the level of development of higher education, especially technical universities. Continuous training of employees and the close relationship of enterprise managers throughout the management vertical have created fertile ground for improving production and monitoring product quality [5].

Large corporations (zaibatsu) dominate the Japanese market. This makes it difficult for startups to compete because of their limited access to capital. Major Japanese corporations usually finance their own research. *Zaibatsu* function as oligopolies in their industries, in the market, in research and development.

SoftBank is one of the largest investors in the world, located in Japan. However, the country has a relatively small amount of investment, which is sent to startups. The first steps have already been taken to solve this problem. The abolition of minimum capitalization requirements and the creation of the Innovation Network Corporation of Japan contributed to the growth of venture capital in the country. In 2016, startups had about 92.8 billion yen, according to Japan Venture Research [6]

The Japanese system of innovation clusters is concentrated in Tokyo. Tokyo's success in attracting and sustaining innovation is not surprising. Its size and the role it plays in the transport network of Japan are large. Tokyo became the financial center of Japan in the period of rapid industrialization after 1868. Now there are more than 60 national research institutions, as well as half of the national research budget of the country.

But to compete with the growing economic forces of Asia, such as Taiwan and Korea, the state has to support regional innovations.

The development of regional clusters in Japan is hampered by the low mobility of personnel and the concentration of research infrastructure in several megacities. The government of Japan needs to adopt a strategic and integrated approach to building the innovative capacity of the regions to meet international standards.

South Korea. South Korea's economy is fourth in terms of GDP in Asia and 11th in the world (nominal GDP is $1.655 trillion).

South Korea is impressive in its growth. It has evolved from one of the poor countries of the world into a high-income country in just a few generations. This economic growth is described as a miracle on the Hang River, which brought South Korea to the ranks of the elite OECD countries and the G-20.

The country invests a significant portion of its GDP in research and development. According to published data by the Organization for Economic Cooperation and Development (OECD), South Korea spent 4.2 percent of its GDP on R & D in 2016.

The country is well known for its obsession with education, which has come to be called "educational fever." South Korea has one of the most highly educated labor resources in the world among OECD countries. In 2015, the country spent 4.7% of its GDP on all levels of education, which roughly corresponds to the average value of the Organization for Economic Cooperation and Development (OECD).

The influence of the government is particularly noticeable in the following five areas: industrial policy, the national innovation system, regional innovation systems, legislation and subsidies. Nevertheless, even with the growing participation of the government in innovation policy, studies indicate some shortcomings in the innovation system of South Korea.

Korea came into the process of industrialization late and for a long time borrowed ready-made technologies from other countries. The so-called *chaebol*, the leading conglomerate firms - Samsung, Hyundai, Daewoo, Lotte, LG are characteristic of the national innovation system of Korea. The government of South Korea promoted the development of chaebols in order to use them for economic growth. These business groups have played an important role in accelerating technological development in industry and the globalization of South Korean businesses. These firms generate a large share of production and exports in the country.

At the same time, medium and small firms, which are also an important part of the national innovation system, do not have adequate state support, access to the technological and market opportunities of large firms, and significantly lag behind them. Venture capital institutions are also underdeveloped: business angels and venture funds that could invest money in small and medium enterprises.

Regarding government research and development, there is a relatively large sector of public research institutions in Korea, but university research and communication with research centers is relatively small [7].

South Korea's largest cluster is the Kumi electronics industry complex. The cluster is the largest technological complex in South Korea, which includes four technology parks. The complex has manufacturing companies, their suppliers, intermediary companies, as well as government organizations, including two universities. The total number of companies in Kumi is 725, the number of full-time employees is about 80 thousand [8].

Further development of the innovation system of Korea largely depends on the degree of attraction of small and medium enterprises in the NIC of the country, as well as the formation of proper infrastructure for them: the development of venture funds, improving the structure of scientific and technological parks.

Singapore. Singapore's economy is rated as the most open in the world. The nominal GDP for 2018 is 554.8 billion US dollars. Exports of products (in part, electronics and chemicals) provide the main source of income for the economy, which allows Singapore to purchase raw materials and minerals that are lacking in the country.

Singapore ranks first in the world ranking of the quality of education, spending on education makes up 20% of the budget of GDP. Singapore attracts a large amount of foreign investment due to its location, skilled labor, low tax rates, developed infrastructure and zero tolerance for corruption [8].

Singapore is actively developing and promoting biomedical research and development. The investment began in 2001 and has continued since then. From 2006 to 2010, the government allocated $ 13.5 billion for R & D, more than double the cost of the previous five year period. Of this number, 25.3% were transferred to the biomedical sector.

At the beginning of 2016, Singapore's Prime Minister, Li Xian Loon, introduced a new concept for the development of an innovative Singapore economy called "Research, Innovation, Entrepreneurship 2020". The strategy aims to support universities, research and innovation centers and the business sector. According to this strategy, most of the funding will be directed to the development of the following areas:

1. advanced manufacturing and engineering;
2. biomedicine;
3. services and digital economy;
4. urban solutions.

Singapore's innovative model is dominated by the public sector.

Singapore has great potential in R&D. This contributed to the development of links between universities and industry, as well as the growth of partnerships between public and private industry. In addition, Singapore willingly accepts highly skilled immigrants. To lead the research institutes, world-renowned scientists are moving to the country. Singapore has the highest number of PhDs per capita.

Singapore has become a link for international cooperation in research and development. The Campus for Research Excellence and Technological Enterprise (CREATE) has established 15 joint research programs between local universities and 10 leading foreign institutes (including the Massachusetts Institute of Technology, the Swiss Federal Institute of Technology in Zurich, and Shanghai Jiao Tong University).

Despite the advantages of the innovation system, Singapore is the most expensive city in the world to live in. This is a deterrent to relocating expats. The high cost of construction prevents global companies from building laboratories and factories.

Also in the economy of Singapore is dependent on the export of goods. Singapore's economy will decline if the economies of neighboring countries deteriorate.

Taiwan. Taiwan's national economy is the seventh largest in terms of GDP (US $ 600.9 billion) in Asia and is in the group of advanced economies. Electronics and information technology make up 35% of the total production structure.

To stimulate Taiwan’s economic development and create innovative economy, the Taiwan government prepared an effective legislative framework, adopted key policy documents for development, and allocated significant financial resources in science and technology [9].

Recognizing the need to learn from the outside world, the government of Taiwan encouraged students to receive postgraduate education abroad. Initially, many graduates found jobs abroad and stayed there (mainly in the United States), because opportunities in the Taiwan region were limited. Since the late 1980s, an increasing number of graduate students began to return to Taiwan. Education and work experience gained abroad has become a good way to transfer technology to the country.

In the 1980s, Taiwan became an economic power with a mature and diversified economy, a strong presence in international markets and huge foreign exchange reserves. Many companies were able to go abroad, internationalize their production, invest in Asia (mainly in China) and in other countries of the Organization for Economic Cooperation and Development, mainly in the United States.

Industrial Technology Research Institute of Taiwan (ITRI), Xin Zhu Science and Industrial Park, and the National Science Council’s Science Department established their offices in Silicon Valley, which provided them with access to contacts with foreign firms and technologies. Many Taiwanese brands have become important suppliers of world-renowned companies such as DEC or IBM, while others have opened branches in Silicon Valley and other places in the United States and have become known.

One of the features of Taiwan is its orientation towards English education. The ultimate goal is to become a country where people are fluent in three languages (Taiwanese, Chinese and English) [10].

Taiwan's innovation system is focused on small and medium-sized firms. Small and medium enterprises make up 85% of total production. Although the development of small and medium-sized businesses made it possible to improve market adaptation and establish inter-company partnerships, most companies in Taiwan remained original equipment manufacturers (OEMs) and did not expand the production of original structures (except for Acer and Asus). This holds back investment in branding and R & D.

Taiwan is also still heavily dependent on offshore capital and technology from the USA, Japan and China.

After the inauguration of the new Taiwanese president, Tsai Ing-wen, the Democratic Progressive Party decided to continue to lead an active innovation economy in Taiwan's IT industry. To modernize Taiwan’s economy, its “5 + 2” initiative in the area of innovative industries is aimed at developing key sectors such as biotechnology, sustainable energy, national defense, intelligent machines, and the Asian Silicon Valley project [11, 12].

After rapid economic growth in the 1980s, in the late 1990s, Taiwan’s economic growth became much more modest. A key factor to understand was the rise of China. China offered the conditions that Taiwan offered 40 years ago (a calm political and social environment, cheap and educated workers). To continue to grow, the Taiwanese economy must abandon its labor-intensive industries that cannot compete with China, Vietnam or other countries, and continue to innovate and invest in information technology.

III. Discussion

Almost all the countries of the Asia-Pacific region began their innovative development by borrowing Western technologies, however, in a very short time they were able to increase their own innovative resources.

Most countries in the Asia-Pacific region have a small amount of natural resources, so education and human resources developed at the initial stages of building an innovation system. In the countries of the Asia-Pacific region, relying on innovative development, there is a high level of literacy of the population; the state is actively implementing student exchange programs [13].

A characteristic feature of the innovation systems of the Asia-Pacific region is the decisive role of the state in shaping the institutional infrastructure and stimulating the innovation process. According to Western theory, science and innovation can only grow in a liberal society. At the same time, the experience of China and Singapore showed that political leadership and socio-economic reforms were successfully carried out under an authoritarian political regime.

In contrast to the countries of Europe, most of the countries of the Asia-Pacific Region (Japan, South Korea, and Taiwan) have a low proportion of basic research. A large share of development is financed by the private sector and is focused on the production of commercial goods and exports. The main part of the fundamental studies is carried out in universities, but the level of their implementation is relatively small.

IV. Conclusion

In conclusion, it can be stated that the national innovation system was an important factor in the development and growth of the economy for many countries in the Asia-Pacific region. The experience of these countries is useful for countries that are just creating innovative policies and have goals to create competitive production for effective connection to the global economy.

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