

RESEARCH ARTICLE

Imitation, Innovation and State Capacity: What Do East Asian Industrial Policies Imply?

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Abstract

Since the global financial crisis, industrial policy is back on the agenda in developing economies after a long break. The renewed interest in the industrial policy manifested itself in the discussions on the new directions for policymaking. A crucial aspect of the recent industrial policies is technology policies, in which the developing policies face the trade-off between imitation and innovation. In this study, we examine the association between industrial policy and state capacity based on a theoretical model. We elaborate on the successful interventionist industrial policies of the East Asian economies in the past in conjunction with state capacity and technology policies. As evidence from Korea, Singapore and Taiwan shows simultaneous implementation of imitation and innovation policies is possible. Recent experience in China further supports this conclusion. The results indicate that state capacity has played an important role in the success of East Asian industrial policies.

Keywords: Imitation • Innovation • State capacity • Industrial policy • East Asia

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Industrial policies have been implemented intensively during the second half of the 20th century. Most successful examples were in East Asian economies such as Japan, Korea, Singapore, and Taiwan. A number of studies have analyzed the latter's experience from various perspectives ranging from economics to political science (Amsden, 1989; Chang, 1993; Chang & Zach, 2018; Wade, 1990; Woo-Cummings, 1999). It is also well known that the early economic development and industrialization efforts in the United States and late-comers in continental Europe such as France and Germany in the 19th century involved strong government interventions akin to the industrial policies in East Asia (Yülek, 2018).

Starting from the 1990s, the interest in industrial policy has declined most notably due to the rise of neoliberal economic doctrines and the so-called Washington Consensus. However, with the inferior economic performance in Japan, the US, and the advanced European economies especially during the Global Financial Crisis after 2008, during which China continued to exhibit high-growth with industrial policies implemented one after another (Akkemik & Yülek, 2020), led the policymakers and economists to rethink the concept of industrial policy and its applicability for developed as well as developing economies. As Wade (2015) and Chang and Andreoni (2020) argued, the governments in advanced economies paid more attention to industrial policy, after a three-decade silence, as a viable policy to escape the adverse effects of the global recession and upgrade their economies after 2008. Aiginger and Rodrik (2020) also stated that industrial policy is "back on the scene." They also argue that industrial policy, combined with competition, trade, and tax policies, should not narrowly specific manufacturing industries but rather focus on any activity that can support high-quality and sophisticated products as well as the development of new technologies. For instance, Lin and Wang (2020), shows that in those economies who have successfully escaped the middle-income trap, the share of production-related services (e.g., energy, transport, communications, finance, insurance, and research and development) sectors are higher than those trapped. Therefore, it is important for governments to adopt an approach that has a wider selection of sectors in industrial policies. By doing so, it becomes practically viable to raise the low-income countries to middle-income status and middle-income countries to high-income status.

The share of services eventually increases in most economies. If it happens before achieving a satisfactory level of industrialization, there is a well-known problem of premature deindustrialization (Rodrik, 2016). An important aim of industrial policy is to cope with premature deindustrialization in developing economies (Aiginger & Rodrik, 2020; Lin & Wang, 2020).¹ This can be realized through government intervention or, alternatively, by providing the necessary market conditions by the government for the

¹ Rodrik (2016) shows that trade and globalization facilitates premature deindustrialization in developing countries.

private sector to develop. The East Asian experience in the second half of the 20th century has shown that the former is more effective as a viable strategy. Combined with an emphasis on exports for development, industrial policies led these economies to reach a high level of technological sophistication and, along with it, a high level of per capita income. The success of industrial policy in avoiding premature deindustrialization is related to the success in raising indigenous technology, learning by doing, and innovation capacity.

Despite opposing views² among researchers, the renewed intellectual interest in the industrial policy provides grounds for hope so that the developing country governments will consider it as a viable strategy for economic development and unfinished/ongoing industrialization. In this study, we elaborate on the relation between technology policies and state capacity within the framework of industrial development by building on the theoretical model in Acemoglu et al. (2003). We also provide a critical and select review of the literature on the relationship between state capacity and industrial development, in particular, in East Asia. We focus our attention specifically on state capacity and interventionist industrial policies.

The structure of this paper is as follows. In Section 2, we briefly describe a model of imitation and innovation. In section 3 we discuss the association between state capacity and industrial policy from a theoretical perspective. In section 4, we provide examples from East Asian experiences. Finally, the fifth section wraps up and concludes.

A Model of Innovation and Imitation

Building on Acemoglu et al. (2003) and Olsson (2012), we introduce a model of innovation and imitation for a small open developing economy in this section. Here we deem it sufficient to briefly outline the main features of the model. Interested readers are guided to the original article for further technical details. This model is very convenient to analyze the industrial and technology policies in developing countries because it takes into account the relative distance of the country to the world technology frontier. A major issue for developing countries is to catch up with the existing technologies in advanced countries. This is also related to state capacity, as we will see below.

Acemoglu et al. (2003) offer an endogenous growth model³ where firms engage in innovation or acquisition of the technologies at the world frontier. In this model, in a newly industrializing economy, firms undertake investments based on imitation of the technologies at the world frontier. When countries catch up and come closer to the world frontier, the strategy of the firm changes from imitation to innovation. The level of technology for a firm is defined as follows:

2 For an interesting discussion see Lin and Chang (2009). For a comprehensive review of opposing views from different perspectives, see Chang (2011).

3 For earlier endogenous growth models, see, for instance, Romer (1986; 1990).

$$A_t(v) = s_t(v)(\eta\bar{A}_{t-1} + \gamma_t(v)A_{t-1}) \tag{1}$$

where A is the level of technology, s is the size of the project, and γ is the skill level of the firm. A , s , and γ are functions of v , intermediate goods. The subscript t denotes time. Note that the final good is produced using labor and intermediate goods in this model. Therefore, v includes capital goods as well. The first term in bracket refers to the gains from the adoption of the technologies (in the form of acquisition or imitation) in the previous period (\bar{A}_{t-1}) and the second term refers to the gains from innovation, i.e., improvements in the existing technology from the previous period (A_{t-1}), which depends on the level of skills of human capital. This equation implies that a large investment (large s) improves productivity. A high level of skills increases the benefits of innovation.

It is quite common that developing countries undertake innovation and adopt foreign technologies simultaneously. If we assume that a fraction θ of the resources is employed for the purpose of the adoption of technologies at the world frontier in the previous period, and the remaining portion of resources $(1-\theta)$ is used for the purpose of innovation, then the level of technology can be rewritten as follows:

$$A_t = \theta\eta\bar{A}_{t-1} + (1 - \theta)\gamma_t A_{t-1} \tag{2}$$

Here we generalize equation (1) to include all sectors, not only intermediate goods. To get the growth rate of technology at time t (g_{At}), we divide both sides of equation (2) by A_{t-1} and subtract 1. Then, we get the following equation:

$$\frac{A_t}{A_{t-1}} = g_{At} = \theta\eta\frac{\bar{A}_{t-1}}{A_{t-1}} + (1 - \theta)\gamma_t - 1 \tag{3}$$

The ratio \bar{A}_{t-1}/A_{t-1} in this equation refers to the distance between the world frontier (\bar{A}) and the country's level of technology in the previous period (A_{t-1}). Renaming this term as δ , we get the following:

$$g_{At} = \theta\eta\delta_{t-1} + (1 - \theta)\gamma_t - 1 \tag{4}$$

Equation (4) implies that when the distance to the world technology frontier is large, the country gains more by catching up through the adoption of world technologies, i.e., a higher growth rate g_A and large θ . Such countries typically have low levels of skills, and hence gains from innovation are expected to be small. When the distance is small, then the country gains more by employing a larger portion of resources for innovation and improving the level of skills. In other words, when the country approaches the world frontier, gains from imitation or adoption of foreign technologies get smaller and gains from innovation are higher.

Acemoglu et al. (2003) argued that relying mainly on imitation and catch-up may have a long-run cost. In other words, the developing countries adopting such a strategy

for a long time may find themselves in a trap where they fail to converge to the world frontier. We argue, in line with Gerschenkron's argument, that government intervention and appropriate industrial policies offer a way out, and state capacity is crucial in this sense. An important issue for policymakers is how to allocate resources in the economy between the activities aiming for the adoption of world frontier technology and those activities aiming innovation by building on the domestic knowledge stock of technology. In the case where the costs involved seem too high, the government may not choose to adopt such a policy which results in the stated trap. Therefore, in what follows, we look at the successful cases in East Asia to find clues about what the government can do.

State Capacity and Industrial Policy

In the previous section, the association between state capacity and industrial policy has been outlined from the view point of economic theory. In this section, we build on this theoretical framework and argue that building of state capacity is a *quid pro quo* for the success of industrial development and industrial policies in particular.

The idea behind government intervention in industrial policy is the existence of market failures which lead to inefficient resource allocation especially in developing economies where industrialization is concerned. The government can play an important role in facilitating the productive resources in an economy towards industries characterized by high income elasticity, prospect for technology development, and strong linkages with other sectors. East Asian economies have often picked the "winners" by establishing close links between bureaucracy and private businesses. This can be also very risky if the government makes mistakes and often the government cannot collect as much information as necessary. The existence of such information asymmetries and capital market imperfections is a major obstacle before the government in this regard. Development banks, to some extent, can be thought to avoid such potential failures through screening and risk management for loans destined to targeted sectors and firms (Fernández-Arias et al., 2020). The intermediary role of government-linked financial institutions like this can also help the government in the assessment of social benefits and returns of industrial investments, unlike private financial institutions that are interested in private benefits and returns. Mazzucato and Penna (2016) further argue that state investment banks can even create markets and help develop new technologies.

Mazzucato (2013) argues that the government can also take the initiative in technology development which then spill over to other sectors, as in the case of the US where many technologies have emerged as the output of government-funded projects, such as GPS, touch screen, and many technologies which have later found their way into digital communication devices and Internet services. In this respect, the

government can take on the risk of developing new and highly innovative technologies as an entrepreneur. Mazzucato's "entrepreneurial state" has received mixed reviews by researchers but offers an alternative interpretation of the market failure argument.

A government can have three approaches to solve the market failures regarding the technology convergence trap as explained in the previous section. It might choose to make the market mechanism work better by limiting its involvement with providing incentives. Alternatively, it might choose to promote the development of technologies and industries that produce more sophisticated products for the aim of raising productivity and upgrading of technology at the economy level. A more radical choice available to the government is to create and nurture those industries and deliberately allocating productive resources in the economy towards these activities. Cherif and Hasanov (2019) name the first one the "snail crawl" approach, the second one the "leapfrog" approach, and the third one the "moonshot" approach. They argue that the effectiveness and success of each of those approaches can be assessed by the following performance criteria: productivity growth, export sophistication, and innovation. In their analyses, Korea and Taiwan, which adopted the moonshot approach, perform better than Malaysia, which adopted the leapfrog approach. Moonshot approach comes with a high risk compared with the other two approaches, and hence with a higher return when it is successful.

Industrial policies have proven to be right in escaping from the middle-income trap in a handful of East Asian economies. Wade (2010) further argued that the "middle-technology trap" is also important to understand as global value chains in the modern global economy force firms in the developing economies to get stuck in the lower value-added processes and tasks of the chain thereby preventing them to evolve into innovative activities. A case in point in East Asia is the Malaysian automobile industry.

It is important to note that while the government has the capability to affect the economic structure and enhance the level of technology in an economy by solving market failures, industrial policies do not necessarily have to be about manufacturing. As Cherif and Hasanov (2019) point out, some services in the modern economy engaging in the introduction of new technologies have become as important as manufactured products for industrial policies. Some examples are research and development services, information technologies, services sectors producing advanced digital technologies, and software. These services have strong linkage effects in the economy.

State capacity is also important to cope with uncertainties for firms through the implementation of industrial and technology policies. Firms face various uncertainties about the future in decision making about investments, choice and adoption of technologies, and investing in innovation, among others. As Chang and Andreoni

(2020) argue, industrial policies can be used to address these uncertainties. They argue that the government can do this in various forms: by leading the development of technologies, by guiding firms in joint research activities in technology development, by imposing technological standards.

As Stiglitz (2017) argued, industrial policies are broad economic policies that affect both the sectoral composition in the economy and the choice of technology. Such a policy involves risk-taking and may end up in failure as well. Stiglitz argues that the main task of industrial policy should be the promotion of a “learning society” which implies that the focus of the policy must be on learning that yields technological change. Since markets are not operating efficiently in doing this (i.e., they underinvest in sectors that promote learning), there is a need for intervention. Government intervention may take the form of providing subsidies and providing the necessary infrastructure and institutions that facilitate learning.

From the political science perspective, according to Singh and Ovardia (2018), the development of state capacity by way of state transformation through the creation of a capable and meritocratic bureaucracy, and pro-business orientation in policymaking are among the necessary political conditions underlying the successful industrial development in East Asia.⁴ These conditions resulted in the transformation of economic institutions in a way to facilitate rapid industrialization often with a time span of only one generation. Singh and Ovardia also argue that the relations between the state and the business world, as organized by the state, shaped the institutional capacity in industrialization. In other words, the state in rapidly industrializing East Asian economies possessed the capacity of successful management and allocation of economic rents among the actors in the business world. This is, no doubt, a political process. However, in the context of East Asia, such relations took place within the realm of the “developmental state,” where almost a consensus was achieved between business leaders and the state about the long-term development aims of the state.

The government’s role in conflict management among interest groups, i.e., winners and losers, is crucial for the success of industrial policies (Andreoni & Chang, 2019). In this respect, the government’s capacity in allocating rents and reallocating resources as an important condition for successful industrialization has also been well acknowledged by various researchers in the field of political economy. For instance, Khan and Blankenburg (2009) have shown that such capacity also requires political capacities, i.e., the ability to organize political power in the society so as to successfully manage the economic rents through the institutions of the state. In other words, the state in rapid industrializing East Asian economies was successful in allocating rents without many confrontations by the interest groups not receiving the rents. The state’s

4 For an interesting paper about the link between governance and economic development, see Kurtz and Schrank (2007). The authors also discuss problems in measuring governance.

capacity to avoid such a clash was instrumental in successful rent management. Among the stated economic rents, an important one at the earlier stages of development was the subsidies allocated to infant industries, which were vitally important because they facilitated learning. The economic bureaucracy paid utmost attention to keep itself away from the influence of the businesses and their rent-seeking activities, most notably in Korea and Taiwan.

The Case of East Asia

Rapid Industrialization and Long-Run Productivity

East Asian economies have achieved rapid economic growth and industrialization in one or two generations starting from the 1960s. This is evident from international statistics. According to the World Bank's *World Development Indicators* (WDI) database, per capita GDP (measured in constant 2010 US dollars) in China, Korea, and Singapore in 1990 was about 2.0, 23.6, and 62.6 percent of that of the US, respectively. The respective figures increased to 4.0, 34.5, and 75.7 percent in 2000 and 14.2, 51.3, and 107.8 percent in 2018. Specifically, Singapore's GDP surpassed that of the US in 2011.

East Asian economies emerged as major powerhouses in the world economy. According to WDI data, total manufacturing value-added (in current market prices) in the US (1.61 trillion US dollars) was about 2.5 times that of China (652 billion dollars) and 1.6 times that of Japan (1.03 trillion dollars) in 2017. However, China's total manufacturing value-added (1.15 trillion dollars) passed Japan (997 billion dollars) in 2007 and the US in 2010 (1.92 trillion vs. 1.79 billion dollars) to reach the top rank. As of 2017, China's manufacturing value-added (3.46 trillion dollars) was 1.6 times that of the US (2.17 trillion dollars) whereas the figure for Japan (1.01 trillion dollars) was only 46 percent of the US. While the aggregate figures imply a rapid surge in industrial production in China, in per capita terms, the story is different. Table 1 presents the manufacturing value-added per capita for selected countries. As of 2019, China still lags behind advanced industrialized economies such as Germany, Italy, Japan, the UK, and the US, although it passed large developing countries such as Brazil, Indonesia, Thailand, and Turkey, and is at par with Malaysia. The rapid rise in per capita manufacturing in Korea and Singapore, which are now rivaling the forerunner in East Asia, Japan, is remarkable. The figures in Table 1 provide evidence for the rapid rise in manufacturing capacity in a select group of East Asian economies, Korea, Singapore, and Taiwan, and most recently, China. A common characteristic of these economies is the active industrial policies of the government during the process of industrialization.

Table 1

Manufacturing Value Added Per Capita for Selected Countries (Current US Dollars)

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019
Brazil	...	1610	1097	1465	2951	1866	1890	2120	1748	1631
China	...	...	...	961	2482	4082	4017	4409	4938	4988
France	7961	9029	7208	9346	9176	8441	8415	8700	9073	8775
Germany	...	13343	9919	13844	15924	16077	16703	17412	18500	17159
India	168	181	188	292	618	688	724	816	811	798
Italy	9893	9757	8635	11858	12414	10347	10749	11259	12017	11502
Japan	...	19135	16297	15424	17813	13767	15264	15035	15038	...
Korea	3696	6832	6680	9910	12427	14168	14216	15566	16218	14674
Malaysia	1510	2874	3038	3622	4872	4598	4421	4612	5027	4994
Singapore	5866	11534	11496	14932	16576	16140	15998	18018	22157	20889
Thailand	782	1378	1024	1501	2710	2823	2903	3205	3481	3528
Turkey	1682	1826	2391	3799	4622	4824	4650	4694	4476	4286
UK	6274	7336	7632	8804	7379	8135	7252	7039	7366	7041
US	...	...	10563	11139	11402	13177	12800	13230	...	...

Source: Calculated using data from World Bank World Development Indicators

The ultimate aim of industrial policies in developing economies is the development of industries deemed important for economic and industrial development. Therefore, it is observed that, in most cases, industrial development policies and plans are motivated by a desire to build the capacity and ability for indigenous manufacturing. There is a myriad of policy tools that can be used for this purpose and the case of East Asian experiences in the second half of the 20th century have shown that effective combination of these policy instruments may yield high manufacturing performance and rapid industrialization often blended with strong government interventions (Akkemik, 2009).

Long-run economic growth is mainly determined by the increase in productivity. Welfare-enhancing policies are expected to lead to an increase in productivity as well. Growth of total factor productivity (TFP), as measured by the portion of economic growth after accounting for the growth of labor and capital inputs and the change in their respective qualities, is often used as an indicator for long-run productivity and technological change in general. Table 2 shows the estimated TFP growth in selected countries from 1960 to 2017. It can be seen that TFP growth was especially high in Japan during the 1970s, in Korea during the 1980s, in Taiwan from the 1960s to the 1990s, and in Singapore during certain periods (the second half of the 1960s and the second half of the 1980s). These periods almost perfectly overlap with the times that the respective governments actively implemented ambitious industrial policies. The figures in the table imply that industrial policies generally had a positive impact on productivity growth in the long-run. After the demise of the industrial policies in these countries from the late 1990s onwards, TFP growth rate also slowed down. In the case of China, TFP growth rates were especially high during the first half of the 1990s, and after 2000. During these periods, the government adopted large-scale national industrial

policies and ambitious innovation policies starting from the mid-2000s. The figures in Table 2 indicate that such policies have had a positive impact on long-run productivity.

Table 2
Total Factor Productivity Growth Rates for Selected Countries (Percentage)

	1960-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2017
US	1.4	0.2	0.0	-0.1	1.0	0.8	0.6	1.0	1.2	0.2	0.4
Japan	3.7	4.2	0.3	0.3	1.1	1.6	-0.4	0.0	0.4	-0.2	0.6
Korea	0.7	3.0	1.5	-0.3	3.2	2.9	1.1	1.7	1.4	1.9	0.2
Taiwan	4.7	2.2	2.0	3.4	1.5	3.9	2.2	2.1	1.2	2.3	0.6
Singapore	1.0	3.4	-1.8	0.6	-1.1	2.4	0.6	-2.3	1.9	-0.2	-1.0
China	1.3	-0.2	-2.6	-2.0	2.3	-0.1	3.0	-0.5	2.6	4.4	0.7
Indonesia	-0.8	1.8	-0.5	0.2	-1.0	1.2	2.2	-3.6	1.2	0.4	2.4
Malaysia	2.0	0.7	-1.6	-1.0	-3.0	2.1	1.4	-0.1	1.3	0.4	1.0
Thailand	1.7	6.5	-1.1	-0.9	-0.6	2.3	0.3	-1.6	3.0	0.7	1.4

Note. The figures refer to period averages.

Source. Calculated using data from the Penn World Tables ver. 9.1.

State Capacity in East Asia

We have summarized above using long-run data that, during the times the governments in the successfully industrializing East Asian economies were implementing interventionist industrial policies, which China still continues, both manufacturing capacity and long-run productivity in the economy have improved at a rapid pace. It can be safely argued that industrial policies have helped these economies build capacity for sustainable development. We argue, in this paper, that this was made possible by a high level of state capacity. Chang and Zach (2018) state that these economies were characterized by a high state capacity, which consisted of two components: technical capacity and political capacity. The former refers to the capacity of policymakers in designing and implementing policies while the latter refers to the capacity in catering to the needs of stakeholders in industrial policies and simultaneously resisting the pressures by interest groups. On the other hand, Chang and Zach warn that high state capacity is not a prerequisite for successful industrial policies. Rather, high state capacity was built during the course of the implementation of the industrial policies.

An important aspect of the successful cases of industrial policies in East Asian economies is the enormous effort of the economic bureaucracy spent on policy design. The long-term commitment of devoted bureaucrats who were granted autonomy in policymaking made it possible to focus their attention on devise appropriate policies even when drastic changes were happening in the regional and global economic conditions. Therefore, the stability in the policymaking process is a key component. Below, we review and elaborate on some important cases of industrial policies in conjunction with state capacity first in the earlier cohort, namely, Korea, Singapore, and Taiwan, and later, in China. While there are other economies

that are of interest such as Indonesia, Malaysia, and Thailand, we limit our review with the stated four countries.⁵

Korea, Singapore, and Taiwan

Korea is a case in point for researchers to understand how to devise effective industrial policies. Korean government implemented active industrial policies until the mid-1990s and the bureaucrats of the Economic Planning Board provided national and sectoral plans and they were the mastermind in industrial policymaking. It is important to note that the Korean government provided support to private firms for their innovation activities starting from the 1970s and most notably in the 1980s. It also established research institutes to conduct research in cutting-edge technologies in hi-tech sectors. Such efforts were effective in building a basis for innovation at a time when Korea was still far from the world technology frontier and allocating more of its resources to learn those technologies (i.e., imitation). Public-private partnerships in innovative research activities and the establishment of techno-parks also helped build domestic innovative capability, especially in the automotive, computer, and electronics industries. One task the public research and development institutions were assigned was the training of research and development personnel and technicians in private firms (Hong, 1997).

Rent management of the Korean state was effective as evident from the establishment and maintenance of the balance of power between the large conglomerates and the state (Khan & Blankenburg, 2019). These rents took the form of subsidies to exports and based on export performance as the main criterion for securing them.

In a recent study, Yülek et al. (2020) show evidence by comparing the case of the development of automobile industries in Turkey and Korea that the high level of success in Korea and the failure in Turkey is related to the difference in state capacity in the two countries. While both countries have started from almost similar conditions in the 1970s, the Korean automobile sector exhibited far better technological development and outperformed the Turkish automobile industry to become one of the global leaders. Yülek et al. show that some of the important features of the different state capacities in these two countries are related to, among others, (i) the ability to build indigenous technological and industrial capabilities and human resources, (ii) the level of industrial entrepreneurship, (iii) the capability to create local brands, (iv) policy design, focus, and vigor, (v) the availability of a wide range of policy tools, technological assistance, and public procurement.

5 A critical evaluation of industrial policies and economic development in Indonesia, Malaysia, and Thailand can be found in Jomo et al. (1997).

Taiwan implemented active and interventionist industrial policies from the early 1950s to the early 1990s. The Taiwanese state was very careful in its industrial policies to ensure effective rent management and avoiding rent-seeking activities of the private sector firms as well as large state-owned firms which may have impeded the rent management system. The economic bureaucracy was also free from any potential influence through the centralized political structure of the ruling party, Kuomintang, owing to the prolonged martial law in the post-war period (Khan & Blankenburg, 2009).

As in the case of Korea above, the government in Taiwan also provided support for innovative activities of domestic firms starting from the 1970s by establishing research centers and techno-parks. The government also engaged in manufacturing by creating joint ventures with private firms. Firms were provided a number of incentives for research and development activities such as cheap loans, tax deduction, tariff exemption, and provision of capital along with the encouragement of technology transfer from foreign firms in export-processing zones to local small and medium-sized firms (Wu & Tseng, 1998). These resulted in the development of indigenous innovative capacity and product development afterward. As in Korea, this happened at a stage where Taiwan was focusing on imitation due to the need to catch up with the world frontier. By the 1990s, Taiwan emerged as a major player in specific frontier technologies in hi-tech areas, most notably in electronics.

In Singapore, since independence in 1965, the government intervened virtually in all markets and implemented industrial policies. However, the story is a little different as the government turned to multinational corporations for industrial development and technological upgrading due to the lack of indigenous entrepreneurship and resources. In the 1970s and the 1980s, the government's technology policy focused on the acquisition of foreign technologies and attracting foreign firms to Singapore by providing massive incentives. In fact, industrialization in Singapore was made possible by large foreign investments. The government also encouraged technology transfer from foreign firms to small local firms that served as suppliers. Starting from the mid-1990s, the government focused on indigenous technology creation in electronics and information technologies. In the 2000s this was extended to include new promising technologies such as biotechnology and satellite systems. For this purpose, the government put in place various support schemes to attract foreign talent as well as domestic.

Rent creation and management of the government in Singapore was different than in Korea and Taiwan. Due to the lack of indigenous entrepreneurship and domestic institutions to start technology creation using domestic sources, it is argued that the government was quite late in promoting research and development in industrial policies, compared to Korea and Taiwan (Wong, 2001). While the government spent much effort to enhance technological upgrading and technology transfer from foreign firms

to local firms, large foreign firms were the main actor in the government's technology policies. The government encouraged the development of domestic firms only after the mid-1980s. Continuous interaction between the bureaucrats, foreign firms, local firms, labor organizations as well as research institutions in the form of deliberate councils helped the government reduce the cost of coordination.

Three cases of industrial policies above show that during the early stages of industrialization, industrial policies focused on the acquisition of foreign technology by way of technology transfer from foreign firms or direct acquisition from abroad. This implies that the term θ , i.e., the share of resources devoted to imitation, in equation (2) was larger in Korea, Singapore, and Taiwan. By the 1970s, both Korea and Taiwan started investing in innovation by establishing public and private research and development institutions in order to develop a national innovation base. This means, the share θ started to decline and the share of resources devoted to innovation, $1-\theta$, started to increase. This process started a bit later in Singapore in the 1990s. This can be seen by looking at the research and development expenditures as a percentage of GDP in Figure 1. By 1996, this ratio had reached 2.3 percent in Korea and 1.3 percent in Singapore. The respective figures for Japan and the US were 2.7 and 2.5 percent. Research and development expenditures passed the 2.5 percent mark in Korea in 2004 and reached 3.0 percent in 2007, 4.0 percent in 2012, and 4.8 percent in 2018. The respective ratio for Singapore was 1.9 percent in Singapore in 2017. In 2018, Korea was far ahead of the developed countries in this indicator, when compared with France (2.2 percent), Germany (3.1 percent), Japan (3.3 percent), Sweden (3.3 percent), UK (1.7 percent), and the US (2.8 percent). Therefore, it is evident from these figures that, especially after the 1990s, enormous amounts of resources have been devoted to innovative activities in East Asia.

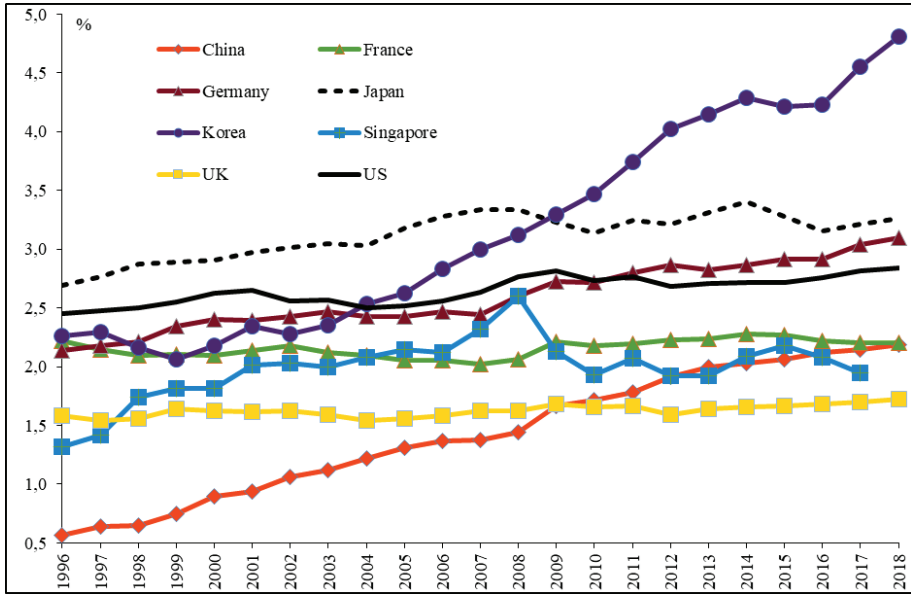


Figure 1. Research and development expenditures percentage of GDP.

Source: World Bank World Development Indicators.

To evaluate the outcomes of technology policies, we look at the comparative patent applications data in the World Intellectual Property Organization statistical database. Patent applications by residents are presented in Figure 2 per GDP and in Figure 3 per million population. Patent applications by residents per 100 billion US dollar GDP (measure in PPP in 2011 constant US dollars) in 1990 was 8813 in Japan and 986 in the US. In the same year, the figures in Korea and Taiwan was 1821. In 1995, it was only 90 in Singapore and well below that in Japan (8206) and Korea (8511). By 2018, the figure in Korea (8561) was far above that in the developed economies such as Germany (1924), Japan (5101), Sweden (1225), and the US (1565). In the same year, residents’ patent applications per million population in Korea (3148) was also far higher (2005 in Japan, 884 in Germany, 871 in the US, and 578 in Sweden).

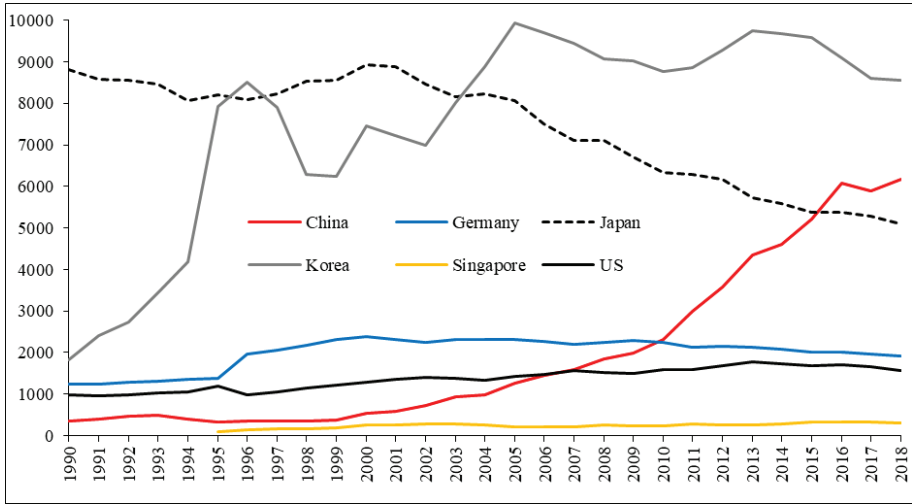


Figure 2. Patent applications by residents per 100 billion US dollar GDP.

Note: GDP refers to purchasing power parity (PPP) based GDP at constant 2011 US dollars.

Source: World Intellectual Property Organization (WIPO) statistics database.

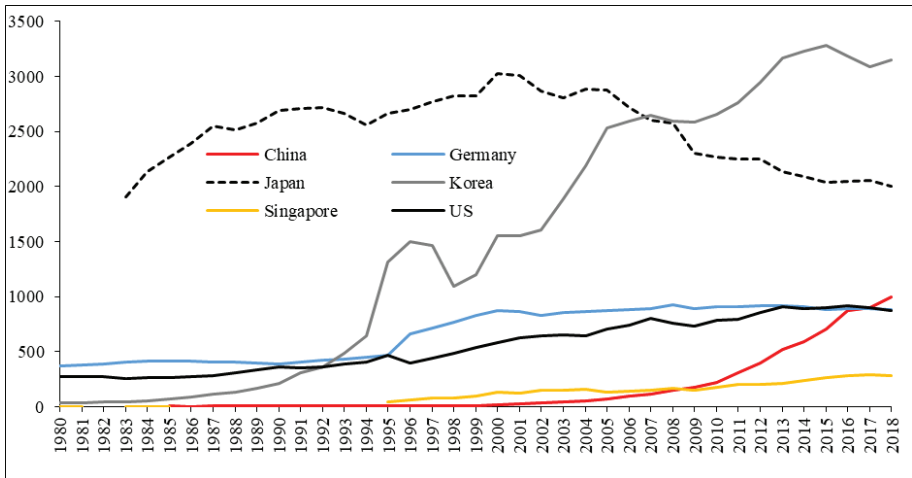


Figure 2. Patent applications by residents per million population.

Note: GDP refers to purchasing power parity (PPP) based GDP at constant 2011 US dollars.

Source: World Intellectual Property Organization (WIPO) statistics database.

China

The case for China is an interesting one given the ongoing rise of China in the world economy as a manufacturing powerhouse. While the Chinese government officially used the term “industrial policy” in the seventh five-year development plan, which

was launched in 1986, innovation was officially pronounced as a policy aim long after. The government has intervened heavily after launching the Medium-to-Long-Term Plan for Science and Technology Development in 2006. The plan envisioned to promote an innovation-based economy based on indigenous innovation. A wide range of instruments ranging from the establishment of public research institutions and technoparks to the provision financial incentives such as direct subsidies, tax deductions, and exemption from import duties. A major turning point in China's technology policies is the assignment of seven hi-tech sectors by the government in 2010 (Akkemik & Menteşoğlu Tuncer, 2019). These sectors included green technologies, new-generation communication technologies, biotechnology, new energy sources, and new materials, and new-generation vehicles. Starting from 2015, such attempts to enhance the innovation capacity of China have become more explicit especially with the launch of the ambitious "Made in China 2025" Plan. This plan aims to foster indigenous innovation in China by enhancing the smart manufacturing capacity of domestic firms and increasing the domestic technology creation capacity in promising and innovative areas such as green technologies, space, new energies, biotechnology, new materials, digital telecommunications, and new information technologies.

The development of state capacity in China is most evident in the case of the development of economic bureaucracy. Akkemik and Yülek (2020) provide an overview of the development of the economic bureaucracy during the process of rapid industrialization in China after 1978. There was competition for power among the economic bureaucratic institutions with differing ideologies in charge of planning and industrial policies. After 1993, the bureaucrats in the State Economic and Trade Commission (SETC), who believed that industrial policies and government intervention is essential for economic development, gained power. In 2003 SETC was transformed into National Development and Reform Commission (NDRC) and was assigned also the installment of the technology policies along with national industrial policies. NDRC bureaucrats paid attention and distanced themselves from the rent-seeking activities of the state-owned firms (Heilmann & Shih, 2013). They have adopted the "administrative guidance" type of interventions like the Japanese economic bureaucracy in the past. Their main role in industrial policies was to maintain coordination across different firms and government institutions and compliance with the government's industrial policies through centralized policymaking while giving more freedom to firms in their economic decisions.⁶ In the 2010s, the new objective of technological upgrading was added to the list of the objectives of industrial policies.

6 An interesting but yet important feature of the state capacity in industrial policymaking in China is the middlemen serving to promote the coordination among a number of government institutions named as "policy brokers" (Heilmann & Shih, 2013). These are former senior government officials and they have close relations with the senior government officials in service.

China offers a case of rapid catch-up with the foreign technological frontier by allocating a dominantly large part of resources and promoting skills development for this purpose during the 1980s, 1990s, and most of the 2000s. Starting from the 1990s, this effort was accompanied by sophisticated and large-scale industrial policies. Aizenman et al. (2018) name this “outwards mercantilism” and argue that this was the main factor behind China’s sustained current account surpluses over the years.⁷ Figure 1 shows that the ratio of research and development expenditures to GDP was a mere 0.6 percent in the late 1990s, during which China was still emphasizing imitation rather than innovation. The technology policies starting in 2006 led to massive support for innovation and research activities. As a result, the stated figure increased from 0.9 percent in 2000 to 1.4 percent in 2007, 2.0 percent in 2013, and further to 2.2 percent in 2018. This figure was the same as that in France in 2018 and higher than the UK (1.7 percent), and quite close to the OECD average (2.5 percent). There, it is safe to assert that more resources have been allocated to innovation in China during the last decade and a half. The outcome of these efforts as measured by patent applications of residents are shown in Figure and Figure 3. The take-off for patent applications happened around 2006, i.e., when the innovation policies were put in place (see Figure 2). In 2000, patent applications per 100 billion US dollars (PPP-based, constant 2011 US dollars) were only 544, far below that in Japan (8942) and the US (1279). In 2007, China (1599) caught up with the US (1574), and this figure reached 3566 in 2012, a little more than half of Japan (3566) but more than twice that of the US (1691). However, in 2018, it reached a remarkably high level of 6183, above that of Japan (5101), and the US (1565), but also of Germany (1924). In terms of per million population, patent applications by residents in China, which was only 20 in 2000, but it reached 116 in 2007. In 2012, it was still about half of the US (396 vs. 856) and much lower than Japan (2250). However, in 2018, China (1001) passed the US (871), as well as Germany (884), although it was still half of Japan (2005) despite the narrowing of the gap. These figures imply rapid catch-up in these two innovation-related indicators with the advanced countries of the world. As a result, China has found its way to the list of technology creating countries. This, however, has not yet materialized into high-income status. According to WDI data, in 2018, GDP per capita measured in constant 2010 US dollars in China (7807 dollars) was still 14 percent of that of the US (54795 dollars). The earlier late-comers Korea (51 percent) and Singapore (108 percent) were more successful in raising income levels while Japan stood at 89

7 Aizenman et al. (2018) elaborate on the new directions in China’s outwards mercantilism after the Global Financial Crisis broke out in 2008. In particular, they argue that the low return on China’s international reserves, mostly invested in US government bonds, led the government to direct the funds accruing from current account surpluses towards investment in higher-yield assets, thereby leading to increased outward foreign direct investments. After 2016, China’s net foreign direct investment position changed from net inflows to net outflows. This external rebalancing was accompanied by bilateral swap agreements with developing countries and loans from the AIIB for infrastructure projects in developing countries. This is clearly related to the government’s Belt and Road Initiative.

percent. Therefore, there is still a big gap to fill in China to escape from the middle-income trap and to reach the status of a high-income economy, which Korea, Singapore, and Taiwan achieved by the 1990s.

In addition to official statistics, recent theoretical and empirical studies have also attempted to evaluate the technology policies in China. For instance, König et al. (2020) built a dynamic theoretical model with heterogeneous firms (in terms of productivity) where firms choose between imitation and innovation to enhance productivity in the future. They test their model using Chinese data for the period 2007-2012. They found that the productivity of research and development in Chinese firms was low despite low opportunity cost. They also show evidence for excessive over-reporting of research and development activities by Chinese firms, i.e., some operational expenditures were misreported deliberately as research and development expenditures. This is clearly a case of moral hazard where firms cheat the government to reap research and development subsidies. König et al. argue that research and development played a minor role in productivity growth in China. In conclusion, they imply that innovation is not yet important for China as it is still far from the world technology frontier. Therefore, based on the findings of König et al. (2020), one can argue that imitation is a better strategy for Chinese firms, as proposed by the model in Acemoglu et al. (2006).

The consequences of industrial policies are also important. The welfare gains from industrial policies may be much lower than expected and technological spillovers may not materialize despite heavy government subsidies for production and investment, as argued by Barwick et al. (2019) for the Chinese government's industrial policies in the shipbuilding industry.

Conclusion

In this paper, we argue that industrial policy has been back on the agenda for developing countries to avoid getting stuck in the middle-income trap and premature deindustrialization, especially after the global financial crisis that started in 2008. We show that technological upgrading is an important component of it and there are two ways to achieve it for developing countries: imitation or innovation. The choice between the two requires an evaluation of the country from the world technology frontier. While a country can choose to allocate resources for both imitation and innovation strategies at the same time, priority should be on imitation when the distance from the world frontier is large and on innovation when the country catches up with the frontier. We provide evidence from success stories in East Asia, namely Korea, Singapore, Taiwan, and more recently, China. The experiences of these countries show that a high level of state capacity is crucial for the success of industrial policies and technology policies, whether it is imitation or innovation. The allocation of resources for technological

upgrading often requires careful rent creation and management, where state capacity is important for successful implementation.

State capacity is important for industrialization and effective industrial policy design and implementation. One thing we have learned from the East Asian case is that building a high-level state capacity often necessitates a capable and skilled group of bureaucrats and technocrats who are not exposed to the influence of strong interest groups whether political or business-related. However, this does not mean the separation of technocrats entirely from those interest groups. Political support and the consent of the businesses, as was the case in East Asia albeit through the visible hand of the government, may facilitate effective policymaking in the long run. Strong commitment to industrialization is the first condition for the success of industrial policies. High-level state capacity complements it. How to build this capacity depends on differing conditions in developing countries.

Wade (2015) argued that a new type of “developmental state” can be built by developing economies with distinct characteristics different from the East Asian developmental states of the past. This new type can bargain with large foreign firms for the transfer of skills to the indigenous firms and workers. By doing so, they can exploit the dependence of foreign firms on global production networks to some extent. On the other hand, it should be noted that the development of the recent smart manufacturing technologies during the Fourth Industrial Revolution may offset much of the expected gains. This is because the recent revolutionary developments in manufacturing and artificial intelligence are likely to reduce the dependence of developed country firms on such low value-added or repetitive processes in manufacturing.

An interesting question is whether the low-income countries of the developing world, most of which are located in Sub-Saharan Africa, can learn from or emulate the recent industrialization experiences and industrial policies of the East Asian economies which have successfully saved themselves from the middle-income trap. Amidst the recent arguments about the rise of Africa, it is yet a matter of concern how African nations can realize a great leap forward in an attempt to take off towards industrialization. Gelb et al. (2020) have argued that African nations need to upgrade skills to ensure higher value-added activities. A similar argument can also be made for Latin American countries.⁸ Whereas transplantation of institutions and industrial policies are difficult to adopt and copy because of the different political-economic backgrounds across countries, the lessons from the East Asian countries about successful design and implementation of industrial policies is still important. Future research in this avenue should focus more on how to design industrial policies fitting the characteristics of these economies.

8 For recent studies about the viability of industrial policies in Africa and Latin America, see Stiglitz and Lin (2014), Page and Tarp (2017), and Otsubo and Otchia (2020).

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References

- Acemoglu, D., Aghion, P., & Zilibotti, F. (2003). Vertical integration and distance to frontier. *Journal of the European Economic Association*, 1(2-3), 630–638.
- Aiginger, K., & Rodrik, D. (2020). Rebirth of industrial policy and an agenda for the twenty-first century. *Journal of Industry, Competition and Trade*, 20, 189–207.
- Aizenman, J., Jinjaraq, Y., & Zheng, H. (2018). Chinese outwards mercantilism: The art and practice of bundling. *Journal of International Money and Finance*, 86, 31–49.
- Akkemik, K. A. (2009). *Industrial development in East Asia: A comparative look at Japan, Korea, Taiwan, and Singapore*. World Scientific.
- Akkemik, K. A., & Menteşoğlu Tuncer, B. (2019). Çin-ABD ticaret savaşları gölgesinde Çin sanayi ve teknoloji politikaları [China's Industry and Technology Policies in the Shadow of the China-USA Trade Wars]. In C. Bakır & M. Yağcı (Eds.), *Çin bilmecesi: Çin'in ekonomik yükselişi, uluslararası ilişkilerde dönüşüm ve Türkiye* [China conundrum: The rise of China's economic transformation in international relations and Turkey] (pp. 77–101). Koç University Press.
- Akkemik, K. A., & Yülek, M. (2020). 'Made in China 2025' and the recent industrial policy in China. In S. T. Otsubo & C. Otchia (Eds.), *Designing integrated industrial policies: Industrial promotion for inclusive development under globalization* (pp. 337–364). Routledge.
- Andreoni, A., & Chang, H. J. (2019). The political economy of industrial policy: Structural interdependencies, policy alignment and conflict management. *Structural Change and Economic Dynamics*, 48, 136–150.
- Amsden, A. (1989). *Asia's next giant: South Korea and late industrialization*. Oxford University Press.
- Barwick, P. J., Kalouptsidi, M., & Zahur, N. B. (2019). *China's industrial policy: An empirical evaluation*. National Bureau of Economic Research Working Paper No. 26075.
- Chang, H. J. (1993). The political economy of industrial Policy in Korea. *Cambridge Journal of Economics*, 17(2), 131–157.
- Chang, H. J. (2011). Industrial policy: Can we go beyond an unproductive confrontation? In J. Lin & B. Pleskovic (Eds.), *Annual World Bank conference on development economics* (pp. 83–109). World Bank.
- Chang, H. J., & Andreoni, A. (2020). Industrial policy in the 21st century. *Development and Change*, 51(2), 324–351.
- Chang, H. J., & Zach, K. (2018). *Industrial development in Asia: Trends in Industrialization and industrial policy experiences of developing Asia*. United Nations University WIDER Working Paper No. 2018/120.
- Cherif, R., & Hasanov, F. (2019). *The return of the policy that shall not be named: Principles of industrial policy*. IMF Working Paper No. WP/19/74.

- Fernández-Arias, E., Hausmann, R., & Panizza, U. (2020). Smart development banks. *Journal of Industry, Competition and Trade*, 20, 395–420.
- Gelb, A., Ramachandran, V., Meyer, C. J., Wadhwa, D., & Navis, K. (2020). Can Sub-Saharan Africa be a manufacturing destination? Labor costs, price levels, and the role of industrial policy. *Journal of Industry, Competition and Trade*, 20, 335–357.
- Heilmann, S., & Shih, L. (2013). *The rise of industrial policy in China, 1978-2012*. Harvard-Yenching Institute Working Paper.
- Hong, S. G. (1997). *The political economy of industrial policy in East Asia: The semiconductor industry and South Korea*. Edward Elgar.
- Jomo, K. S., Chung, C. Y., Folk, B. C., Ul-Haque, I., Phongpaichit, P., Simatupang, B., & Tateishi, M. (2019). *Southeast Asia's misunderstood miracle: Industrial policy and economic development in Thailand, Malaysia and Indonesia*. Routledge.
- Khan, M. H., & Blankenburg, S. (2009). The political economy of industrial policy in Asia and Latin America. In M. Cimoli, G. Dosi, & J. E. Stiglitz (Eds.), *Industrial policy and development: The political economy of capabilities accumulation* (pp. 336–377). Oxford University Press.
- König, M., Song, Z., Storesletten, K., & Zilibotti, F. (2020). *From imitation to innovation: Where is all that Chinese R&D going?* National Bureau of Economic Research Working Paper No. 27404.
- Kurtz, M. J., & Schrank, A. (2007). Growth and governance: Models, measures, and mechanisms. *Journal of Politics*, 69(2), 538–554.
- Lin, J. Y., & Chang, H. J. (2009). Should industrial policy in developing countries conform to comparative advantage or defy it? *Development Policy Review*, 27(5), 483–502.
- Lin, J. Y., & Wang, Y. (2020). Structural change, industrial upgrading, and middle-income trap. *Journal of Industry, Competition and Trade*, 20, 359–394.
- Mazzucato, M. (2013). *The entrepreneurial state: debunking the public vs. private myth in risk and innovation*. Anthem Press.
- Mazzucato M., & Penna, C. C. R. (2016). Beyond market failures: The market creating and shaping roles of state investment banks. *Journal of Economic Policy Reform*, 19(4), 305–326.
- Olsson, O. (2012). *Essentials of advanced macroeconomic theory*. Routledge
- Otsubo, S. T., & Otchia, C. S. (2020). *Designing integrated industrial policies volume II: For inclusive development in Africa and Asia*. Routledge.
- Page, J., & Tarp, F. (Eds.). (2017). *The practice of industrial policy: Government-business coordination in Africa and East Asia*. Oxford University Press.
- Rodrik, D. (2016). Premature deindustrialization. *Journal of Economic Growth*, 21(1), 1–33.
- Romer, P. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94, 1002–1037.
- Romer, P. (1990). Endogenous technological change. *Journal of Political Economy*, 98, 71–102.
- Singh, J. N., & Ovidia, J. S. (2018). The theory and practice of building developmental states in the global south. *Third World Quarterly*, 39(6), 1033–1055.
- Stiglitz, J. E. (2017). Industrial policy, learning, and development. In J. Page & F. Tarp (Eds.), *The practice of industrial policy: Government-business coordination in Africa and East Asia* (pp. 23–39). Oxford University Press.
- Stiglitz, J. E., & Lin, J. Y. (Eds.) (2014). *The industrial policy revolution, vol. 1: The role of government beyond ideology*. Palgrave Macmillan.

- Wade, R. (1990). *Governing the market: Economic theory and the role of government in East Asian industrialization*. Princeton University Press.
- Wade, R. (2010). After the crisis: Industrial policy and the developmental state in low-income countries. *Global Policy*, 1(2), 150–161.
- Wade, R. (2015). The role of industrial policy in developing countries. In A. Calcagno, S. Dullien, A. Márquez-Velázquez, N. Maystre, & J. Priewe (Eds.), *Rethinking development strategies after the financial crisis, volume I: making the case for policy space* (pp. 67–79). UNCTAD and Hochschule für Technik und Wirtschaft Berlin.
- Wong, P. K. (2001). The role of state in Singapore’s industrial development. In P. K. Wong & C. Y. Ng (Eds.), *Industrial policy, innovation and economic growth: The experience of Japan and the East Asian NIEs* (pp. 503–579). Singapore University Press.
- Woo-Cumings, M. (Ed.). (1999). *The developmental state*. Cornell University Press.
- Wu, R. I., & Tseng, M. S. (1998). The development of the information industry in Taiwan. In K. Takahashi (Ed.), *Asia’s development experiences: How internationally competitive manufacturing firms developed in Asia* (pp. 76–124). FASID.
- Yülek, M. (2018). *How nations succeed*. Palgrave Macmillan.
- Yülek, M. A., Lee, K. H., Kim, J., & Park, D. (2020). State capacity and the role of industrial policy in automobile industry: A comparative analysis of Turkey and South Korea. *Journal of Industry, Competition and Trade*, 20, 307–331.