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Financing Industrial Development in Korea and Implications for Africa

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1. Introduction

South Korea (officially, the Republic of Korea) has achieved rapid economic growth for several decades, since the early 1960s. In 1996, South Korea finally joined OECD and the ranks of high-income economies. Its economic growth is noteworthy, because its initial conditions were quite similar to many African countries, in that South Korea underwent several decades of colonial rule, several years of civil war, and a period of hunger and food shortage and thus reliance on US food aid in the 1950s. It was worse in terms of resource endowments, with all the minerals located in North Korea. Furthermore, although it launched a series of 5 year economic plans, beginning in the early 1960s with the new political leadership (ex-military, President Park), Korea was once in the same situation as other developing countries, in terms of facing the continual external imbalances with persistent trade deficits, until the late 1980s (Lee and Mathews 2010; Lee 2016, Ch. 1).

While the initial emphasis of the industrial policy was promotion of labor-intensive sectors for earning dollars by exporting in the 1960s and 1970s, the government put a new emphasis on technological development, mostly since the 1980s, with some preparation in the 1970s. The preparation for such a policy shift was started with establishment of government research institutes (e.g., Korea Institute of Science and Technology or KIST) in the 1970s to conduct problem-solving R&D for private firms and to transfer the R&D outcomes to them. Beginning in the mid-1980s, a decisive policy shift occurred, when the government encouraged private, in-house R&D by allowing tax exemptions for R&D expenses, and even initiating public–private joint R&D to break into higher-end segments and sectors involving bigger and riskier projects (Lee 2013c; Lee and Kim 2009). This policy initiative succeeded in building the competitive and high-end manufacturing sector, which was an important factor that led to a trade surplus in 1986, for the first time in the modern Korean history. Since then, Korea has been able to overcome the persistent trap of external imbalances or stop–go cycles of crisis and reforms.

It was Amsden (1989) that attributed such successful economic catch-up to industrial policy by the government, getting prices wrong and creating rents for targeted sectors. Industrial policy in Korea, under the leadership of the Economic Planning Board (EPB), has more or less followed the practices of Japan, which is well documented in the influential

work of Johnson (1982), who attributed the Japanese miracle to the role of one super ministry called MITI (Ministry of International Trade and Investment) in Japan. One of the first definitions of industrial policy was in Johnson (1982), who defined it as policies that aims to improve the structure of a domestic industry in order to enhance a country's international competitiveness.

While Japan and Korea have made remarkable success in catch-up development, owing to industrial policy, some other countries followed the free market principle of the so-called Washington Consensus and focused on macroeconomic stabilization and trade and financial liberalization. While the latter group also experienced some economic growth, it tended to be short-lived or of the stop–go cycle type, because those following the Washington Consensus principles failed to bring up capabilities of private sectors (Lee and Mathews 2010). While Rodrik (1996) noted the importance of sequential or gradual adoption of 10 policies of the Washington Consensus in East Asia, different from the simultaneous adoption in Latin America, he missed the fact that East Asia had further built up and upgraded capabilities, since the mid-1980s, before moving to more marketization (the next five policies in the Washington Consensus) (Lee and Mathews 2010).

When we see catch-up growth as the process of capacity building, what we have in mind is the capacity of private corporations. The capacity of latecomer economies to grow capable private companies is the most important and fundamental criterion to determine the success or failure of economic development or growth. The corporations may initially be state-owned firms (e.g., the Pohang Iron and Steel Company [POSCO] in Korea), when the risks for private capital are too high. The idea, however, is to move them towards private ownership (i.e., make them "public" through an initial public offering [IPO]) eventually, after they build up certain levels of capabilities or competitiveness. Thus, this paper considers the essence of industrial policy to be building the capabilities of private firms to sustain long-term economic growth, rather than picking winners or providing protection for some firms or sectors (Lee 2013b).

Among various aspects of capacities, emphasis should be on technological capabilities, because without these, sustained growth going beyond the middle-income trap is impossible (Lee 2013c). In this era of open market competition, private companies cannot sustain growth if they continue to rely upon cheap products; they need to be able to move up the value-chain

to higher-value added goods, based on continued upgrading and improvement and technological innovation. Furthermore, another important feature of the Korean model is that these private companies have been "locally owned" companies, including locally controlled joint ventures (JVs), not foreign controlled subsidiaries of the multinational corporations (MNCs). MNCs are always shopping around the world, seeking cheaper wages and bigger markets. Therefore, they cannot be relied upon to generate sustained growth in specific localities or countries, although they can serve as useful channels for knowledge transfer and learning.

In what follows, we discuss the role of the government or industrial policy in this process of capability building, with focus on the financing aspect of the policy implementations. This paper can be regarded as sequel to Lee (2013a) and Lee (2015). The former has a more theoretical focus, discussing the three types of failures—market, system, and capability—failures as a justification for government activism, whereas the latter discusses the different tools of industrial policy at different stages of development.

In Section 2, we first elaborate the nature of financial control by the government, which has been one of the enabling conditions for industrial policy since the 1960s (its take-off). We also explain the roles and evolution of key developmental banks, such as the Korea Development Bank, Ex-Im Bank, and Industrial Bank for small and medium enterprises (SMEs). Section 3 elaborates the three episodes of industrial policy and financial arrangement in these cases, such as the case of establishment of POSCO, targeted development of bottleneck technologies for SMEs, and leapfrogging into digital TV since the mid-1990s. Then, Section 4 concludes the paper with a discussion of the implications for African economies.

2. The Financial Systems and Industrial Policy in Korea

2.1 Financial Control and Industrial Policy

The serious scarcity of capital in the 1960s and 1970s in Korea forced firms to depend heavily on credit for raising finance beyond retained earnings. In the absence of effective capital markets, the state used its control over the banking system to channel domestic and foreign savings to selected industries or firms (Lee and Lee 2016; Ch. 2). The new regime

that took power in 1961 nationalized the commercial banks, and thus, the banks were owned by the government until the 1980, when they were privatized. Although many banks have been privatized, the Korean government still maintains effective control over the banking institutions through its personnel policies. In Korea, the government exercised almost direct control over private sectors through their control of credits.

For an effective state activism or industrial policy, state ability for financial control was critical. One often does not notice the critical difference between the state's financial control through credit allocation and other control instruments, such as tariffs, import quotas, tax incentives, and entry or trade licenses. First, financial control implied more discretionary control. With credit allocation, the state can control not only the financial ability of firms, but can also impose the firm's compliance in other matters. Second, a qualitative difference was that the state's financial control was not based on its political authority, which was the case for other instruments that are supported by legislation or regulations; rather the state's financial control was based on state's economic power, which was associated with its ownership of banks. Third, whereas most other controls, except licensing, were aimed at specific industries or sectors, and thus, affect firms only indirectly, financial control was directly aimed at individual firms.

In this regard, a simple but fundamental fact should be noted: the state's financial leverage over firms carried the power of control because firms had a strong motivation to better their performances and because firms believed credit supply to be critical. In Korea, the firms' motivation for success derived from private ownership and the expectation that the firms would be the beneficiaries of their good performance. Thus, even if big business firms were under so-called soft budget constraints due to their special connections with state agencies, that did not necessarily lead to weak motivational efficiency, as it did in socialist firms, but can, in fact, led to exactly the opposite behavior, i.e., excessive risk taking.[1]

Korea had a huge saving gap in the 1960s, with domestic savings at 9 percent of GDP and gross investment 15 percent of GDP, and thus, had to rely on foreign borrowing to fill the gap. That is why exports were so important and the critical binding constraint for growth for an economy at lower and middle-income stages. Despite the low income and thus low domestic

[1] Park (1990) mentioned risk taking in the form of excessive and duplicative investment in the heavy industry drive in Korea in the late 1970s.

saving, Korea had maintained a higher investment rate, and one of the reasons for this was the low-interest rates, suppressed by the government. So, Korea was basically under a condition of financial repression, but it may be considered as "financial restraints," in the terms of Hellman, Murdock, and Stiglitz (1997), in that the real interest rates had been at least positive. Despite this suppressed interest ratio, domestic savings ratio in Korea had continued to increase, owing to the growth of income associated with strong investment over the decades (Cho 1997); the domestic savings rates had increased from 9 percent in the early 1960s and reached about 30 percent in the mid-1980s.

In the Korean experience, the banking sector had always been supposed to "serve" the real sectors by providing a stable supply of the so-called "growth money" at affordable rates, whereas the manufacturing or production sectors had always been given priority. Of course, such practice had been possible because Korea established several development banks, such as Korea Development Bank, Ex-Im Bank, and Industrial Bank, and also because most of the commercial banks were under government ownership or control until they were privatized in the mid-1980s. With very a small margin between the lending and deposit interest rates, profitability of banking sectors was very low, which boosted the profitability of the manufacturing sector, so that private investment flowed into manufacturing rather than into financial businesses.

Furthermore, manufacturing sectors were often earning rents, owing to entry control by the government in adjusting the "optimal number" of firms in each sector, in consideration of the market size, so that the admitted firms were, in effect, guaranteed minimum levels of profits (rents), which can be a source of investment funds for next period. Making the rate of return in certain industrial sectors higher than interest rates can be another means to direct industrial policy, especially in a situation facing high interest rates.

In Korea, this tradition of implementing entry control in many sectors had been regarded as a type of industrial policy modeled on Japanese practices (Johnson 1982). The practice had two meanings. The first was to sort out the "good" and "bad" producers, and the second was to allow stable profits for the selected producers, so that they were assured long-term profits, that they may be encouraged to invest more in fixed capital for business expansion. This practice also had the effects of having the return rates higher than interest rates, which was also good for boosting private investment. Simply put, the idea was that, for instance, five

firms with profits in a sector are better than 10 firms with no profits. Such practice of entry control had been one of the typically used tools of industrial policy in the past in Japan and copied in Korea.

2.2 The Roles and Evolution of Several Developmental Banks

2.2.1 Korea Development Bank (KDB)

The Korea Development Bank (KDB) has been the main vehicle for policy loans, or the so-called development financing in Korea, with its value of assets of 269.7 trillion won (232.5 billion USD) in 2016. The bank was established at 1954. The main function of Korea Development Bank was to provide funds for industry, especially for manufacturing, agriculture, and mining. In the 1950s, the bank's main source of funds was foreign aid from United States, and using these funds, KDB invested in basic industries such as the fertilizer and cement industries and recovery of the power plant destroyed by the Korean War (Korean Economy Compilation Committee 2010). Private firms needed endorsements from the finance minister to obtain KDB loans when the source of funds was not aid money. Thus, the overall size of policy loans from KDB was relatively small. Until 1960, their policy loans were less than 16 billion won (250 million USD).

In 1961, the new government changed development strategy from import–substitution industrialization to export-led industrialization. To do that, they made supplying of the policy loans the main "duty" of the financial sector, with KDB as the pillar bank in this regard. Laws concerning the KDB were revised four times in the 1960s, and the bank's registered capital increased from 40 million won (0.32 million USD) in 1961 to 150 billion won (520 million USD) in 1969, with the legal right to borrow money from foreign countries (KDB 2014). Using these funds, policy loans from KDB increased by about 12 times from 20.3 billion won (162.7 million USD) in 1961 to 239.13 billion won (608.6 million USD) in 1972 (Son 2013). Most of loans were used for production facilities, and 55.9 percent of the funds, out of the total loans made in Korea for production facilities, were provided by KDB (KDB 2014). KDB also provides guarantees for loans when Korean firms borrow from foreign financial

institutions. The amount of the guarantees increased from 18.1 billion won (139.2 million USD) in 1963 to 600.3 billion won (1.73 billion USD) in 1971 (KDB 2014).

The Korean government started fostering heavy and chemical industry in 1973. These industries have characteristics, which require a large amount of investment and a long time horizon to be profitable. To supply such investment funds for heavy and chemical industrialization, KDB acquired loans from foreign financial institutions, such as the Asian Development Bank (ADB) and the International Bank for Reconstruction and Development (IBRD), and issued foreign currency bonds in the international capital market. Funds from foreign financial institutions and foreign currency bonds increased rapidly from 4.79 billion won (12.2 million USD) in 1972 to 478.7 billion won (989 million USD) in 1979 (KDB 2014). As a result, about half of KDB funds came from foreign countries in 1979. Remaining funds of KDB mainly come from the "National Investment Fund," which was raised by issuing bonds sold to households and private banks. The government forced every commercial bank to buy the bonds of the National Investment Fund, using as much as 20 percent of the annual increase in their savings deposits (Nam 2009). Using these funds, policy loans from KDB increased very rapidly, by about 10 times from 318.47 billion won (799.5 million USD) in 1973 to 3.12 trillion won (6.4 billion USD) in 1980. These funds were used mainly for heavy and chemical industries, such as shipbuilding, steel, machinery, chemical, automobile, and electronics industries.

In the 1980s, the focus of industrial policy changed from sector selective industrial policy to bottleneck technology development (Shin and Lee 2012). In accordance with the change, since 1981, law concerning KDB has specified that KDB could provide funds for R&D in the emerging industries. Also established, in 1984, was the "Korean Technology Financing Corporation," to match increasing venture capital demand. Due to these changes, the rate of increase of KDB policy loans slowed down in the 1980s, which increased from 3.12 trillion won (6.4 billion USD) in 1980 to 10.59 trillion won (15.8 billion USD) in 1989. In terms of source of funds, the share of loans from foreign countries and foreign currency bonds decreased as the Korean economy grew. Instead, the share of domestic bonds and deposits increased from 13.2 percent in 1980 to 80.4 percent in 1989 (KDB 2014).

2.2.2 Export-Import Bank of Korea

The Export-Import Bank of Korea was established in 1976, to provide long-term policy finance to exporting firms, active in the export of capital goods. Given that the capital goods sectors were one of the least developed sectors (Lee and Kim 2016), strong export financing was needed to offset some of the competitiveness disadvantages facing the Korean firms. The new strategy of the Korean government, since the mid-1970s, to promote heavy and chemical industrialization also targeted exports of capital goods. To do that, long-term export financing was needed at that time, because international markets for capital goods were basically buyers' markets, and many foreign buyers required deferred payment conditions to sellers. Furthermore, it usually takes a long time to make capital goods, so it is very difficult for firms in latecomer countries to export without long-term financial support, if foreign buyers demand deferred payment conditions (Export-Import Bank of Korea 1996).

To support domestic exporting firms facing the deferred payment condition from the foreign buyers, the Export-Import Bank of Korea provided long-term policy loans, with repayment periods as long as 10 years. Annual interest rate was 7 percent, which was relatively very low level. After the establishment of the Export-Import Bank of Korea, the amount of export financing increased from 134.2 billion won (277 million USD) in 1977 to 444.3 billion won (918 million USD) in 1979, and to 774.7 billion won (890 million USD) in 1985. Share of exports, supported by loans from the Export-Import Bank of Korea, among total exports also increased from 1.5 percent in 1977 to 4.8 percent in 1984 (Export-Import Bank of Korea 1996). From 1976 to 1985, 76.5 percent of their export financing went to the shipbuilding industry. It supported rapid export growth in the shipbuilding industry for which the annual average export growth rate was 20.5 percent during this period. Remaining funds went to other heavy and chemical industries. In the late 1980s, exports of shipbuilding and plants decreased due to change of international conditions, so that the amount of export financing decreased to 314.4 billion won (356 million USD) in 1986. In response to this decrease, the Export-Import Bank of Korea expanded the list of target industries to include electronics and electrical instruments.

From the late 1980s, the Korean economy posted a trade surplus for the first time, and thus, some of the government regulations against outbound foreign investment by domestic firms were relaxed. In accordance with the easing of the regulations, the Export-Import Bank of

Korea provided policy loans to Korean firms that invested in foreign countries. Facing rising wage rates in Korea, firms in the light industries, such as textile industries, tried to move their production facilities to developing countries, which had cheaper labor costs. Thus, the Export-Import Bank of Korea provided them with financial services. As a result, loans for international investment increased from 5.17 million dollars in 1987 to 574 million dollars in 1995 (Export-Import Bank of Korea 1996).

2.2.3 Industrial Bank of Korea (IBK) for the SMEs

The Industrial Bank of Korea (IBK) was established by the Korean government in 1961. Its main function was to provide loans for SMEs. The law on the IBK specified that the share of the SMEs in its total loans should be at least 90 percent (IBK 2011). In addition to firms in manufacturing, mining, and transportation, since 1973, firms in the construction, commerce, and service sectors could also be regarded as the client SMEs for IBK. Nevertheless, the main focus was manufacturing SMEs with respect to IBK's contribution to export-led industrialization strategy. One difference between IBK and either KDB or the Export-Import Bank of Korea was that the majority of IBK's funds came from deposits by households and firms, and the share from international borrowings or from the National Investment Fund was small. However, compared to KDB and the Export-Import Bank of Korea, the sizes of their policy loans were relatively small. The amount of a policy loan from IBK was about one-third of that from KDB in the 1960s and 1970s.

To support export-led industrialization, IBK increased their policy loans very rapidly from 2.1 billion won (16.8 million USD) in 1961, to 52.7 billion won (170 million USD) in 1970, and to 645 billion won (1.3 billion USD) in 1979 (Son 2013). Share of SME loans from IBK, among the total amount of SME loans was 21.7 percent in 1970. IBK also provided SMEs with consulting service or technology guidance (with the UN Development Programme [UNDP]) to improve the competitiveness of SMEs.

In the early take-off period in Korea, the main focus of development strategy was on a selected number of big businesses, which were the leading exporters during the period. Especially, heavy and chemical industrialization, from the mid-1970s, targeted big businesses that could meet the requirement of a certain size of fixed capital investment. In this policy

background, the SMEs weren't the main focus of industrial policy. However, the new regime, which took power in 1980 after the death of the President Park, introduced some changes in industrial policy, such as the shift from sector-specific targeting to technology-specific targets. Another change, since the mid 1980s, was to allocate more resources for SMEs in technology-intensive businesses. Since 1981, IBK has provided policy loans for SMEs that make various intermediate goods, such as diverse parts, industrial materials, and tools, and sell to big firms. Since 1986, IBK has provided long-term policy loans to these SMEs. In 1989, IBK began providing policy loans for small firms whose potential for future growth was good but their number of employees was less than 50. These small firms usually had difficulty in getting loans from commercial banks, which required some value of collateral. Thus, IBK provided policy loans to these firms without requiring much collateral. Due to this kind of financial support, policy loans from IBK increased from 970.5 billion won (1.6 billion USD) in 1980 to 6.69 trillion won (9.45 billion USD) in 1990.

3. Stories of Industrial Policy and Financing

3.1 Industrial Policy to Develop a Strategic Sector: The Case of Pohang Steel [2]

Growth and development of the steel industry in Korea has been represented by a state-owned company, POSCO. Typically, state activism is justified when there is a certain degree of positive externalities, such as that of market failure prevailing in terms of the gap between private and social returns. POSCO's case fits into this category for state intervention. Steel is an input in diverse sectors of production. Given the high degree of the scale economy and a limited size of the domestic market, throughout the history of Korea, steel goods were certain to be underproduced if left with private firms, and private monopoly would charge much higher prices. Reliance on imported steel alone would lead to no benefits from backward and forward linkages. Under these conditions, entry by establishing a state-owned enterprise (SOE) seemed to be the rational choice in the context of the past Korean economy.

During the reconstruction period after the Korean War (1950–1953), the rising domestic demand for steel products led to the need for the construction of an integrated steelworks.[3]

[2] This sub-section relies on Lee (2015)

At the time, most Korean steelmakers used scrap iron, rather than pig iron, as raw material. With scrap metal running out, the need for a stable supply of pig iron increased. In addition, Korean steel firms in those days were small and specialized in only one segment of the whole process of steel production. This inefficient separation underlined the advantage of having an integrated steel mill.

In the absence of private capitalists able to take on a heavily capital-intensive, integrated steel project, government initiative was inevitable. However, the Korean government's six attempts for 11 years between 1958 and 1968 all foundered. The main reason for the failure lay in financing the projects. Opposing the Korean government's plan to build an integrated steel mill, the World Bank and the US Agency for International Development (USAID) expressed concerns about Korea's ability to repay foreign loans and questioned the need for a large-capacity steel mill in a small developing economy (D'Costa 1999, 64; Song 2002, 57). Rather, the World Bank and USAID suggested first developing steel-consuming industries, such as machinery, automobile, and shipbuilding (Song 2002, 57). The Korean government rejected their opinion and insisted that steel-consuming industries were not a prerequisite for the successful development of the steel industry, and that the steel industry should grow first for the effective development of steel-consuming sectors. Former President Park Chung-hee took the initiative and gave top priority to the steel project in the second five-year economic development plan (1967–1971). The steel project was one of the three key projects of the plan. The others were the Ulsan petrochemical complex and the Gyungbu Expressway (Song 2002, 42–43).

The Korean government created the state-owned steel firm POSCO in 1968. The government held 56.2 percent of the company's shares, and the remaining 43.8 percent was held by the state-run Korea Tungsten Co. Two years later, the company commenced construction of the initial phase of the nation's first integrated steelworks in Pohang. The long-lasting principal problem of financing was overcome by "ingenious" methods (D'Costa 1999, 63–64). Through agreements with the Japanese government in 1969, the Korean government allocated part of the war reparation funds from the Japanese to the Pohang project. A total of $73.7 million from the war reparation funds for three years was assigned to the first phase. Another loan worth $50 million was provided by Japan's Export–Import Bank.

[3] This paragraph is based on Lee (2015).

Japanese sources accounted for approximately 60 percent of the capital needs of the first phase (Song 2002, 76). The rest was covered by local capital.

Table 1 presents the sources of financing by phase. Direct investment from the government accounted for 11.3 percent of the project's total costs. The government's intervention and assistance enabled POSCO to access domestic and foreign sources, accounting for approximately 66 percent. Domestic sources were state-run and private bank loans with very low interest rates, actually negative in reality. To mobilize resources from abroad, the government negotiated with foreign lenders on behalf of its national producer and guaranteed POSCO's loan payments. Evident from Table 4 is the increasing share of POSCO's own funds from 0 percent (Phase I) to 53.4 percent (Phase IV-2), whereas that from foreign capital declined from 59.1 percent to 33.3 percent over the same period. These changes indicate that POSCO's ability to generate internal funds was gradually enhanced while the government nurtured the industry through various instruments, which is addressed in the next subsection.

Table 1 Financing for the Pohang project (US$ million)[4]

Phase	Period	Govt. capital[a]	Domestic funds[a]	Own funds[a]	Foreign capital[a]	Total costs[a]
I	1970–1973	111 (33.2)	26 (7.7)	0 (0.0)	197 (59.1)	334 (100.0)
II	1973–1976	19 (3.2)	39 (6.5)	157 (26.6)	376 (63.6)	591 (100.0)
III	1976–1978	225 (16.2)	101 (7.3)	293 (21.1)	768 (55.4)	1,387 (100.0)
IV-1	1979–1981	121 (7.8)	336 (21.7)	327 (21.1)	768 (49.5)	1,552 (100.0)
IV-2	1981–1983	0 (0.0)	47 (13.3)	189 (53.4)	118 (33.3)	354 (100.0)
Total		**476 (11.3)**	**549 (13.0)**	**966 (22.9)**	**2,227 (52.8)**	**4,218 (100.0)**

Source: Song (2002, 118)

Note: [a] Percent of total costs in parentheses

[4] Original units are in Korean won. The won–dollar exchange rates used in the conversion are calculated by averaging the daily exchange rates for each phase: 361.00, 448.89, 484.00, 555.36, and 729.31 won/dollar for phases I, II, III, IV-1, and IV-2, respectively.

In 1970, the steel mill's first-stage construction commenced in Pohang. By 1983, its production capacity had expanded four times. Additional integrated steelworks were constructed in Gwangyang in the mid-1980s. As a result, the Korean steel production increased sharply. By 1993, the only Korean integrated steel firm broke the 30 million tonne mark, which placed Korea in sixth place in the global crude steel production. During the period of 1973 to 1993, the compound annual growth rate (CAGR) of the Korean crude steel output was 21.2 percent, whereas that of the world was 0.7 percent. In 1998 and 1999, POSCO became the world's biggest steel producer, surpassing the former top producer Nippon Steel (Lee and Ki 2017). Currently, POSCO has two integrated steelworks in Pohang and Gwangyang, and it produces approximately two-thirds of Korea's total steel output.

Notably, this successful development was made possible by the combination of government activism and the SOE's aggressive technological learning and capability building. In its early stage, POSCO simply purchased and used stabilized or standard technologies and facilities. At the time, overseas training was the primary source of learning. In the 1980s, as POSCO increasingly threatened rival companies in the global export market, access to a foreign knowledge base became more difficult than before. Thus, POSCO established its own R&D system, which was composed of three parities: industry (POSCO), university (Pohang University of Science and Technology [POSTECH]), and institute (Research Institute of Science and Technology [RIST]). The in-house R&D system facilitated the company's stage-skipping catch-up, as it adopted the most up-to-date technologies and facilities in the second steel mill project. The building of POSCO's technological capabilities can be considered a path-following catch-up at the initial stage and a stage-skipping catch-up at the later stage, according to the classification of the three types of catch-up proposed by Lee and Lim (2001).

As a matured industry, technological uncertainty was low in steel production. Furthermore, the Koreans' entry and expansion at a later stage took advantage of the window of opportunity associated with the lowered price of factory equipment and facilities during global recessions, namely, the first and second oil shocks (Lee and Ki 2017). Market uncertainty decreased through government and private efforts to develop automobiles, shipbuilding, and other steel-consuming industries. Finally, after its stable establishment in terms of international competitiveness, this SOE was completely privatized in 2000.

The Steel Industry Promotion Law was announced on January 1, 1970, three months before construction of the first phase of the Pohang plant. The law, which was valid for 10 years, empowered the government to grant POSCO various financial and administrative support for (1) access to long-term and low-cost foreign capital; (2) purchase of equipment and raw materials; (3) construction of port facilities, water and electricity systems, roads, and railroads; (4) research and technical training; (5) reduced prices on electricity, gas, and water; and (6) discounts for rail transport and port dues (D'Costa 1999, 65; Lee and Ki 2017). At the same time, the law made changes in the Regulation Law on Tax Reduction and Exemption and in the Tariff Law. POSCO was exempted from corporate tax and received an 80 percent tariff cut on the import of equipment (Nam, 1979, 78).[5] After an extension of another 20 years, the Steel Industry Promotion Law was discontinued in 1986 (D'Costa 1999, 65).

Construction of the first phase for production capacity of 1.03 million tonnes was completed between 1970 and 1973. By 1983, four expansions had been carried out, increasing the total capacity of the Pohang Mill to 9.6 million tonnes (D'Costa 1999, 65). Empowered by the law, the government was able to provide a large fund for the Pohang project in various forms. The government pumped $476 million into the project. Additionally, in the form of infrastructure support, tax and tariff cuts, and discounts for public utility charges, the government invested approximately $840 million (Song 2002, 118–19).

When passed, the Steel Industry Promotion Law was criticized as being beneficial solely to POSCO. To be eligible for the previously mentioned government support: (1) a steel firm should have an integrated steel mill with more than one million tonnes annual capacity; and (2) the government should hold over 50 percent stake in that company. POSCO was the only firm to meet those criteria. As a way to establish the steel industry, Park's administration concentrated all available resources on the single, state-owned POSCO and its integrated steel mill rather than creating the environment for private firms to grow in a market mechanism and with free competition. The absence of a capitalist class for a capital-intensive steel project enables us to argue that such direct intervention was inevitable and justifiable at the time.

[5]Steel firms with an integrated mill with more than 100 thousand tonnes annual capacity were eligible for this tariff cut.

Since 1973, POSCO received a further boost through a substantial change in the economic growth policy of the Park administration. The Heavy and Chemical Industrialization (HCI) Program (1973–1979), designed to shift the Korean economy away from the low value-added light industry, selected six heavy and chemical industries for intensive nurture: steel, petrochemicals, automobiles, machine tools, shipbuilding, and electronics (D'Costa 1999, 65). This program accelerated POSCO's growth in two ways. First, the government strengthened its support for the steel industry, mainly through low-interest financing and tax cuts. Second, and more importantly, the HCI drive made the government realize the necessity for the expansion of the Pohang plant and, furthermore, the construction of an additional integrated steel plant. The selected sectors from the program were mostly steel intensive; thus, a significant increase in steel demand was expected from these industries. As a result, following the announcement of the HCI strategy, the Pohang plant was expanded four times from 1973 to 1983. Construction of the second steel plant began in 1985 against the backdrop of the thriving heavy industry (Song 2002, 99, 159–60).

3.2 Industrial Policy to Develop Bottleneck Technologies for the SMEs

The Industrial Base Technology Development Projects (IBTDPs) for the period of the 1987–1991 (which was later renamed as "Industrial Technology Development Projects") symbolizes the shift to a functional, promotion-type industrial policy from the earlier style of sector-promotion industrial policy (Korea Industrial Technology Evaluation Institute 2007). This shift was initiated by the abolishment in July 1986 of the Industry Promotion Law, which targeted seven sectors, and by the recognition of a new law called the Industrial Development Law in the same year. This new law established the legal basis for the implementation of the firm survey on their demand for specific industrial technologies, and for implementing various projects to develop "industrial base technologies" (see Table 2 below). The IBTDPs were intended and implemented to develop the so-called bottleneck technologies that can be commonly applicable to a large number of the SMEs, preferably in the form of the tripartite joint R&D by the private–academic–public labs. Also, the ministry in charge changed from the Ministry of Science and Technology to Ministry of Trade and

Industry for this IBTDP. As can be seen in Table 2, about half of the funding was from the government budget in each project.

Table 2. Industrial Base Technology Development Projects (IBTDPs), 1987–1995

Unit: 100 mil. won

	1987–1990	91	1992	1993	1994	1995	Total
No. of projects	945	551	480	420	422	464	3,282
(new)	617	333	179	258	173	243	1,803
(continuing)	328	218	301	162	249	221	1,479
Investment amount	2,152	1,369	1,395	1,706	2,644	3,701	12,967
(government budget)	1,026	712	727	887	1,414	1,908	6,674
(private sector funds)	1,126	657	668	819	1,230	1,793	6,293

Source: Korea Industrial Technology Evaluation Institute (2007, 45, Table 3–8).

Table 3. Outcomes of the Survey to Identify the "Needed" Industrial Technologies

		1986	1987	1988	1989	1990	1991
Number of technological areas (number of the units in charge of the survey)		219 (-)	185 (-)	225 7	102 (9)	200 (-)	200 (27)
Number of experts involved the surveys		818	981	852	492	1,205	1,416
Number of the participating firms		585	733	724	535	1,107	5,994
Budget for the surveys (million won)		205	247	241	240	251	701
A Total number of technologies identified for projects	No. of technologies identified as needed to be developed	581	562	564	417	638	947
	No. of technologies identified as needing further guidance and assistance	118	168	117	56	105	217
	No. of technologies identified to be imported	837	202	202	46	75	165
	Total	1,536	932	883	519	818	1,329

Source: Korea Industrial Technology Evaluation Institute (2007, 12, Table II-3).

One of the noteworthy features of the IBTDPs was trying a bottom-up approach, compared to the previous top-down approach, to identify key bottleneck technologies by

conducting large-scale surveys to firms (see Tables 3 and 4). From 1987 to 1991, five rounds of surveys were conducted, with the spent budget of 1,885 million won, which led to identification of 1,329 needed technologies. Out of these, 934 technologies were funded for development, with a success rate of 84.4 percent.

In this scheme (Table 3), the technologies were classified into several categories, such as those to be funded by these projects and to be developed domestically, and those that could be imported rather than developed domestically. Table 4 shows the diverse financing options for the different identified technologies. Only those classified in Group I (for instance, those identified as badly needed technologies in many production sites or regarded as common bottleneck technologies) were intended to be funded by this IBTDP. In comparison, those in Group III, such as technologies easily developed with direct grants to the involved firms, are to be developed by direct grants to the specific firms from banks such as KDP or IBK.

Table 4. Implementation Plan of the Technology Development Projects Identified by the Demand Surveys

Classification	**Characteristics of the technologies**	**Support plan**
Group one	• Technologies badly needed in the production sites of the firms • Basic (generic) technologies identified as common bottlenecks • Technologies with high commercialization • Possibilities and ones that are soon expected to developed by existing firms	• To be funded by this IBTDPs and/or other policy loans
Group two	• Long-term, large-scale projects • Technologies that require more and broader, basic researches to be successfully developed	• To be funded by the Targeted (focused) R&D Projects administered by the MOST
Group three	• Technologies easily developed with direct grant to the involved firms	• To be provided loans for the required expenses for R&D: • Long-term, low-interest rate loans (Industrial Development Funds) • General policy loans (recommending loans from technology development funds by the Korea Development Bank or Industrial Bank of Korea)

Source: Korea Industrial Technology Evaluation Institute (2007, 12, Table II-4).

3.3 Industrial Policy for Leapfrogging: Digital TV by Public–Private Joint R&D [6]

Along the tradition of Neo-Schumpeterian economics, there has been proposed a thesis of leapfrogging by Perez and Soete (1988). This idea of leapfrogging emphasizes the importance of utilizing emerging technological opportunities in the process of catching up. Perez and Soete (1988) focused on how a catching-up country, not being bound by costly investment in capital goods and infrastructure of the old paradigm, can leapfrog into a new technological paradigm ahead of the advanced countries. Seen from this view, the emergence of digital technology, since the 1990s, was also an opportunity for the latecomers to try leapfrogging.

Actually, in the mid 1990s, Korean companies emerged as the world leader in several innovative digital products (Lee et al 2005). Korea was the first country in the world to develop the CDMA-based (Code Division Multiple Access) digital mobile telecommunication. Also, it was via an LG product that the UK enjoyed its first digitally broadcast TV programs, and via Samsung products that Americans watched the historic launch of the space shuttle Discovery. Samsung and LG command numerous world firsts in terms of technologies and licenses in related fields of digital technology. Since the late 1990s, Samsung and LG have enjoyed the top market shares in digital TVs, both in the UK and in the US. Now, the absolute majority of the TV exports by Korea is of digital TVs, which have replaced analogue TV. This signifies the shift from analogue to digital goods, as the main export item in Korea. Here, let me provide a story of emergence and growth of the digital TV industry in Korea and, thereby, examine the role of industrial policy in this episode of leapfrogging into digital TV by the Korean firms. The period of analysis is from the early 1990s to 2002–2003, and here I rely heavily on Lee, Lim, and Song (2005), which is a detailed case study.

Initial actions toward high definition television, HDTV, by the Korean government and firms were heavily influenced by the Japanese lead in analogue HDTV. The Japanese research group came to Korea during the 1988 Seoul Olympic games and staged a promotional tour of their achievements in the hope that the Koreans would follow their way, as in the past. Recognizing that HDTV would be a next-generation, hot consumer item with

[6] . This sub-section relies on Lee et al (2005).

immense technological and market potentials, the Korean government first established the Committee for Co-Development of HDTV in 1989. This committee had a participation of three ministries (Ministry of Commerce, Industry and Energy; Ministry of Information and Communication; and Ministry of Science and Technology) and 17 institutions comprising private firms, government research institutes (GRIs), and universities.

The Korean government wanted to promote HDTV as one of the most important export items for the next generation, for the 21st century. The government initiated a grand research consortium for HDTV. It was led by the Video Industrial R&D Association of Korea, the Korea Electronics Technology Institute (KETI), and the Korea Institute of Industrial Technology (KITECH), joined by Samsung, LG, Hyundai, Daewoo Electronics, and other private firms. The Video Industrial R&D Association of Korea took the role of supervising the progress of all the research projects. It evaluated technical aspects of the projects, coordinated opinions among firms involved in the R&D consortium, and collected research proposals and details on the progress of each of the research projects from the firms. Administrative work for the whole research project was carried out initially by Korea Institute of Industrial Technology (KITECH) and later, by Korea Electronics Technology Institute (KETI), a spin-off institute from KITECH. The administrative work included preparing reports for the progress of the research project and for reporting details of R&D expenditures and administrative work for technical licensing fees. In addition, KITECH and ETRI carried out both the coordination of smaller consortiums and R&D in two specific fields of the whole project.

The research project was first to interpret and absorb the foreign knowledge and eventually to develop HDTV sets. The total budget for the 5 years, for 1990–1994, was 100 billion Korean won (roughly 100 million USD), with the government and the private sector to each pay a half of the total.

Right after the start of the Korean project, General Instruments (GI), a leading American firm in digital TV technology, staged a historic demonstration of the possibility of digital TV in 1990. The head of the research team at GI was a Korean American, named Dr. Woo-Hyun Paik, who later joined LG Electronics, in 1998, as the CTO (Chief Technology Officer). Now, with the Korean research project for HDTV decisively underway, in spring 1991, digital HDTV targeted US markets, leaving behind Japanese- or European-led analogue HDTV. The

problem was that the US standard was not yet determined. In this regard, one interesting strategy by the Korean team was the decision to develop several alternative standards simultaneously, with different private companies in charge of different standards. At that time, there were identified four leading standards in the US. Thus, Samsung was chosen or assigned to develop the standard by GI and the MIT coalition; LG, that by the Zenith and the AT&T coalition; Daewoo, that by RCA; and Hyundai, that by Farouja.

The public–private coalition encouraged private firms to stick to these risky R&D activities by channelling R&D funds and forming a network of researchers from firms, universities, and GRIs. In the project, there was a clear division of labor among the participating units. The whole project was divided into digital signalling (satellite and terrestrial), display (CRT, LCD, PDP), and ASIC chips (application-specific integrated circuits chips, encoding, decoding, demultiplexer, display processor). Each unit, GRI, or private firm, was assigned to different tasks with some intentional overlaps among them; namely, two units took the same task to avoid the monopoly of research outcomes. This government-led consortium had the effect of providing the private companies with the legitimacy of the project; and without this, the companies admitted, their project would have stopped because they could not have just kept pouring money into a project with uncertain cash outcomes. Furthermore, the consortium provided the firm's R&D team with the opportunity to meet and collaborate with university and other public sector researchers. The R&D staffs, during a subsequent interview, acknowledged that particularly helpful was the interaction with university professors—especially those who had just returned from the United States with a PhD degrees in digital technology-related fields.

4. Concluding Remarks and Implications for Africa

4.1 The Korean Experience of Financing Industrial Development

For an effective industrial policy, state ability to control financial resources in a national economy is often critical. Financial control implies more discretionary control, such that the state, with its power in credit allocation, can control not only the financial ability of firms, but can also assure the firm's compliance in other matters, such as industrial policy implementation. In the Korean experience, the banking sector was intended to "serve" the

real sector by providing a stable supply of so-called "growth money" at affordable rates, whereas the manufacturing or production sectors always had been given priority.

Of course, such practice was possible because Korea established several development banks, such as the Korea Development Bank, Ex-Im Bank, and the Industrial Bank, and also, because most of the commercial banks were government-owned until the mid-1980s, and influenced by the government even after privatization. Additionally, manufacturing sectors often earn rents, due to entry control exerted by the government in adjusting the "optimal number of the firms" in each sector, considering the market size so that admitted firms may be guaranteed a minimum level of sorts for profits (rents) that can be invested in the next period. Thus, making the rate of return in certain industrial sectors higher than interest rates is one of the tools for industrial policy, especially when relief from high interest rates is needed.

Diverse cases of industrial policy and financing may have some policy implications for economies in Africa, which are trying to build their industrial bases. Tools of policy and financing can be different, depending upon the nature of the sectors and projects. For a project like physical infrastructure, or those with strong externality, the practices of POSCO in the Korean steel industry may be applicable. More direct intervention, in the form of SOEs, can be justified. Building oil or gold refineries in Africa can be accomplished by using these kinds of SOEs, which can be privatized later, as in the case of POSCO. Korea Air, the top airline in Korea, was also a SOE. For targeted development of certain technologies in Africa, especially for medium-sized enterprises (MEs), the bottom-up approach taken in the IBTDPs, executed in Korea's economic past, can have useful implications, in terms of how to identify "needed technologies'" by conducting firm surveys and arranging for diverse financing tools. Finally, in efforts to break into newly emerging sectors or businesses, the public–private joint R&D or foreign–domestic joint R&D practiced in Korea's past can be a useful device of industrial policy for necessary sharing of knowledge, funds, and risks.

4.2 External Imbalances and Industrial Policy for Export Manufacturing in Africa

It is not surprising that many countries in Africa at low-income stages have had trade deficits for many years. That is basically due to weak export capabilities, compared with ever-strong demand for imported goods in African economies. Korea also went through the

three decades of trade deficits, until it recorded its first trade surplus in 1986; since then, it has maintained a trade surplus (Lee 2013b). Korea, in the early 1960s, had a 1 to 9 ratio of exports to imports, which is much worse than a typical country in Africa. Thus, Korea had a huge savings gap with the domestic savings only at 9 percent of GDP and gross investment at 15 percent of GDP, thus relying on foreign borrowing to fill the gap. This illustrates why exports are so important and are the critical binding constraints for growth for an economy at lower or middle-income stages.

Given that getting out of a trade deficit may take several decades, a country at a lower-income stage may find it necessary to take transitory measures to manage the balance of payments. In looking for specific policy tools, the past experience in Korea could be useful. In the 1960s and 1970s, Korea maintained a tight centralized control on foreign exchanges within the economy, with all export earnings (foreign currencies) first put under the control of the government (Bank of Korea), and then allocated for "justifiable uses," like payment for imports of capital goods (Amsden 1989). One of the reasons for the tight control of foreign exchanges under the closed capital market in the early period had to do with the fact that export promotion and free capital mobility cannot work together; export promotion often involves undervaluation of currencies (or typical economic conditions in emerging economies tend to involve frequent depreciation), which is a signal or incentive for people to take their money abroad (or put their money in foreign currency-dominated bank accounts).

In these practices, imports of "non-necessaries" such as luxury consumer goods, tended to be discouraged by high tariffs, diverse non-tariff barriers, or social campaigns, and it was difficult to get permission to use dollars. For instance, even imports of foreign fruits (e.g., bananas) was discouraged by high tariffs or non-tariff barriers. In general, tariffs tended to be low for capital goods while very high for consumer goods, which Korea aimed to promote for exportable goods—which was termed as asymmetric protection in Shin and Lee (2012). Such protection was found to have significant impacts, not on TFP (total factor productivity) changes, but on the volume and market shares of the Korean export products. These practices also meant that there was a tight control of capital outflow (capital flight); for instance, ordinary people could not have their bank accounts in foreign countries, and foreign banks were not allowed to open business in Korea until the late 1980s.

Despite low income and, thus, low domestic savings, Korea maintained a higher investment rate, and one of the reasons for this was the low-interest rates, with rate hikes suppressed by the government. Despite this suppressed interest ratio, domestic savings ratio in Korea continued to increase, owing to the growth of income associated with strong investment over the decades. This experience may have some implications for African countries, including Uganda where interest rates are currently very high, over 24 percent, in spite of inflation rates not being that high, whereas very low interest rates are applied to savings deposited into banks. This situation is very bad for private investment and reflects the asymmetric power and dominance of the lender over borrower, and also the dominance of the banking sector over the real sector. If both sides have equal power interest rates for savings should also be high. In other words, financial markets appear to be oligopolistic and imbalanced in the power of the supply and demand, and can be said to be a state of market failure, which may justify some form of government intervention, including regulation on the interest raters. In other words, the banking sector is earning extra rents associated with oligopoly, which is quite the opposite of the desirable state of the productive sector enjoying rents, as in Korea's past, where the banking sector had always been tasked to "serve" the real sector by providing a stable supply of so-called "growth money" at affordable rates, and the manufacturing or production sector had always been given priority.

4.3 Dilemma and Prospects of the Resource-based Development in Africa

In situations in many African countries, like Uganda, despite competitive exchange rates (undervaluation or deprecation), exports tend not to respond. This situation is not so surprising, because competitive exchange rates would work only in an economy with a strong manufacturing basis. Relatedly, Ramanayake and Lee (2017) find even a negative effect of undervaluation on growth in mineral-exporting groups, and positive (no significant) effects of undervaluation in manufacture-exporting groups. This finding is consistent with the fact that if currency is more undervalued in countries that depend greatly on natural resource exports, then less income is earned in terms of dollars, because natural resource exports are often insensitive (inelastic) to exchange rates. Thus, there is an important contrast between manufacture- versus mineral-exporting countries, such that depreciation often tends to exert

countercyclical effects of recovering exports and growth in economies with a strong manufacturing base (or non-negative effects on average), which is not the case in mineral-exporting economies. These mineral-exporting economies face the growth-impeding and procyclical effects of undervaluation during the times of weak performance of the economy with the typical balance-of-payment crisis. The growth-impeding and procyclical effects of undervaluation underscore the difficulties facing economic growth in mineral-exporting economies and, thus, the dilemma of the so-called "resource-based" development model. In other words, the nature of the curse is not only the symptom associated with the Dutch disease, but also being stuck in the resource-based sector with little chance of entry into manufacturing, due to the countercyclical effects of the low valuation of currencies.

Therefore, while entry into, and promotion of, manufacturing sectors would be a desirable long-term development goal for typical countries in Africa, the condition of already-fee capital mobility and already-privatized banking sectors indicates that the role of the government in promoting manufacturing would have limited impacts, except in a few countries like Ethiopia. Low valuation of currency would lead to capital flight and less domestic savings available for investment, and control of interest rates for boosting investment in industrial sectors is not that feasible under the private (or foreign) dominance of commercial banking. The situation of Kenya that recently tried a form of interest ceiling indicates the dilemma.

If domestic effort to promote exports is limited, FDI is, of course, an option but attracting FDI in the manufacturing sector has not been easy in many African countries. If this is the case, a more radical or innovative idea, for instance, for a country like Uganda, might be leapfrogging into IT service or "Smart Agriculture," bypassing the stage of manufacturing. A preceding case of leapfrogging has been happening in India, which bypassed manufacturing to leapfrog into IT service as the engine of growth (Lee 2013c, 178–205). There is also a growing recognition that agriculture is no longer a traditional industry but a "high-tech" sector, or now called the sixth industry, as a combination of the primary, secondary, and tertiary industries. It is combined with IT or digital technologies, as it braces for the benefits of new innovations, recently associated with the so-called Fourth Industrial Revolution. An example would be The Netherlands, which is leading "Smart Farming and Dairy." In 2015, its export value in agriculture was the second largest in the world, or 438 billion Euro, with a

share of 20 percent in total exports of the country. Agriculture may be a more attractive sector to attract FDI than manufacturing in some African economies, like Uganda, in terms of its comparative advantages. Of course, the agro-food industry and processing segment of the primary sector industry can also be a good option for industrial development. In this regard, a good example is the case of a brand of coffee company, called "Good African Coffee," established by an entrepreneur from Uganda named Rugasira (2013), which is already successful in global market with its brands and sales network in Europe and North America. This case is important because this company does not export crude or unprocessed coffee, but high-valued, processed, and branded coffee.

References

Amsden, Alice. 1989. *Asia's Next Giant: South Korea and Late Industrialization*. Oxford: Oxford University Press.

Cho, Yoon Je. 1997. "Government Intervention, Rent Distribution and Economic Development in Korea." In *The Role of Government in East Asian Economic Development*, edited by M. Aoki, H.-K. Kim, and M. Okuna-Fujiwara, 208–32. Oxford: Oxford University Press.

D'Costa, Anthony P. 1999. *The Global Restructuring of the Steel Industry: Innovations, Institutions, and Industrial Change.* London and New York: Routledge.

Export-Import Bank of Korea. 1996. *20 Years of History of Export-Import Bank of Korea* (in Korean).

Hellman, T., K Murdock, and J. Stiglitz. 1997. "Financial Restraint: Towards a New Paradigm." In *The Role of Government in East Asian Economic Development*, edited by M. Aoki, H.-K. Kim, and M. Okuna-Fujiwara, 163–207. Oxford: Oxford University Press.

IBK (Industrial Bank of Korea). 2011 *50 Years of History of Industrial Bank of Korea* (in Korean).

Johnson, Chalmers 1982. *MITl and the Japanese Miracle: The Growth of Industrial Policy, 1925–1975*. Stanford, CA: Stanford University Press.

KDB (Korea Development Bank). 2014. *60 Years of History of Korea Development Bank* (in Korean).

Korean Economy Compilation Committee, 2010, *The Korean Economy: Six Decades of Growth and Development*, Vol. 1 (in Korean)

Korea Industrial Technology Evaluation Institute. 2007. Evolution of Industrial Technology Policy: With a Focus on the 20 Years of Industrial Technology Development Projects (1987–2006) (in Korean).

Lee, Keun. 2013a. "Capability Failure and Industrial Policy to Move beyond the Middle-Income Trap: From Trade-based to Technology-based Specialization." In *Industrial Policy Revolution I: The Role of Government Beyond Ideology*, edited by Joseph E. Stiglitz and Justin Lin Yifu, 244–72. Houndsmill: Palgrave Macmillan.

Lee, Keun. 2013b. “How Can Korea Be a Role Model for Catch-up Development? A Capability-based View.” In *Achieving Development Success*: *Strategies and Lessons from the Developing World*, edited by Augustin K. Fosu, 25–49. Oxford: Oxford University Press.

Lee, Keun. 2013c, *Schumpeterian Analysis of Economic Catch-up: Knowledge, Path-creation, and the Middle Income Trap*. Cambridge, UK: Cambridge University Press.

Lee, Keun. 2015. “Capability Building and Industrial Diversification.” In *Development and Modern Industrial Policy in Practice: Issues and Country Experience*, edited by Jesus Felipe, 70–93. Cheltenham, UK: Edward Elgar Publishing.

Lee, Keun. 2016. *Economic Catch-up and Technological Leapfrogging: Path to Development and Macroeconomic Stability in Korea*. Cheltenham, UK: Edward Elgar Publishing.

Lee, K., C. Lim, and W. Song 2005. ‘Emerging Digital Technology as a Window of Opportunity and Technological Leapfrogging: Catch-up in Digital TV by the Korean Firms’, *International Journal of Technology Management* 29 (1-2): 40-63.

Lee, K., and J. H. Ki. 2017. “Rise of Latecomers and Catch-up Cycles in the World Steel Industry.” *Research Policy* 46 (2): 365–75.

Lee, K., and B. Y. Kim. 2009. “Both Institutions and Policies Matter but Differently for Different Income Groups of Countries: Determinants of Long-run Economic Growth Revisited. *World Development* 37 (3): 533–49.

Lee, K., with Y. Kim. 2016. “Technological Catch-up in the Capital Goods Sector.” In *Economic Catch-up and Technological Leapfrogging: Path to Development and Macroeconomic Stability in Korea*, by Keun Lee, 231–49. Cheltenham, UK: Edward Elgar Publishing.

Lee, K., with H. Y Lee. 2016. “Historical Origins and Initial Conditions for Economic Catch-Up.” In *Economic Catch-up and Technological Leapfrogging: Path to Development and Macroeconomic Stability in Korea*, by Keun Lee, 15–29. Cheltenham, UK: Edward Elgar Publishing.

Lee, K., and C. Lim. 2001. “Technological Regimes, Catching-up and Leapfrogging: Findings from the Korean Industries.” *Research Policy* 30 (3): 459–83.

Lee, K., with C. Lim. 2016. “Catch-up and Leapfrogging in Six Sectors in the 1980s and 1990s.” In *Economic Catch-up and Technological Leapfrogging: Path to Development and*

Macroeconomic Stability in Korea, by Keun Lee, 167–206. Cheltenham, UK: Edward Elgar Publishing for the Asian Development Bank.

Lee, K., C. Lim, and W. Song. 2005. "Emerging Digital Technology as a Window of Opportunity and Technological Leapfrogging: Catch-up in Digital TV by the Korean Firms." *International Journal of Technology Management* 29 (1–2); 40–63.

Lee, K., and J. A. Mathews. 2010. "From Washington Consensus to BeST consensus for World Development." *Asian–Pacific Economic Literature* 24 (1): 86–103.

Nam, Duck-Woo. 2009. *On the Road to Economic Development*. Seoul: Samsung Economic Research Institute (in Korean).

Nam, J. 1979. Cheolganggongeobui teukseonggwa sugeupgujo (Characteristics and the Structure of Supply and Demand of the Steel Industry). Seoul, Korea Development Institute (in Korean).

Park, Y. C. 1990. "Development Lessons from Asia: The Role of Government in South Korea and Taiwan." *American Economic Review* 80 (2): 118–21.

Perez, C., and L. Soete. 1988. "Catching-up in Technology: Entry Barriers and Windows of Opportunity." In *Technical Change and Economic Theory*, edited by Giovanni Dosi, Christopher Freeman, Richard Nelson, Gerald Silverberg, and Luc Soete, 458–79. London: Pinter Publishers.

Ramanayake, Sanika, and Keun Lee. 2017. "Differential Effects of Currency Undervaluation on Economic Growth in Mineral- vs. Manufacture-Exporting Countries: Revealing the Source of the Vicious Procyclicality in the Resource-cursed South." Forthcoming in Innovation Policy, Systems and Management, edited by in Jorge Niosi. Cambridge University Press.

Rodrik, D. 1996. "Understanding Economic Policy Reforms." *Journal of Economic Literature* 34 (1): 9–41.

Rugasira, A. 2013. *A Good African Story: How a Small Company Built a Global Coffee Brand.* London: Bodley Head.

Shin, Hochul, and Keun Lee. 2012. "Asymmetric Protection Leading Not to Productivity but Export Share Changes: The Case of Korean Industries, 1967–1993." *Economics of Transition* 20 (4): 745–85.

Son, Sang-Ho. 2013. *Assessment, Analysis and Prospect of Korea's Policy Loan*, Korea Institute of Finance, Seoul. (in Korean).

Song, Sungsoo. 2002. *The Historical Development of Technological Capabilities in Korean Steel Industry: Posco from the 1960s to the 1990s. Ph. D. Thesis (*Program in History and Philosophy of Science). Seoul: Seoul National University.