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Economic Theories on the Model of High Technology Parks and a Typical Example in Vietnam

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The fact that there have been many Science and Technology Parks (STP), such as the establishment of the Hi Technology Parks in Vietnam, is undeniable. However, there are some doubts about STP's contribution to economic development and progress and a lack of literature in the field exists with limited theories as well as economic analysis of the advantages of independent parks of hi-tech. This paper therefore introduces research results under three aspects. One, the theories of science and technology inputs in economic development. Two, the theoretical base to identify the benefits of STP. Lastly, the base for the independent location of STP. In addition, by looking at a successful hi-tech park in Vietnam, this paper proposes that Vietnam should create its Regional Innovation System (RIS) for continuous progress.

Key words: *Science and technology, the Hi-technology Park, knowledge economy.*

Introduction

Labor, in its simplest form – the fundamental aspect of the slavery economy and land – the pillar of the feudal regime and capital – the central component of the capital economy, are no longer the only key drivers in development and advancement of a nation. Rather, the knowledge economy, or current digital economy have been demonstrated to be pivotal for fostering economic development for nations, especially underdeveloped economies. Evidently, OECD countries are the clear result of such shifts, which have taken place to steer nations from an industrial economy to a post-industrial knowledge economy where economic productivity and advancement are primarily determined by technological change and regional knowledge absorbability (Foray and Lundvall, 1998). This is an outcome that has been

realized through decades of economic revolutionization triggered by modern views of neoclassical economists on the role of science and technology.

One important reference in technological discussions is the Schumpeterian theory which emphasizes the role of innovations and knowledge acquisition of entrepreneurs (Shin, 2016). To date, various empirical studies have pointed out that the substantial differences in output among countries are primarily due to discrepancies in technological capability, as reflected in recent reviews. Furthermore, the phenomenon of diminishing returns indicates that it is insurmountable for low-income economies to even up their welfare with their high-income counterparts by capital accumulation or individual investments. This suggests that, in the long term, only technological development that occurs at a faster pace could help low-income nations to outstrip developed nations in terms of the standard income per capita (Koh and Wong, 2005).

The establishment of the Science and Technology Parks – STP can devise a means for accumulation of infrastructure and resources. The model of High Technology Zone (HTZ) is also a resemblance of STP. At first glance, STP seems to parallel other special zones aiming for development fostering such as Industrial Zone, Free-Trade Zone and Economic Zone. However, STPs, or HTZs, have been considered as separate identities from the rest. This is due to the view of fundamental theories on the role of knowledge, science and technology in which HTZs, when being developed territorially, were articulated as a potential driver for the economy. Such theories will be described in the following sections of this essay. Deriving from the reviews, some important policy implications regarding establishment of a Regional Innovation System – RIS will play an important in developing knowledge economy in Vietnam.

Economic Theories on the Role of Science and Technology in Economic Development

The recognized importance of knowledge for economic progress is not a new notion. For example, Adam Smith mentioned the contribution of experts in his theory. Another economist, Friedrich List, suggested that the institutional and infrastructure factor could make significant knowledge contributions. On the other hand, Schumpeter and advocates view innovation as a promotor for development of economies. These theories have given rise to deeper analysis of the impact of technology on knowledge and innovation in the last century.

Preliminary investigations, although ambiguous, attempted to seek factors that underlie the growth of a particular country and to analyze the magnification effect of knowledge which occurs alongside innovation. Indeed, an early conclusion claimed that the supply of inventions, as well as technological absorbability and adaptation are a forerunner of

innovation, which plays a key role in improving economic efficiency of a nation (Gomulka, 2006). This was later elucidated in another well-known study by Samuelson (1965).

Investigations of Nicholas Kaldor have related the factor of technical change to economic growth, establishing the foundation for future research focusing on this variable identified in the 1960s (Kaldor, 1957). Contributions of Nicholas Kaldor are vast ranging from theories on business cycle, distribution and Kaldor-Hick efficiency. However, his most prominent work is the work related to technical progress function, contributing to advancements of new development theories. Those theories had advanced the recognition of the role and the contribution of technological innovation on the economy (Targetti, 2005). Romer is a typical economist who is keen on investigating the influence and impact of technology on the economy and repositioning the role of technology and inventions.

In the period of 1960s to 1980s, the new theories in parallel with empirical observations on technical changes had been prospering. To date, in any model of analysis, the role of technology on development has been pivotal and undeniable. In other words, this factor is the focal interest in virtually all economies where land, capital and labor have been saturated due to economy openness, free mobilization of resources and common characteristics of a flat world market. It has been articulated that the development of the knowledge economy is pressing the demand for knowledge generation and utilization (Saublens et al., 2016).

Policies on science and technology therefore require attention with regard to generation of new knowledge from pioneering research. For underdeveloped economies with limited resources, the effects of technological amplification as well as execution of technology policies are even more apparent. Similarly, an economy that is isolated from technological advances also requires rapid absorption acquisition of existing technologies through close relationships with technologically advanced nations (Koh and Wong, 2005). These factors imply that a strategy that is based on global competition is essential, as elaborated in a previous analysis (Boggio, 1996). Recently, these theories have recently been accentuated with the digital revolution along with rapid knowledge dissemination in the information society (Foray and Lundvall, 1998).

In general, innovation, which aids the development of a knowledge-based society, often manifests in two main forms. First, innovation may associate with the introduction of new or improved products and services for arising and intrinsic needs in the market, consequently creating added value for enterprises and customers. Second, the fostering effect of innovation may take place through enhanced productivity of enterprises that are adopting the innovation. It is worth noting that this still holds for economies with highly developed technologies, thus making this effect is the long-lasting objective to pursue (Lesjak and Bole, 2017). However,

this benefit also depends on specific national policies and their inclusion into developmental strategies. In addition, such embodiment strategies should also be approached under perspective of development of infrastructure, adoption of performance-based policies on science and technology and improvement in institutional environment (Koh and Wong, 2005).

Theoretical Backgrounds and Practice on the Role of High Tech Zone

Impact of technology on economic development is universally accepted and is an established concept. However, integration of technology as a driving factor into the economy has been challenging. In fact, the question of how to access and absorb knowledge and foremost, how to generate new knowledge and technology, has not been completely solvable. One practical solution that is offered historically is the establishment of science and technology parks, in which high technology zone emerges as a main scheme. First science parks were established in the 1950s (The Stanford research park in US in 1951). In 1970s, many countries had set up science parks and technology districts as a key part in garnering new resources for development. This trend was later widely spread in 1980s (Rowe, 2014; Rowe, 2014) and induced many Asian countries to invest and develop science parks up until the end of the 1990s (Koh et al., 2005).

The model of Science and Technology Park manifests in many forms. Review studies show that the trend of setting up new industrial space or innovative milieus or industrial districts is becoming increasingly common in the context of recent active economic development (Saublens et al., 2016). The birth of Science and Technology Parks is the inevitable consequence of executing development objectives and realizing endogenous growth theories as well as pressing demand of the knowledge economy. According to Porter (1990), cluster-based theories based on the competitive advantage is the track through which microeconomic processes of a nation could interact with the macroeconomic environment as well as with the national institution to create broad impact on the reform capacity of an economy (Porter, 1996).

On the one hand, the technological demand of STP is enormous and research cost could be alleviated significantly if those who wish to possess such technologies are situated in STP. This obviously creates disadvantages such as increased competitive pressure for technology development. On the other hand, skilled workers could also be supplied by nearby training facilities, posing a competition in accessing such labor resources. For an enterprise, the choice of locating themselves into a STP may offer them opportunities to acquire new knowledge, especially tacit knowledge. Likewise, universities that closely tie with STP could easily transfer patents. The theory of economic convergence suggested that the knowledge

dissemination, increased benefits and reduced cost are due to the presence of multidisciplinary institutions and external factors (Albahari et al., 2017). Such converging factors explain the phenomenon of clustering of enterprises, which is the fundamental for the establishment of STP. There are even theories and empirical studies that pointed out that location per se is also accountable for cost of the resource, such as in views of Henderson (1986) and Krugman (1991); Albahari et al., (2010). Even though the discrepancy of enterprises in STP and those outside is minor, positive effect of location on performance of enterprise is increasingly reported (Albahari et al., 2017).

Several studies taking enterprises residing in STP as the research scope have emphasized the significant role of STP in three aspects including labor, innovation outcome and sales. These results have been empirically proved for three mechanisms including effect on economic performance, impact on innovative activities and influence on the link between enterprises with universities and research institutions. In general, it has been articulated that increased employment, sales and benefits are observed in enterprises located in STP in comparison with those located outside STP (Albahari et al., 2010).

Theoretical models have been devised recently based on the theory of clubs to explain why an enterprise should be located within a STP in operation. When it comes to the role of STP, there are two studies that are frequently referred to (Etzkowitz and Leydesdorff, 2000; Carayannis and Campbell, 2009). In the former study, the notion of triple helix was proposed. The idea concerns the mutual innovation between government, university (and research institution) and business, through which the influence mechanism of STP on the three bodies for innovation could be established (Rowe, 2014). Apparently, the role of Research triangle park (RTP) is indispensable in this theory. However, later studies began to incorporate market/society as the fourth indicator, changing the triple helix into quadruple helix. This complements the model as the expected outcome of the triple helix is a new and innovative product or service, which requires market/society to create employment and general prosperity. These notions are the fundamental objectives of the establishment of STPs (Rowe, 2014).

Economic Advantages of the Model of Independent High Technology Zone

In parallel with the STP is the appearance of other economic zones, such as industrial zone or economic zone. In reality, a large number of STP has been established and is operating independently. Therefore, an important decision faced by nations adopting the model is either to continue allowing independent operation or to integrate STP into existing economic zones. The issue should be first solved theoretically. It is apparent that model of economic zone is an established model that has a long-lasting history in parallel with STP. Specifically, the first

economic zone was set up in Iceland in 1959 and has gained popularity until today (Farole and Akinci, 2011). The success of an economic zone is dependent on various factors. To date, not all countries have been successful when pursuing this pathway. Even China, who has been considered as a big winner with an exemplar of Shenzen zone, also faces numerous challenges in other economic zones.

Ultimately, every choice regarding establishment of STP should steer the nation to fulfill the objective of a developed economy. Therefore, oftentimes, activities of economic zones focus on expediting commercialization, attracting investment and liberating trade flow through establishing free trade zones. In reality, instead of usual activities of creating space for industrial manufacturing and facilitating flow of goods in commercial sectors, some economic zones may narrow their focus into developing into providers of financial services or entering the international logistics as a key chain. The stark difference between Shanghai and Shenzen economic zone gives a good example for this (Tiefenbrun, 2015). However, there is insufficient evidence that supports the notion that an economic zone should operate with fully established infrastructure dedicated for research and scientific activities, research and development and technology transfer respectively. Even in China where many economic zones have been established, there still exists STP operating parallel with economic zones.

The explanations for the independent coexistence of foresaid economic zones and STP could be numerous. The first explanation may originate from the crucial importance of knowledge and intellectuals in new societies in which most nations focus on building a solid foundation of science and technology. This context could be reflected by the presence of territories dedicated for innovation processes and knowledge dissemination. Furthermore, such territories become particularly relevant in the context of increasing dependence on technologies of manufacturing industries to enhance commercial competitiveness.

Second, economic zones that focus on non-science activities are incapable of generating new knowledge, a complex process that often results in financial benefits and positive outcomes in the long term only. In other words, it would be difficult to charge economic zones to take the role of establishing a scientific foundation. This is due to the profound difference between infrastructures of a standard economic zone, which mainly serve the purpose of mass-production, and those catering to development and commercialization of research-derived products in STP. In general, the establishment of economic and commercial zones is perceived as an advancement on strategically positioning for a number of manufacturing, exhibition and distributing activities. Since it is unnecessary for these parks to connect with high-level training institutions, economic and commercial zones are generally not considered as typical science parks. Even if the integration of STP into economic zones takes place, STP

cannot operate on existing infrastructures of an economic zone, causing possible waste and hindering operation of STP.

Meanwhile, according to International Association of Science Parks, STP aims to promote and manage knowledge and technology flows among universities, R&D institutes, enterprises and the market. In addition, it also plays to role of stimulating the establishment of innovation-based enterprises through incubation and commercialization (Albahari et al., 2017). In other words, STP is recognized as the space for high-tech enterprises to situate and the birthplace for high added-value as well as skill-demanding works. From which, highly-specialized works, which could not be found in other places, could be provided. STP is also considered as place to connect enterprises with knowledge-providers through RIS or through regional and international exchange systems.

The university-industry linkage and spillover effects of research institutions on firms and their mechanism have been investigated in various studies. Recent evidence of Lyu et al. (2019), where the collaboration network among firms, universities and academics in Zhongguancun, a technological hub in Beijing, China was spatially explored, shed some light on this complex interaction. Structurally, the cooperative network of the park shifted from the initial nodes of state owned enterprises and large public universities in the early stage of 1980s to a larger, more stable network consisting of subsets of smaller collaborations and agents in the mature stage of 2009 and onwards. In addition, the engine for the network growth also differs depending on the stage in which major investment focus is determined. While the collaboration network in the park at the first phase of establishment mainly revolved around government-based connections that propel several major national projects, later innovation networks were market-driven, built upon an increasing number of intermediary agents, governments and financial institutions.

The proposed mechanism that describes the industry-university-research collaboration is two-fold. First, technology could be diffused, or adapted, via licensing and offering of research and consulting services to enterprises. Second, the knowledge transfer could occur through the emergence of university-affiliated companies, which played a key role in developmental stage of the park. The presence of university or research institute in the hi-tech park was also forecast to boost employment of the park (Chen and Link, 2018). However, this influence on employment is minor, and possibly insignificant, in the context of ubiquitous communication technology.

The former channel is among well-researched areas in the study of industrial agglomeration. For example, in the empirical study of Zeng (2019) in the context of biopharmaceutical cluster in Wuhan, China, it was revealed that betweenness centrality and clustering

coefficient, two measures for influence of an entity in a cluster network and were proxied by number of mutual agreements and exchanges, positively affected performance and technological innovation of enterprises in the network. In addition, greater degree of structural holes, defined as the indirect connectivity between two actors in a network, was found to be inversely correlated with innovation. These results further justify the policy of divesting large enterprises of controlling power over the market and suggest a better institutional environment is critical for technology diffusion. These results were confirmed in another study where the firm-to-firm linkages in Zhangjiang hi-tech park are found to be the decisive factor in certain stages of the value chain of IC manufacturing (Zeng et al., 2011).

Another interesting mechanism regarding acquisition of tacit knowledge of enterprises was described in the study of Isabel (Díez-Vial and Fernández-Olmos, 2015). It was argued that the absorptive capacity of on-park firms depends on their internal R&D efforts, suggesting that knowledge externalities might not be diffused evenly across tenants. To be specific, adequate investment in R&D activities could enable enterprises to understand and exploit academic knowledge obtained from other firms and institutions in the network. Simultaneously, firms with proper R&D are more engaging in the innovation network where all players are also well-invested in R&D and are expected to be active contributors. In addition, the relationship of firms with university and research institutions may facilitate the understanding of tacit knowledge of firms, thus in turn enhancing product innovation in the long term. These arguments were empirically tested by utilizing a large longitudinal dataset of Spanish companies, showing positive effects of both cooperation with universities and internal R&D efforts on the number of new products.

The establishment of independent STP has become a new pathway for economic development. As such, STP is now a common policy implementation in Europe and the number of STP has been growing rapidly even in regions with the underdeveloped R&D foundation. STP plays a crucial role in identifying suitable policies concerning science, technology and innovation at the regional scale. However, it is worth noting that STP should be treated differently from other economic zones only when it solely focuses on research and developing technologies.

Some typical STPs in China and Vietnam

China has been an exemplar in adopting technologies in manufacture of spearhead products via establishment of Hi-Tech parks that cover a wide spectrum of hi-tech products and services. Zhangjiang Hi-Tech Park is among the China's most successful accomplishments since the initiation of the Torch program of Chinese Ministry of Science and Technology in 1988. In addition to integrated circuits and pharmaceuticals, the park's main activities, the

park also houses numerous science incubation and entrepreneurship centers (Chen and Karwan, 2008). Figures in 2007 indicated that the Zhangjiang accounts for approximately 18.3% of the national turnover in the field of information and communication industry in China. Further examination into the statistics also reveals that around 48% of IC manufacturing turnover and 39% of testing and packaging sales could be attributable to companies in the Zhangjiang park. This suggests that the park only specializes in some mid-range and low-cost stages in manufacture of electronics.

Different to China, development of STP in Vietnam is still in the infant stage and so far, only a few high-tech parks has been well-established. Saigon Hi-Tech Park (SHTP), one of the only three national hi-tech parks in Vietnam, is a trustworthy destination for hi-tech investment in Vietnam. The park is located in District 9 of Ho Chi Minh City and was established on October 24, 2002 by the Vietnamese Government. The Park is developed on an area of 913 hectares and includes two phases of development, of which the first Phase occupies 300 hectares and 613 hectares of the remaining area is of the second phase. With a strategic location which is in proximity to the city's center, airport and sea ports of HCMC, and surrounded by 43 industrial parks and export processing zones of the Focal Economic Region of Southern Vietnam, the Park has full advantages to become a "technology and science city", a heartland and a spearhead of HCMC and of the nation. SHTP veers itself to be a techno-polis playing an important role of strongly enhancing the technological and intellectual base of Ho Chi Minh City (HCMC) and the Focal Economic Region of Southern Vietnam, serving as a Vietnam's model of technological innovation, intellectual capital development and innovation economy.

As of 2019, there are a total of 123 tenants operating in the SHTP with foreign investment coming from 8 countries including Japan, Singapore, Korea, Thailand, US, France, Denmark and Italy. SHTP tenants operate in four major fields including microelectronics, biotechnology, automation and materials and energy. Figure 1 below shows the annual net investment in the zone. Generally, the investment poured into the park was uneven and there were two investment spikes in 2006 and in 2014, which were respectively due to the reception of two large investments from Intel ($1 billion) and Samsung Electronics ($2 billion), making the park the largest area for manufacturing of electronics and scientific products. However, except for these two large foreign investments, the SHPT maintained a relatively balanced investment composition between domestic and foreign funds. The presence of large internationals in the park obviously serves as a stimuli for investments of other technological enterprises, both domestic and international. Evidently, investment figures in the period of 2015-2018 were higher than those in the period of 2009 to 2013 due to the establishment of supporting enterprises in electronics.

Figure 1. Annual net investment in SHTP and composition in the last five years

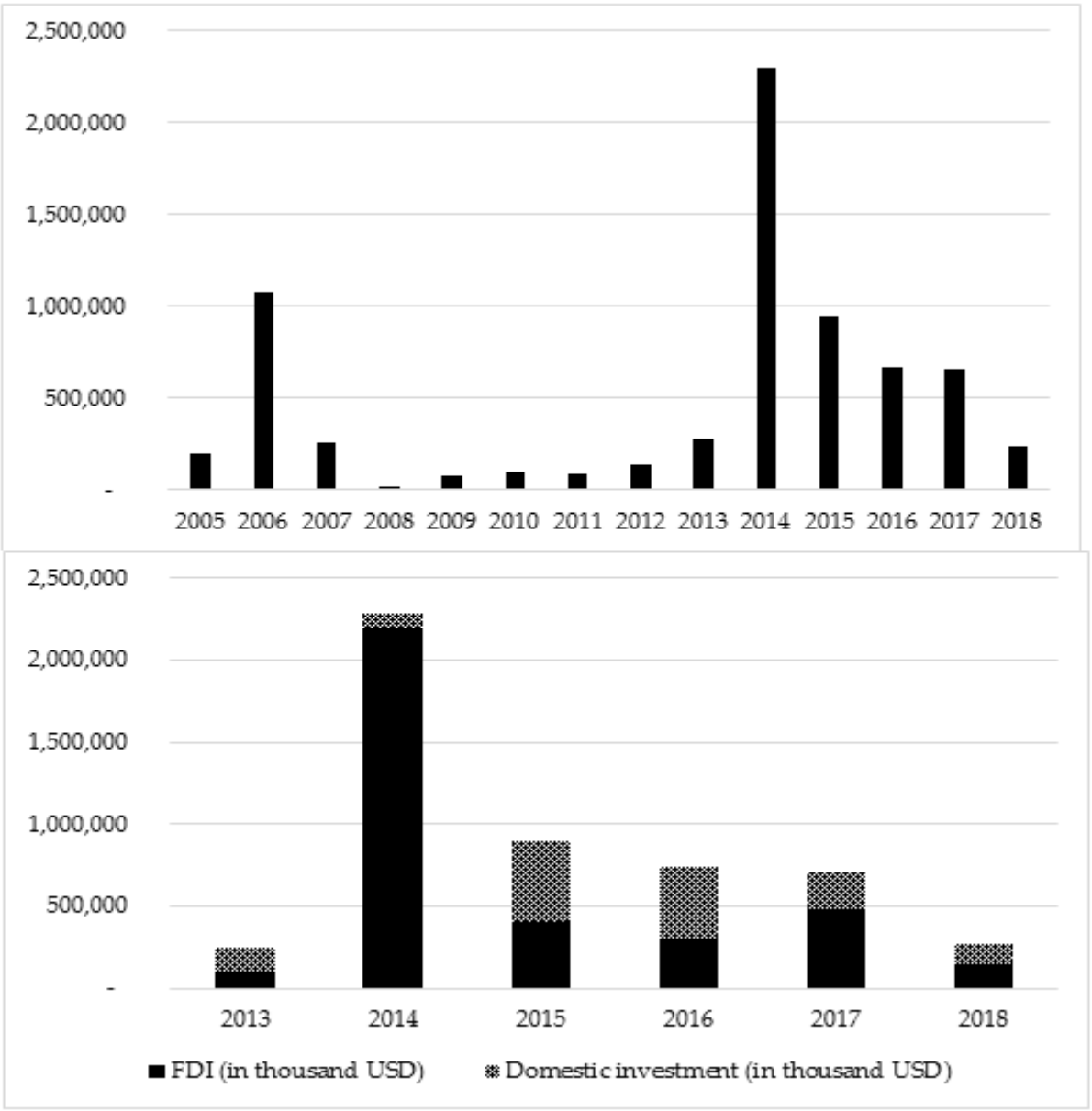


Figure 2 below presents the annual turnover and export values of tenants in the SHTP. Overall, turnover and net export have been rising steadily during the course from 2006 to 2018. In the period of 2006 to 2012, sales witnessed exponential growth rates, ranging from 92% to 160%. While the later period experienced a stagnating sales growth with the range from 13% to 59%, it was observed that these rises were of greater scale in value and mostly due to the operation of two big manufacturers of Intel and Samsung Electronics. To be specific, in the year of 2015, 2016, 2017 and 2018, rises in turnover was approximately 1.5, 2.7, 3.7 and 2.9 billion USD respectively. In addition, it was found that most of export figures

were correlated with sales and accounted for over 90% of each annual total sales. This suggests that exporting has been the main activity of SHTP and the park is a significant contributor to the budget of the city. The contribution of the SHTP to the local provincial budget in 2018 was approximately 283 million USD, mostly stems from import taxes, accounting for around 1.7% of the revenue of the city budget.

Figure 2. Annual total turnover of the SHTP and its composition

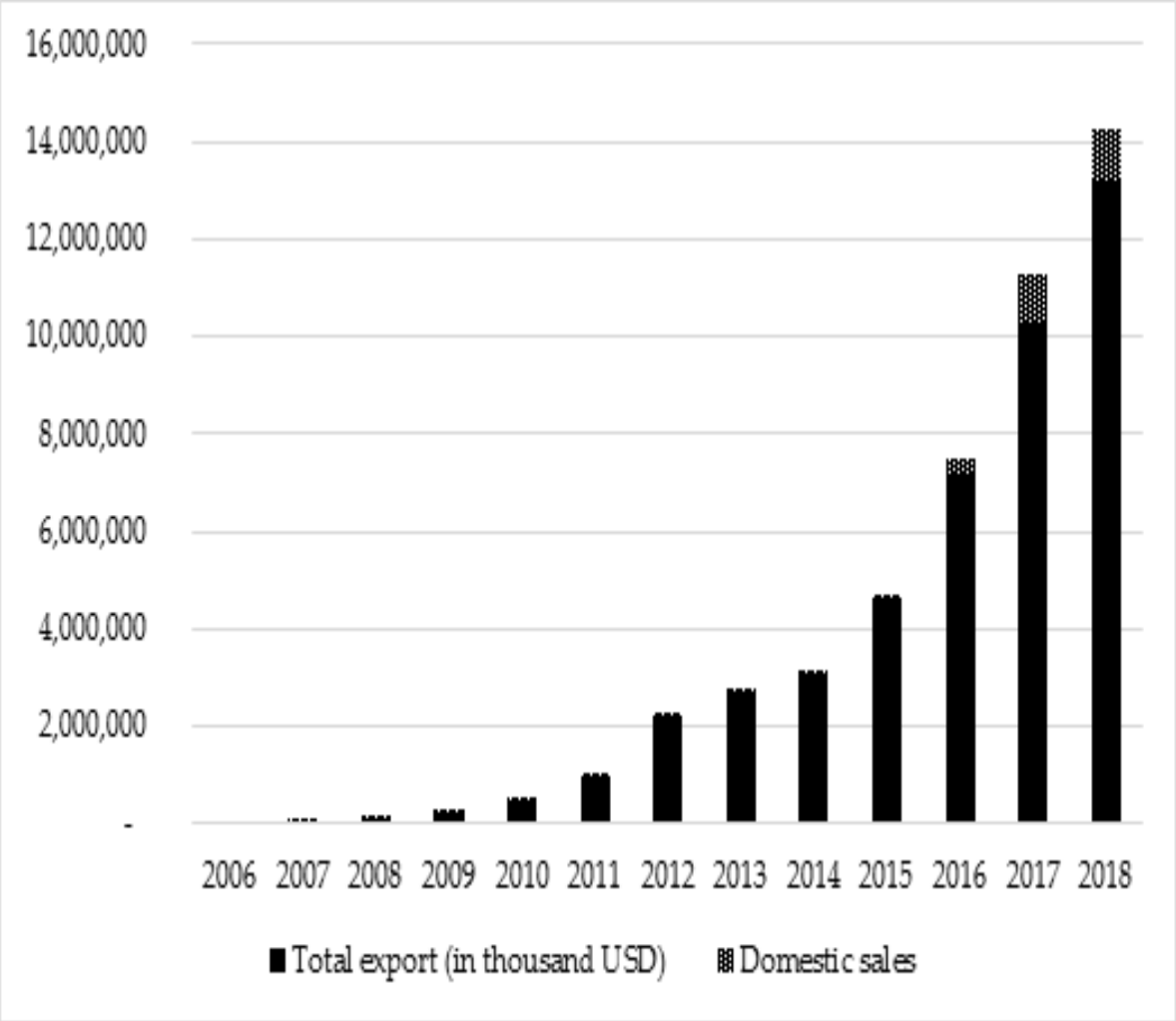
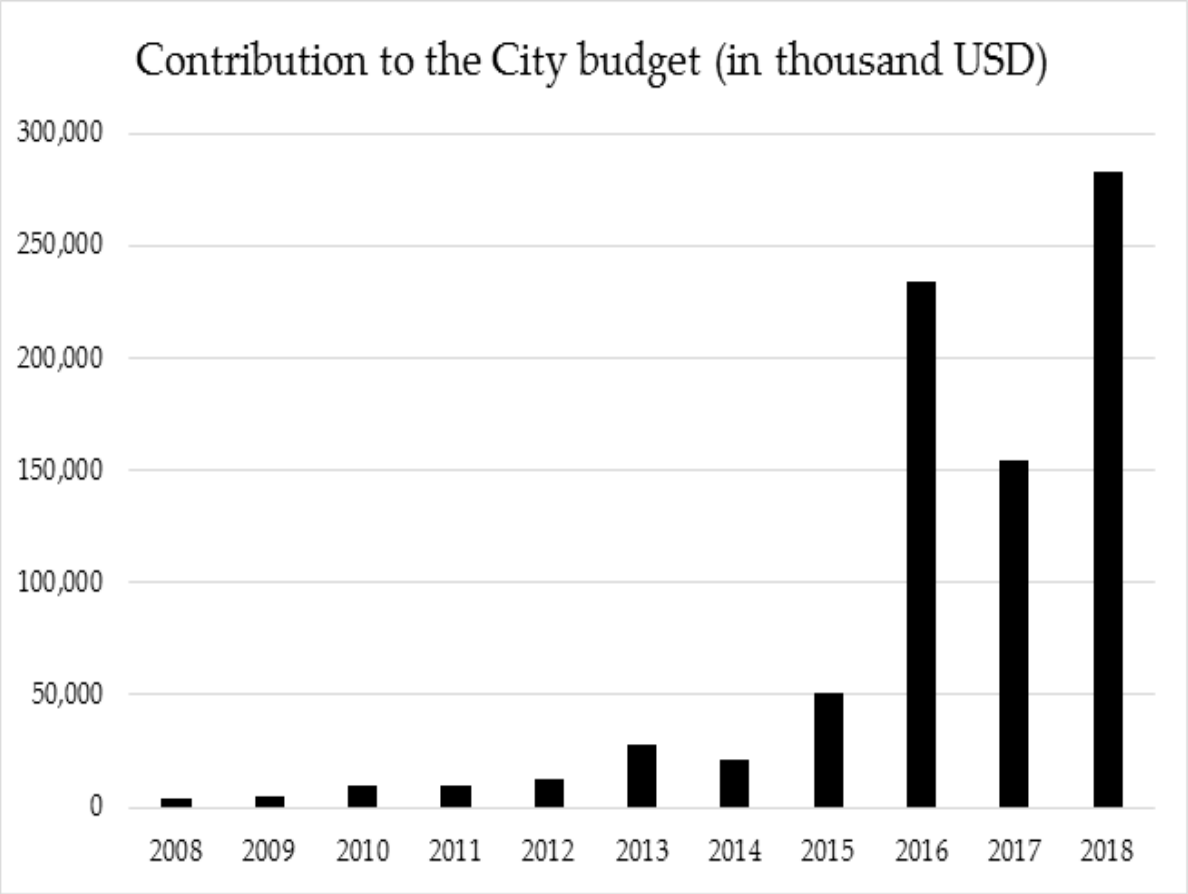


Figure 3. Contribution to the City budget



Sharp rises in domestic turnover, mostly coming from the technological services, were also observed in 2016, 2017 and 2018. This coincides with the initiation of many domestic investments in this period (as presented in Table 1 below), suggesting that the investment from Samsung electronics has compelled the attention of local investors to see the park as a potential business opportunity and that the park is a promising destination for technological enterprises, especially those offering analysis services and supporting manufacture. In addition, a handful of university-based research institutions (two from Vietnamese universities and one from a Japanese university) have begun to establish recently. Despite ambiguous benefits of this feature in China (Zeng et al., 2011), this movement aims to address the inadequate university-industry collaboration in Vietnam, which was ranked very low in comparison with other ASEAN and Asia countries (Innovation Policy, 2019). Although these institutions are not likely to largely contribute to export nor sales of the SHTP, it is expected that interaction between university and the private sector in the park could support the activity of technological enterprises situating in the park and that improved accessibility to research funding could be attained for university campuses with close proximity to science-specific banks and technological services.

Table 1: Number of investment projects from 2013 to 2019

Year	No. of FDI projects	No. of local projects
2013	2	5
2014	2	5
2015	9	18
2016	5	12
2017	9	19
2018	8	14
2019	1	1
Total	**54**	**100**

Conclusion

According to OECD, government policies concerning science-technology, industry and education should follow the new targets of the knowledge economy (Foray and Lundvall, 1998). This explains why technological advances that influence the economy in the long term should be scrutinized under a broader approach of the national innovation system – NIS, making NIS increasingly popular in the knowledge economy (Foray and Lundvall, 1998). STP is an obviously indispensable part of NIS (Lesjak and Bole, 2017). When taking to role as a connector as previously mentioned, STP could contribute to the development of NIS into RIS (Jukka et al., 2011) where interaction among actors in economic activities (especially the interaction between user and manufacturer) as well as the connection among businesses and communities become a critical concern (Shin, 2016).

In fact, RIS is not a theory of endogenous growth or pure economic geography. Rather, RIS is based on socio-economic changes, highlighting the influence of institutions on the development progress and close links among actors in the public and private sector and innovation processes in the region, Therefore, social capital, networking and education are the advancements of interest in RIS. The notion of clustering is also accentuated in RIS where static ideas of investment and connecting of fixed industries is referred. Although this notion is heavily criticized and debated (Shin, 2016), high tech zones continue to play an important role in simulating activities for development and research in the regional scope and in enhancing competitiveness of regional economies.

In the last three decades, Vietnam has recognized the importance of the knowledge economy and begun establishing national and provincial high tech zones, software parks, biotechnology parks, applied agriculture zone and recently the concentrated information technology zone. The contributions of these to the regional and nation economies is substantial. This proves that Vietnam has approached and adopted correctly the policies on

science and technology. The law on high technology in 2008 has officially codified NIS of Vietnam. More importantly, this law document has elevated the target of NIS from the starting point of "developing productive forces" to the new aims of (i) innovate high technologies, (ii) manufacture high tech products and (iii) develop high-tech industries.

However, while the NIS only reflects the beginning phase of development, which has been already shaped profoundly in Vietnam, The later phase of RIS has not been identified. This creates policy gaps for the Government and accentuates the negative consequences of dependence on NIS, which might obstruct the bottom-up development of STP. Taken together, in this discussion, the development towards RIS is proposed as an appropriate policy approach for Vietnam in the current context.

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