

LESSONS ON THE ROLE OF THE US GOVERNMENT IN TECHNOLOGY DEVELOPMENT AND INNOVATION

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Summary:

The article has raised the need for Vietnam to increase the role of the Government in developing technology and innovation to achieve the goal of sustainable growth. Through the lessons of the US Federal Government in developing the fundamental and core technologies based on the experiences of: (i) Defense Advanced Research Project Agency (DARPA); (ii) Small Business Innovation Research (SBIR) Program; (iii) Orphan Drug Act; (iv) National Nanotechnology Initiative, the author offers 7 recommended suggestions to boost the process of technology development and innovation in Vietnam.

Keywords: Science and technology; Innovation; American government; Vietnam.

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1. Introduction

As Karl Marx once noticed, technological development is the driving force for human development generally and capitalism particularly. The Austrian economist Joseph Schumpeter (1883-1950) inherited Marx's view and developed that capitalism develops through the innovations of business owners, that is, the creation of new production technology and new products and new markets. Schumpeter's ideas play an important role in long-term economic development and have been named for a school of economics: the Schumpeterian school of economics (also known as the new Schumpeterian school of economics). This Schumpeterian school of economics believes that the competition driven by technological progress is stronger and more important than the Classical price competition.

Nowadays, there is a competition in the world to gain technological advantage on a global scale and Vietnam is not existing outside this fierce race.

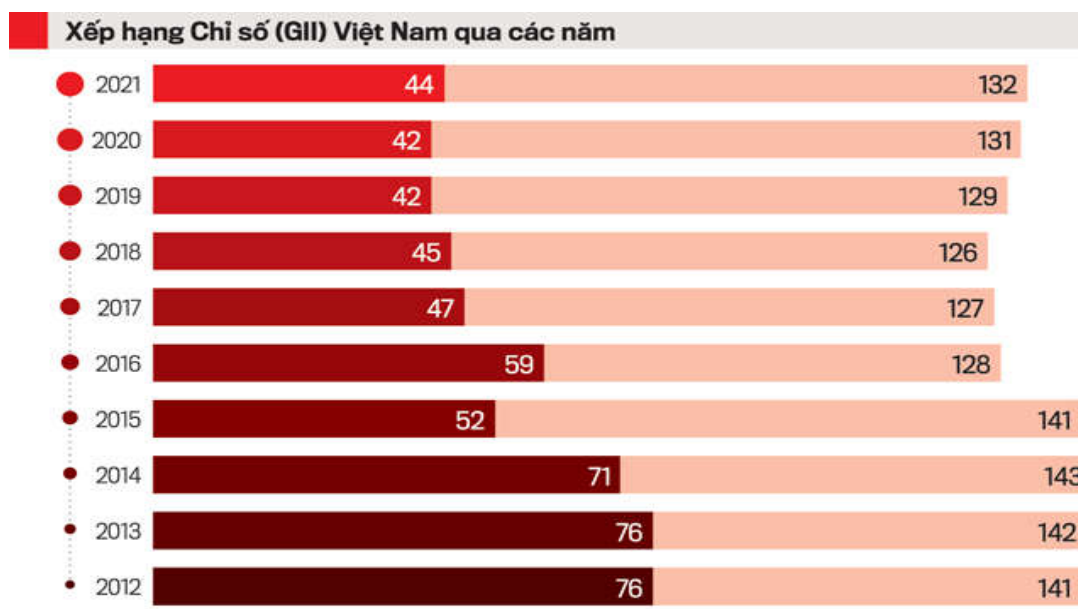
The Communist Party and Government of Vietnam consider innovation as one of the key factors for the short-term, medium-term, and long-term socio-economic development.

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On May 11th, 2022, the Prime Minister signed Decision No. 569/QĐ-TTg promulgating the Science, Technology, and Innovation Development Strategy until 2030. The document clearly states: “Building and developing the system national innovation centers, regional and sectoral innovation centers, and creative start-up supporting centers in order to develop and integrate and to form innovative clusters with industrial parks high-tech, residential areas, financial centers, venture capital funds, universities, research institutes,...”.

Furthermore, innovation is an essential demand within the context of the 4th Industrial Revolution, and the digital transformation and is a prerequisite for sustainable development as the goal of Decision No. 622/QĐ-TTg dated May 10th, 2017 of the Prime Minister on promulgating the National Action Plan to implement the 2030 Agenda for Sustainable Development stated: Maintaining the sustainable economic growth while making progressive, equitable society and environment protection, effective management and use of natural resources, proactively respond to the climate change; ensure that all people can develop their full potential, participate and enjoy equally the fruits of development; building Vietnam to be such a society that is peaceful, prosperous, inclusive, democratic, equity, civilized and sustainable.

Table 1. Vietnam Global Innovation Index ranking for period 2012-2021



Source: WIPO, 2021

Vietnam's innovation index (GII) has improved significantly during a decade: from 50% of the lowest index countries in 2012 and moved to the 30% of the highest innovation index countries by 2021. However, this

innovation index has been almost unchanged in the last 5 years. This poses many problems for Vietnam's economy while facing with the post-Covid19 global crisis along with many challenges and problems that need to be resolved in the new context.

America currently is the world technology leading country with many technology giants in the businesses field, such as Apple, Microsoft, Alphabet - the parent company of Google, Amazon, and Meta Platforms - the parent company of Facebook.

Among the world's largest value brands, the top 10 highest ranking in 2022 enterprises compounds from 07 US enterprises, 02 Chinese enterprises and 01 Korean enterprises, and only 2 enterprises - the Industrial and Commercial Bank of China (ICBC) and Wal-Mart - are not belonging to the high technology sector. The top 5 positions out of top 10 are American owned businesses, leading by Apple with a brand value of US\$355.1 billion.

Ranking in this year by industry, 1/3 of the brands belong to the technology based and service sectors, with a total value of 2,000 billion USD, and increasing 36.8% in value compared to 2021. It followed by the media and telecommunications sectors with a total brand value of 1,000 billion USD, with value increase of 19.2%.

Ranking by country in the 2022, the US and China account for 75 out of the top 100 brands and the top 6 countries account for 95% out of the list.

Thus, the world economy overall picture is led by technology-based companies and the foundation of which is innovation.

Concerning to Vietnam, among the top 10 brand value businesses, there are only 02 technology-related businesses: Viettel and Vietnam Posts and Telecommunications Group (VNPT), 4 out of 10 are Commercial banks, and 7 out of 10 are state-owned enterprises. There is only 1 enterprise in the technology-based sector is in the top 50 enterprises with brand value, that is FPT ranked 21/50 (*Brand Finance Vietnam 50, 2022*).

This fact shows that currently Vietnam's technology-based enterprises have a very modest position in the country's economy.

In the world today, all countries, including developing countries like Vietnam, want to learn from the success of the US economy, especially in the fields of technology and innovation. This article hopes to answer the question: What role has the US government played in America leading the world in technology today?

2. American-style entrepreneurial state

Since its founding, America has been torn between two schools of thought, the interventionist policies of Alexander Hamilton (1755-1804) and the

maxim of Thomas Jefferson (1743-1826) that “a government that intervenes least means best intervenes”. Over time with the American pragmatism, this opposition was resolved by leaving the Jeffersonians to the rhetoric and the Hamiltonians to the policies (*Erik Reinert, p. 123*).

The developmental state was first proposed by Chalmers Ashby Johnson (1982). According to him, the developmental state is a state management model in which the state sets out development-oriented policies, creating an environment and conditions for economic sectors to develop their full potential, ability in a competitive environment and international integration; strengthening supervision to detect possible imbalances, and ensuring macroeconomic stability.

America is held up as a model for creating national prosperity through the dynamism and innovation of the private sector. But in fact, the state has taken on and engaged in business risk in a super-large scale to promote innovation and promote private sector development through shaping a market that promotes innovation. In the US, businesses develop in a start-up society with a unique culture, where the State plays an initiating role by investing in the newest and very basic fields, and the State provides early-stage finance where venture capitalists do not want to invest and leave, and at the same time, State coordinates highly innovative activities for the private sector. The State, through laboratories and government agencies, has ability to quickly disseminate new ideas. The state can also skillfully use its public procurement, its operational and regulatory functions to shape markets and promote technological progress. In this way, the State acts as a catalyst for change, like a lightning bolt to light the fire of creativity and prosperity.

The US government supported the following project to serve as a premise for today's technological and innovative development of the world's No. 1 power in economy, education, and technology.

Firstly, the Defense Advanced Research Projects Administration (DARPA)

DARPA was founded in 1958 with the goal of bringing to America technological superiority in various fields, especially those related to technology-based fields. This agency has a budget of more than 3 billion USD per year, 240 employees, operates flexibly at low costs and is independently connected to the Government. The agency's operational structure aims to bridge the gap between the long-term academic “ivory tower” research and the relentless military technological development.

More than simply funding research, DARPA also funds the establishment of computer science departments, supports startups in the early-stage research, contributes to semiconductor research, and supports human computer interface research as well as oversees the early development of

the Internet. Many of these important activities were carried out by the Department of Information Processing Engineering, established in 1962. Such strategies greatly contributed to the growth of the computer industry in the 1960s and 1970s, and many technologies subsequently integrated in personal computer designs developed by DARPA-funded researchers (*Abbate, 1999*).

DARPA employees engage in the process of connecting business and technology by linking university researchers with interested entrepreneurs to form a new company, find a larger company to commercialize government technology or support public procurement. Personal computers appeared during this time, with the launch of the first one by Apple in 1976. Then came the explosion of the computer industry in Silicon Valley, and this was made possible by DARPA's key role in driving faster and better technology change in computer and microchip design.

Secondly, the Small Business Innovation Research (SBIR) Program

During the 1980s, the US government acted to build on the successes of DARPA's decentralized industrial policy. The SBIR program requires Government agencies with large research budgets to set aside a portion of their research funding (initially 1.25%) to support small, independent, and for-profit companies. As a result, the Program has supported a significant number of highly innovative startups (*Lerner, 1990; Audresch, 2003*).

Within the framework of this Program, there is a development of state and local government-funded organizations to assist entrepreneurs with successful applications to the SBIR Program to have secured funding for their projects. The SBIR program plays a very important role in the innovation system because it becomes the first address for entrepreneurs who participate in technological innovation to apply for funding. This program has provided more than \$2 billion USD each year to support high-tech companies directly and promote the new businesses development and assist the commercialization of hundreds of new technologies from the labs to market.

Thirdly, the Orphan Drug Act

The Orphan Drug Act of 1983 (ODA) made it possible for small, endeavored biotechnology companies to gain a fair profit share of the drug market. The Act includes certain tax incentives, clinical and R&D subsidies, an expedited drug approval process, along with significant intellectual property rights and marketing rights for those products developed for rare diseases therapies.

Under the protection of this Act, the small companies have been allowed to improve their technology platforms and scale up their productions. It helps

them move up and to become major players in the biopharmaceutical industry. In fact, the ODA played an important role for larger biopharmaceutical companies such as Genzyme, Biogen, Amgen, and Genentech to grow up and to developed as they have been seen today (*Lazonick and Talum, 2011*). Since the ODA 1983 introduction, 2,364 products have been designated as “orphan” drugs and 370 of which have received marketing approval (FDA).

The important role of the ODA in guiding the development of the biotechnology industry is undeniable, however, this is just one of the important moves taken by the US Government to support the biotechnology industry. Lazonick and Talum summarized the role of government as follows: The US government plays not only a role of the knowledge creation investors but also of the drug development subsidizers and drug market protectors, and last but not least is the role of the drugs buyers for the biopharmaceutical companies. Due to the Government generous funding, Biopharmaceuticals became a big business thanks to Government funding and they remain heavily dependent on grants from the Government (2011).

Thus, the US government has spent some decades using proactive intervention policies to promote the private sector innovation in pursuit of broad public policy goals. The Government is not tied to any firm, but it chooses “picking winner” approach. A skillful government will reward the innovation and in a relatively short period of time will redirect resources to the potentially promoted companies through its supply-side or demand-side policies and will intervene by financing the start-up companies. The government does not only simply create the conditions for innovation, but also actively funds original basic research and creates the necessary networks between public agencies and the private sector to promote commercialization process. And this is far away different from British Government current policy approach, which believes that the State simply needs to push the private sector to take the action.

Fourthly, national Nano technology initiative

The state can play an entrepreneurial role to promote the new technologies development, creating a foundation for long-term economic growth. The US government made strategic investments in nanotechnology in the 1990s, when the technology was still obscure to almost everyone and the State went beyond merely establishing the appropriate infrastructure, basic research funding and rules and regulations establishing. How far-sighted the US government was to dream of the possibility of ushering in a nanotechnology revolution by making “no matter what” initial investments and by forming flexible networks of public actors such as: universities,

national laboratories, government agencies and even the private sector, to start a new revolution that many believe is even more important than the previous computer revolution. And this was the vision and effort of a group of scientists and engineers at the National Science Foundation and the White House under President Bill Clinton in the late 1990s. Washington chose nanotechnology as a leading candidate, initiated supporting policies and invested billions of dollars for this industrial development.

Private enterprises usually invest in developing products with competitive costs within a period of 3 to 5 years. It is difficult for management to justify to its shareholders the large investments in long-term, basic research needed to create products based on nanotechnology. In addition, the interdisciplinary nature of the required research is incompatible with many current business structures. In this case, the Government is like a midwife in linking industries related to the nanotechnology revolution such as physics, chemistry, materials science, biology, medicine, computer simulation and engineering. Investment in nanotechnology will likely “generate future growth in industrial productivity, and the nation that leads in the nanotechnology discovery and deployment will have a big economic and military advantage in decades to come (*Motoyama, Appelbaum, and Parker 2011, p. 113*).

Finally, the US Government took the action. They not only chose nanotechnology as the area of strongest support, but also implemented the national nanotechnology initiative (NNI), reviewing regulations and rules related to nanotechnology by studying risks and become the largest investor, even beyond what has been done in biotechnology and life sciences. Currently, it can be affirmed that the 21st century is the century of nanotechnology. Nanotechnology impacts most sectors of the economy such as electronics, healthcare, education, national security, energy, food... and all they are commercialized thanks to innovative breakthrough technology that the US Government funded and pioneered. In short, the United States has a very successful industrial policy, even though the United States is perceived as a free-market-oriented country. Through two mechanisms, funding for basic research on technology, medicine and military research budgets and procurement, the United States has ensured that their companies are world leaders in some basic technologies such as genetics, digital technology and robots, nano technology, cloud computing,... Research funded by the US military has created much of the basic structure of the Internet and the global positioning system (GPS).

Mariana Mazzucato (2020) emphasized the importance of US Government support for the success of large US technology companies such as Apple,

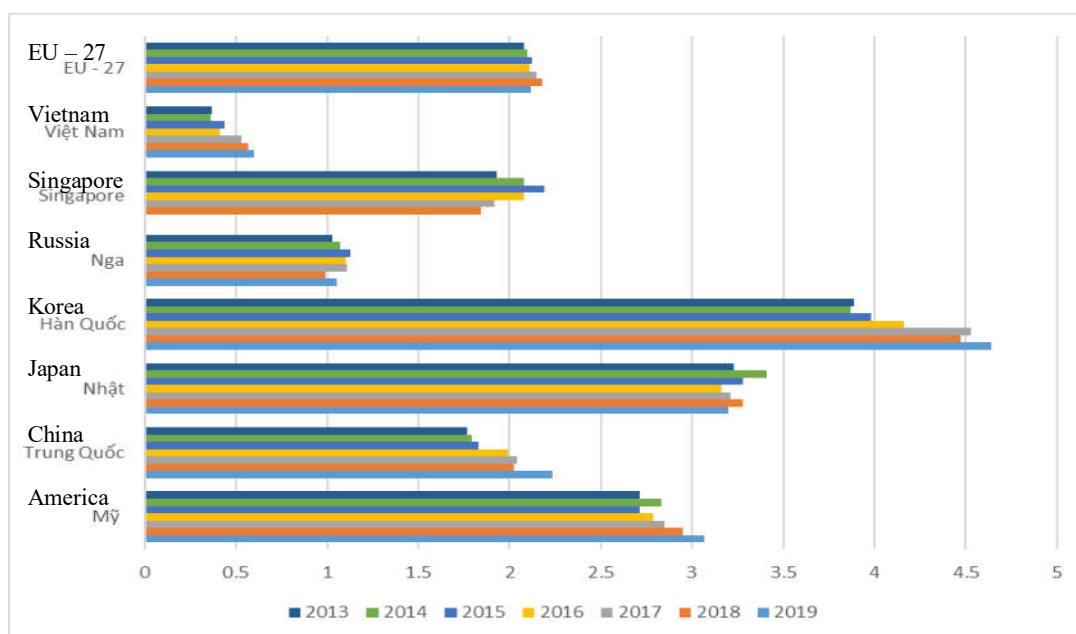
along with private enterprises. Without the huge amount of investment from the public sector to develop computers such as: counting memory, clicking wheel, multi-touch screen, GPS, liquid crystal display, micro hard disks, cellular technology, signal compression, Lithium-ion batteries and the internet revolution, the world-famous products such as iPhone, iPod, iPad... cannot be as smart as they are today.

3. Some lessons for Vietnam in innovation and technology development

3.1. Vietnamese context

Kim and Lee (2009) have demonstrated through reliable data and methods that, for middle-income countries, limitations on R&D activities and higher education are obstacles to long-term growth.

Therefore, the Vietnamese government needs to invest more in R&D as well as higher education.



Source: Calculated based on UIS.STATEXPOR, Eurostat

Figure 1. Proportion of spending on R&D in Vietnam and some countries period 2013-2019 as % of GDP

If we calculate the proportion in GDP, although we have made many efforts to increase spending on R&D, by 2019 it only reached 0.6% of GDP, while China was over 2% of GDP, the US was over 3% of GDP, The EU is also over 2% of GDP, Japan is 3.2% of GDP, South Korea is 4.64% of GDP, the average of OECD countries is 2.68% of GDP, the highest is Israel at 5.44% of GDP. The world average investment rate for R&D is 2.2% of GDP.

Regarding public spending on higher education in Vietnam, it currently only accounts for about 0.27% of GDP, while public spending in developed countries is all over 0.6% of GDP, and in developing countries are not less than 0.5% of GDP, in Former Eastern European countries are all above 0.8% of GDP.

In the new context of digital transformation and digital economy today in Vietnam, the role of the Government in digitizing the economy with the goal of growth based on knowledge and science and technology along with innovation in all fields, is very urgent and necessary because the private sector is still hesitant to invest in R&D.

Furthermore, currently, the largest enterprises in Vietnam are not technology-based enterprises. The State needs to be stronger in spending state budget on private sector projects which are investing in new technology. The Government has recognized the important role of the private sector in economy and the necessary to build a dynamic and creative private sector, including State direct support in investment and land and regulations to develop this area based on science and high technology and help it to inherit or be able to create new technologies on its own. As said, among the top 10 largest businesses in the United States, there are 8 businesses specializing in the technology-based sector such as Apple, Amazon, Google, Tesla..., while no technology-based companies appeared among the top 10 largest branded companies in Vietnam.

3.2. Some lessons for Vietnam

Firstly, the Government need to increase investment in R&D to at least 1% of GDP in the short term and 2% of GDP in the long term. Spending on R&D in Vietnam is currently at 0.6% of GDP, less than 1/3 of the world average of 2.2%. Based on nominal average GDP, Vietnam will be equal to 25% of the world's average income in 2022, close to the proportion of Vietnam's spending on R&D as a % of GDP compared to the world. If calculated according to GDP according to purchasing power parity (PPP), GDP per capita is equal to 50% of the world level. Therefore, in the opinion of the research team, we need to increase investment in R&D in the next few years to 1% of GDP to at least half the world average. The target by 2045 for investment in R&D is 3%, corresponding to a country with a high average income.

Secondly, the Government needs to increase spending on higher education to at least 0.5% of GDP in the short term and approach to 1% of GDP in the long term. There is needed to increase investment in national and regional universities, ant upgrade the two scientific academies and establish their

branches in key economic regions. At the same time, Government needs to upgrade national research institutes and centers. They also identify fundamental basic research and apply bids selections publicly and transparently among strong research groups from domestic universities and research institutes.

Thirdly, reviewing the financial autonomy process of universities, especially public research-oriented universities such as the two National Universities and Hanoi University of Science and Technology. From a personal point of view, universities may be autonomous in terms of regular spending, while investment in infrastructure still belongs to the State, especially investment in key laboratories and basic sciences such as mathematics and physics, chemistry and information technology, economics, and history.

Fourthly, through research-oriented universities, the Government can order the research on innovation and core technologies. It is possible to select and have remuneration schemes for world-leading scientists in accordance with the world practice to create a premise for top-notch research and high technology transfer, to gain world-level inventions in technology fields such as information technology, AI, internet of things, big data,...

How to have a well-functioning national innovation system to strongly promote the domestic brain and creative capacity? That is, the Government needs to encourage the process of innovation and idea creation.

Fifthly, the Government can select some small and medium-sized enterprises to support the firm's level research and development. There needs to be specific and realistic policies for attracting private enterprises to invest in R&D, especially large and well-run state-owned enterprises such as Viettel, Vinamilk, MobiFone,...

Sixthly, the Government focuses on biotechnology for agriculture, especially high-quality rice varieties breeding, and investing in agricultural processing technology, especially fruit.

4. Conclusion

The government is not only an investor, but also a wise investor. For many reasons, Government is not an effective entrepreneur, and this is the research result of the 2001 Nobel Prize in Economics (*Michael Spence, 2012, page 130*). Economic decisions from the state can stifle the development of new business directions or, conversely, can pave the way for a completely new business direction. Therefore, we hope that the lessons of American innovation will help Vietnam improve its science,

technology and innovation related policies and create a foundation for a mighty and developed based on science and technology Vietnam./.

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