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COMPARATIVE ANALYSIS OF SMART ECONOMY DEVELOPMENT IN SELECTED COUNTRIES OF SOUTHEAST ASIA

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Abstract. *Research subject*. The development of the global economy indicates the formation of a new trend in the formation of the smart economy, which currently covers both developed and developing countries. According to the analysis, developed countries are leaders in economic development precisely because of the development of technologies that are the basis for the formation of the smart economy and the smart intellectualisation of economic activity. The smart economy in Asia is actively developing due to the intensive introduction of the latest technologies, innovative management approaches, and increased resource efficiency. Asian countries such as China, Japan, South Korea, Singapore, and India are leaders in the development of the smart economy. At the same time, Asian countries have been demonstrating one of the highest rates of economic development since the beginning of the XXI century, which is primarily due to the active technologisation of production and the spread of communication technologies in all areas of economic activity. Several technology centres are emerging in Asia, concentrating technology companies and creating a favourable environment for the development of the smart economy. *Methodology*. The article conducts a comparative analysis of the factors contributing to the development of the smart economy in individual Asian countries, identifies the most influential factors and the degree of their impact on each country. The *purpose of this study* is to identify the factors influencing the development of the smart economy and compare their impact in the economies of China, India and Singapore. To achieve this goal, the following research objectives are envisaged: to identify factors that have a significant impact on the development of the smart economy in different countries; to assess the impact of individual factors on the development of the smart economy in China, India and Singapore; to compare the impact of individual factors of the smart economy on the economies of these countries; and to assess the models of smart economy development in China, India and Singapore. *Conclusion*. The smart economy in Asia is characterised by unique features that reflect the cultural, technological and economic conditions of the region. The key features of the Asian smart economy include a high level of digitisation and technological integration, active development of smart cities, financial technologies (FinTech), a focus on automation and robotics, innovation hubs and support for start-ups, environmental sustainability and green energy, and the digitalisation of governance and public services. Asian countries are also distinguished by the integration of smart technologies into the everyday life of citizens and the support of innovation ecosystems at the state level.

Keywords: smart economy, development of the smart economy, factors influencing development, smartisation, intellectual capital.

JEL Classification: F00, F60, F64, O14, O18, O21, R15

1. Introduction

Recently, the smart economy has been actively developing not only in developed countries, such as the United States, Europe and Japan, but also in developing countries, particularly in Asia. The smart economy is actively developing in China, India and Singapore. An examination of the factors that shape the evolution of the smart economy in diverse nations offers insights into the existence of a universal approach to fostering the smart economy across different

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countries. Consequently, each country possesses a distinctive array of resources and circumstances that shape the evolution of a smart economy. Accordingly, the influence of specific smart economy development factors varies across countries.

The problems of the development of the smart economy in the world as a whole are being studied by both domestic scientists, for example, O. Nosyrev (2018), Z. Shatska, A. Khlystun (2021), N. L. Frolova (2020), I. Kalenyuk (2021), I. Uninets (2021) and foreign scientists such as W. Zhang, S. Zhao, S. Wan (2021), Yu Yao (2016), S. M. Sureshchandra, J. J. Bhavsar, J. R. Pitroda (2016), P. Lombardi (2011), Marcus Conlé, Tobias ten Brink, Wei Zhao (2022) and others. However, Asian countries have become quite active in this market and are beginning to catch up with European countries in their policy of smart intellectualisation of economic activity. This requires studying the experience and factors of the smart economy.

The purpose of this study is to identify the factors influencing the development of the smart economy and compare their impact in the economies of China, India and Singapore. To achieve this goal, the following research objectives are envisaged: to identify factors that have a significant impact on the development of the smart economy in different countries; to assess the impact of certain factors on the development of the smart economy in China, India and Singapore; to compare the impact of certain factors of the smart economy on the economies of these countries and to assess the models of smart economy development in China, India and Singapore.

The working hypothesis of this study is that the factors that influence the formation of the smart economy in different countries differ depending on the characteristics of the country's economy and the stage of development of the country's economy in general and the smart economy in particular.

2. Main Research Material

In today's world, the smart economy is an economy based on the introduction of digitalisation and information and communication technologies (ICT) into traditional sectors of the economy, which significantly increase the efficiency of traditional sectors of the economy through more efficient use of resources and the creation of new opportunities for economic development. But in addition, the smart economy involves the development of new sectors of the economy that actually enable the digitalisation of traditional industries. These new industries include the electronics industry, the IT sector, i.e., software development, communications and telecommunications.

The development of the smart economy ensures the more efficient use of resources, particularly labour, which in turn creates the potential for the attraction of a greater number of workers to new sectors of the economy. The creation of new economic sectors and the expansion of the range of goods and services, including digital ones, contribute to the accelerated economic growth of the respective country. It is for these reasons that governments are interested in developing the smart economy sector, as it allows them to accelerate economic growth, identify new resources and sources of economic growth. In light of the above, it is pertinent to inquire as to the factors that facilitate the advancement of the smart economy. This is particularly relevant in the context of Ukraine, which can draw upon the experiences of other countries to foster the growth of its own smart economy in a more organic and expeditious manner.

The largest smart economies are developed in countries that are global economic leaders, namely the United States, China, the EU, and Europe as a whole. Japan is somewhat behind the leaders in the development of the smart economy, having once been one of the leaders in the development of the electronics industry and smart technologies in general, but now lagging behind, although it retains significant potential in the electronics industry and in certain sectors of the smart economy.

The US economy is currently the benchmark for the development of the smart economy, as many new ideas and technologies that are then spread around the world originate in the United States. However, in addition to the US, China and Europe, new centres of smart economy development are emerging in the world that were previously considered to be backward or secondary in this area. These are primarily countries such as India, Singapore and some Southeast Asian countries (Malaysia, Vietnam, Indonesia). It is advisable to consider the factors that influence the development of the smart economy in both old and new centres of smart economy development (Figure 1).

Below is a more detailed examination of the impact of certain factors on the development of the smart economy. Having its own electronics industry in the form of designing and manufacturing various electronic devices and components is not a prerequisite for the development of the smart economy, but the presence of this factor significantly increases the opportunities for its development. After all, the economy receives its own computers, smartphones, chips and other electronic components, which makes it possible to use advanced technologies in the development of the smart economy. In the absence of a domestic electronics industry, access to modern electronic components and devices is essential, as they constitute the basis for the development

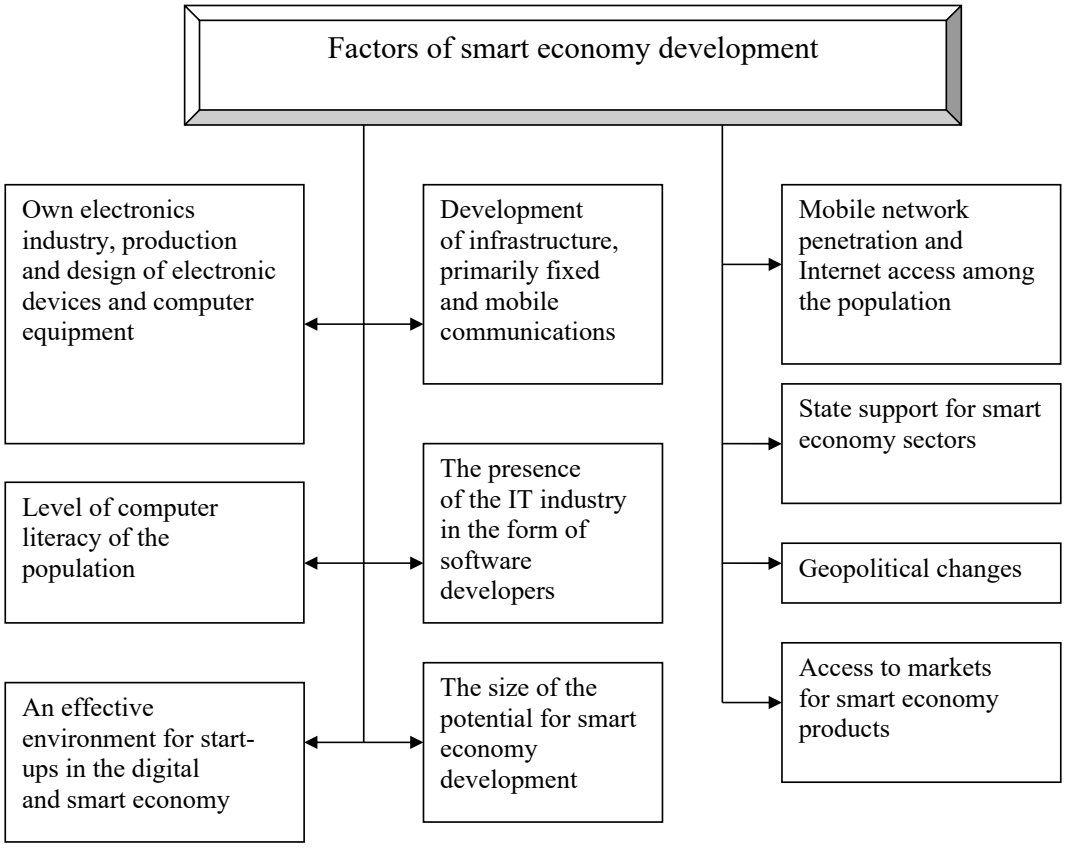

Figure 1. Key factors in the development of the smart economy
Source: compiled by the authors on the basis of (Shatska, Khlystun, 2022)

of the smart economy. Those countries that are unable to access modern electronic components will be at a disadvantage in the development of the smart economy in comparison to their competitors. Furthermore, the production and design of electronic components and products constitute an integral aspect of the smart economy, thereby markedly accelerating its development within the country.

Infrastructure development represents a critical determinant of the evolution of the smart economy. Infrastructure is primarily concerned with the communication infrastructure, including the prevalence of access to broadband internet, the prevalence of fixed and mobile telephone service, mobile internet, and electricity availability. For instance, in developed countries, the availability of electricity is not a significant issue and is typically taken for granted. However, in some Asian countries, such as Afghanistan, Syria, certain regions of Pakistan, India, and even China, access to electricity can be a significant challenge.

The availability of infrastructure is inextricably linked to the extent of mobile penetration and internet access for the country's population. It is insufficient to construct infrastructure; it is also necessary to guarantee the provision of communication services for the population. The issue of access can be approached from two perspectives: the technical feasibility of communication access and the economic feasibility of doing so. China and India are countries with a high population density, which facilitates technical access to mobile and fixed-line communications and broadband Internet. The laying of communication lines in densely populated regions allows for the technical connection of a large number of people at the same time, thus facilitating the provision of these services to a significant proportion of the population. The affordability of the Internet refers to the ability of the population to purchase the requisite technical devices that facilitate access to the Internet and mobile communications, including smartphones, computers, tablets, and laptops, as well as to pay for the associated services.

The level of computer literacy is an important factor in the development of the smart economy, as the ability to use computers and smartphones means that the population can be involved in the smart economy either as consumers of digital services and other smart economy products or as production personnel for whom computer literacy is a prerequisite. Computer literacy is impossible

without simple literacy, i.e., the ability to read and write, so the higher the level of literacy and education in a country, the higher the opportunities for the development of the smart economy.

The development of a smart economy is impossible without a strong IT industry in the country's economy, i.e., firms that develop software and create new digital products. The IT industry is represented by two sectors: companies that create ready-made digital products and solutions, and companies that work on behalf of foreign companies and their representative offices, not creating a finished product but creating its individual elements or outsourcing their staff to foreign IT companies.

It is evident that state support is a crucial factor in fostering the growth of a smart economy. This is particularly evident when a country is attempting to rapidly catch up with the advancements made by other nations over decades. Furthermore, state support is required to safeguard the industry from foreign competitors and to guarantee economic security on a national level. The provision of state support for the industry is achieved through a variety of means in different countries. To illustrate, in the United States, government support for the smart economy manifests in the form of public procurement, trade policy, tariffs and restrictions on international trade in smart economy products. In China, state support is manifested in several ways. Firstly, the state directly participates in the capital of companies involved in the industry. Secondly, the state finances specific areas of development and research. Thirdly, the state creates conditions for the development of the industry, including through tax and tariff policies. Finally, the state guarantees investments for foreign investors in the industry (Made in China 2025, 2018).

In India, the government exerts regulatory control over the industry through the implementation of government measures designed to attract foreign investment, the provision of financial support for the development of digital infrastructure and the funding of initiatives aimed at enhancing computer literacy and access to mobile communications and fixed Internet for citizens, particularly those belonging to the most economically disadvantaged segments of the population (India's Vision 2030 – Drishti IAS, 2022).

The degree of government support for the smart economy is inextricably linked to the availability of an ecosystem conducive to the growth and development of startups within the smart economy. The most renowned incubator for such startups on a global scale is Silicon Valley in the United States. This locale is home to a multitude of prominent corporations, higher education institutions, research laboratories, and small firms engaged in the development of novel products and concepts for the industry. Analogous environments to Silicon Valley can be found in China (Zhongguancun) and India (Bangalore and other cities). In China, the establishment of technopolises and innovation centres is financed by the state. In the United States, the preference is for indirect influence on the activities of such organisations. In India, regulation combines both direct state intervention in the industry and indirect influence through various economic instruments to regulate the industry.

The potential for the development of the smart economy in a country is defined as the current level of implementation of smart technologies in the country's economy and the potential benefits from their implementation at the level inherent in countries with the most developed smart economies. In turn, the potential benefits from the introduction of digital and smart technologies depend on the current size of the economy, the size of the domestic market, and the difference between the current level of smart economy development in the country and the potential level. Thus, countries with a large current economic size and a large population and a low current level of smart economy development have the greatest potential for smart economy development. For example, the United States has a large economy and a large domestic market, but also the highest level of smart technology adoption in the economy at the moment, which means that the potential for growth is relatively low and requires research and significant investment in innovation to exploit. China also has a strong economy, a larger population and a lower level of smart technology adoption than the US, so the potential for smart economy development is higher here. India has the largest population in the world and a much smaller economy than the US and China, but the level of smart technology adoption in the economy is low, so the adoption of smart technologies will provide high returns, so India has the highest potential for developing a smart economy.

The geopolitical changes taking place in the world are a factor that has only recently begun to play an important role for major Asian economies. Currently, there is a geopolitical confrontation between the United States and China, in which the United States will be supported by other Western countries and Japan. This geopolitical confrontation is manifested in the trade war between the US and China, which has led to the US imposing restrictions on the supply of equipment for the production of microchips using the latest technological processes to China. China, in turn, has imposed restrictions on the export of rare earth elements, about 70% of the world's production of which is concentrated in China. This led Western companies to move the production of electronic

components and products from China to other countries, mainly India. On the other hand, China has begun to develop its own microchip manufacturing technologies. This has led to the growth of the "smart economy" in India and some other Asian countries, as well as to a change in the role of trade and production intermediaries in the region, such as Singapore.

In the smart economy, there are positive economies of scale, meaning that as production and sales increase, unit costs decrease. This is especially true for software and other digital products that have high initial production costs but cost very little to make or sell a copy. Therefore, sales growth in the smart economy is profitable, and thus market access plays an important role. Large countries with a large domestic market have an advantage because they can protect their domestic market from competition through protectionist measures. Smaller countries are forced to seek permission to enter foreign markets and integrate into international value chains to successfully develop a smart economy.

Three Asian countries with strong and fast-growing smart economies were selected to compare the impact of various factors on the development of the smart economy: China, India and Singapore. These countries differ in the conditions and resources available for the development of the smart economy. Below is a comparison of these countries in terms of the readiness of the population and infrastructure for the development of the smart economy (Table 1).

China and Singapore have similar adult literacy rates, approaching 100%, while India lags behind, with over a quarter of the population illiterate. Singapore's expected and average years of schooling are also significantly higher than those of China and India. At the same time, China's figures are slightly higher than India's. From this it can be concluded that Singapore has the most educated population, including in the field of computer literacy. China has a strong position in literacy, and the level of education is uneven, with large cities and coastal provinces in China having high levels of education, while rural areas and western regions have relatively low levels. Overall, China is well positioned for the development of a smart economy, given the size of the country. India has the lowest literacy rate in the world, which means that a quarter of the population cannot be involved in the digital economy. The average level of education in India is also the lowest, although the country also has a high level of inequality in education by geography, social group and gender. Thus, India needs to raise the overall level of education of its population, which will expand the potential for the development of a smart economy in the country. After all, raising literacy to 95-96% means engaging an additional 350 million people in the smart economy, which is more than the US population.

Singapore is the leader in terms of the number of fixed-line subscribers, China is in the intermediate position, and India is lagging behind with only 1.8 fixed-line subscribers per 100 people. It should be noted that fixed telephony is losing its relevance for the development of a smart economy: the pace of fixed-line development is declining in all the above countries. In Singapore and China, the number of mobile subscribers exceeds 100 per 100 people, but it should be noted that citizens often have two or more mobile phone numbers from different operators for different purposes. In India, this figure is less than 100, but in fact, given that a portion of the population has multiple mobile numbers, mobile coverage in India is insufficient and has potential for growth (Digital transformation in Singapore: a smart nation in 2025, 2024).

The number of mobile broadband subscribers also lags far behind India, while in Singapore and China it exceeds the population, also because a large proportion of the population has two or more mobile

Table 1
Indicators of the readiness of the population and infrastructure of China, India and Singapore for the development of the smart economy

Indicator	China	India	Singapore
Adult literacy rate, %.	96,4	74,2	98,1
Average duration of study, years	7,6	6,7	11,9
Expected duration of study, years	14,2	11,9	16,5
Number of fixed-line telephone subscribers (per 100 people)	14,7	1,8	35,5
Number of mobile subscribers (per 100 people)	125	81	156
Number of active mobile broadband subscribers (per 100 people)	109	56	171
Number of Internet users (per 100 people)	73,1	46,3	91,1
Number of fixed broadband Internet subscribers (per 100 people)	41,35	2,36	37,36
Number of households with access to the Internet (%)	76,5	55,3	96
Number of households with a computer (%)	47,5	10,7	90

Source: compiled by the authors on the basis of (Literacy rate by country 2024, 2024; World Bank Open Data, 2024; Statista, 2024)

broadband numbers. Singapore has the highest proportion of internet users in the population at over 90%, which is a limit as not all of the population may be internet users for various reasons. In China, this figure is also high and has a slight potential for growth, but it is unlikely to be more than 80% due to the large share of the rural population in China. In India, less than half of the population has access to the Internet, but this share can only be increased to 70%, as the literacy rate of the population does not allow for more.

India's peculiarity is that the share of subscribers with fixed broadband is very small, as it requires significant investment in the construction of Internet lines, and the main focus has been on the development of mobile Internet and access through public free Wi-Fi hotspots. In China, the share of fixed broadband users is higher than in Singapore, as the Chinese government promotes fixed broadband as more reliable, efficient and cheaper to operate than mobile internet. In terms of the number of households with a home computer, one can also see that India is developing mainly mobile technologies, where the cheaper option of including a person in the smart economy via a smartphone and mobile Internet is chosen, rather than purchasing computers or laptops, which are more expensive and economically unaffordable for the majority of the Indian population.

Singapore has almost solved the problem of Internet access for the entire population, as 96% of all households have access to the Internet. In China, this figure reaches three quarters of households, and in India it exceeds half.

Singapore has the strongest position in the development of the smart economy due to the development of Internet access, mobile technologies, computerisation of the population and the level of education. At the same time, Singapore has the lowest potential for the development of the smart economy, as there are no growth reserves by attracting new users to the digital sphere, and growth can only occur through intensive factors such as the development of new technologies and innovations, and an increase in the share of the workforce employed in the smart economy. China has a strong position in the development of the smart economy, and due to the size of its economy and population, and therefore the market for smart economy products, it has significant potential for the development of the smart economy. India has the lowest starting point

Table 2

The impact of certain factors of smart economy development on China, India and Singapore

Factor	China	India	Singapore
Electronic industry	Actively developing on the basis of its own technologies	Represented mainly by foreign companies and the assembly industry	Highly developed, integrated into global value chains
Digital infrastructure	Highly developed, relies on fixed internet access	Betting on the development of mobile internet and mobile communications	Highly developed, organic development
Mobile and Internet penetration	High, with lagging behind in rural and western regions	Below average, actively developing	Very high
Level of computer literacy	High level, the level of education of the population is above average	Below average, a large proportion of the population is illiterate	Very high, high level of education, including in the IT sector
The level of development of the IT industry	A strong IT sector with its own developments, which exports some of its products	It is based on foreign companies and IT outsourcing, while its own companies are developing	Strong own companies, but focused on the external market
State support	Direct participation in companies in the industry, financing innovative research programmes, creating conditions for the development of the industry	State programme to expand public access to the Internet and mobile communications and stimulate the industry	Creating conditions for innovation, foreign investment and international cooperation in the industry
Innovative environment	Strong, large number of start-ups	Strong	Strong, focused on innovative development
Potential for the development of a smart economy	High due to the large size of the economy and population	Very high, but requires considerable time to master	Low, only due to innovative development
Geopolitical changes	Significant influence, development of own technologies	Transferring production and facilities to India from China	Insignificant impact
Entering foreign markets for smart economy products	High, with a downward trend, the domestic market is closed	High, tends to expand	Very high level of integration of the industry into the global market

Source: compiled by the authors on the basis of (World Bank Open Data, 2024; Zhang, Zhao, Wan, Yao, 2021)

due to low levels of education and literacy, as well as weak digital infrastructure. But at the same time, India has the greatest potential for smart economy growth, as there is an opportunity to attract hundreds of millions of people as consumers of smart economy products.

Each of the factors in the development of the smart economy has its own characteristics for each of the above countries (Table 2).

In these three countries, the factors influencing the development of the smart economy exhibit varying degrees of influence. In China, the most significant factor influencing the development of the smart economy is the government's support for this sector. This includes protectionist measures, geopolitical changes that have led to the need to build a smart economy that is more independent of Western companies, the existence of a robust innovation environment that allows the generation of technologies in the industry, and the potential for growth due to the expansion of internet and mobile penetration, which is attracting new consumers and labour to the smart economy industries.

The development of India's smart economy is significantly influenced by a number of key factors, including the high potential for industry growth, government support through the digitalisation of the Indian economy and the expansion of mobile communications and internet access for underserved communities, geopolitical shifts that facilitate foreign investment in India's electronics and IT sectors, and the country's notable innovation capacity. Concurrently, a proactive government strategy is in place with the objective of addressing shortcomings in the advancement of India's digital economy and expediting the exploitation of the potential inherent in the smart economy. For example, the weak development of fixed broadband Internet access is being compensated by the development of mobile Internet, expensive computers as Internet access devices are being compensated by cheap smartphones, free Wi-Fi access points are being developed in public places, and measures are being taken to improve the computer and general literacy of the population.

The advancement of the smart economy in Singapore is predominantly shaped by two key factors: the accessibility of foreign markets for smart economy products and the integration of Singaporean companies into global value chains. Other significant contributing factors include the high level of computer literacy and educational attainment of the population, a strong potential for innovation, and a well-developed digital infrastructure. Indeed, Singapore serves as a nexus between the digital economies of disparate countries, a function facilitated by the ethnic and cultural structure of the Singaporean population. Consequently, the majority of Singapore's population is of Chinese ethnicity (73%), with English being the primary language spoken by the majority of the population. Additionally, there is a notable proportion of Indian ethnicity (9%). This indicates that Singapore's economy is closely integrated with those of Western countries, as well as China, Taiwan, and India. In the absence of access to the markets of other countries, the development of Singapore's smart economy is untenable, given the limited size of the domestic market.

3. Conclusions

The study has demonstrated that the factors influencing the development of the smart economy exert varying degrees of influence on different countries. This is attributable to the disparate range of resources available for the advancement of the smart economy across different countries, varying stages of economic development in general and the smart economy in particular. The factors that determine the development of the smart economy in some countries may be of secondary importance or have a limited impact on the development of the smart economy in others. It can thus be concluded that there are no universal recommendations for the development of the smart economy in any country. The specific set of measures for the development of the smart economy, as well as the sequence of their application, is contingent upon the particular conditions of the country in question, including the prevailing international economic and political circumstances.

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