KDI SCHOOL

WORKING PAPER SERIES

KDI 국제정책대학원
KDI School of Public Policy and Management

KDI SCHOOL WORKING PAPER SERIES

Market Structure of the Nuclear Power Industry in Korea and Incentives of Major Firms

Ilchong Nam

KDI School of Public Policy and Management

December, 2013

Working Paper 13-10

* We are grateful to the KDI School of Public Policy and Management for providing financial support.

Market Structure of the Nuclear Power Industry in Korea and Incentives of Major Firms

Ilchong Nam

1. Introduction

The first nuclear power plant in Korea started operation in 1978. It was built by a turnkey contract between a U.S. vendor, Combustion Engineering, and the Korean government as Korea had no firm that had any experience with nuclear power generation. In the next 35 years, Korea built and operated a large nuclear fleet that produces around 40% of all electricity generated along with the network of a large number of firms that supply goods and services in the upstream and downstream of nuclear power generation. The successful development of the nuclear power industry in Korea culminated in the export of 4 nuclear power plants in United Arab Emirates in 2009.

What happened in the nuclear power industry in Korea since 2009 contrasts drastically with the success it had boasted. A seemingly endless string of procurement scandals broke out to reveal that the industry has suffered from a total failure in its system of testing and certifying parts and equipment used in nuclear reactors as a result of widespread corruption. The failure in the procurement system of Korea Hydro and Nuclear Corporation (henceforth KHNC) raised concerns about not only safety but efficiency as well. One possible explanation is the monopsony of KHNC in the market for goods and services that are used as inputs by nuclear generators. In other words, because KHNC is the only firm in Korea that owns and operates nuclear power plants, its managers were able and had incentives to procure goods and services through uncompetitive processes.

However, this theory is not convincing when we consider the fact that in most countries and regions that have nuclear power plants, there is only one generation company that owns and operates nuclear power plants but they have not been involved in procurement failures of the magnitude that have been found in Korea. This theory becomes less convincing

when we consider the fact that KHNC operates in a competitive wholesale electricity market.

KHNC operates in only the nuclear power generation stage in the vertical structure of the nuclear power industry. Other stages are reactor design, construction, manufacturing of parts, equipment, and software used by nuclear power plants, and front and back ends of the fuel cycle. In order to understand the factors that led to the total failure of the procurement market of KHNC, one needs to understand competition in each horizontal stage as well as the relationship between different horizontal stages.

In this paper, we ask a much broader and more important question about the effectiveness of competition in the entire nuclear power industry. Nuclear power industry in Korea is characterized by the monopoly in most stages and an ownership and control structure of key players that are quite unique in Korea. KHNC is owned 100% by Korea Electric Power Corporation (KEPCO henceforth), which is also the dominant shareholder of KEPCO E&C in the reactor design market, and KEPCO Fuel that operates in the front end of the fuel cycle[1]. KEPCO also owns 5 major generation companies that compete with KHNC in the wholesale market along with hundreds of smaller firms, most of which are privately owned. In addition, KEPCO is the monopsonist in the wholesale market as it is the only firm in the retail market.

To make matters more complicated, KEPCO does not control KHNC and 5 other firms in the generation stage it owns as the government prohibited KEPCO from exercising control rights of its subsidiaries in the generation stage. A consequence of this is that the vertical integration of KEPCO, KHNC, KEPCO E&C, and KEPCO Fuel is fundamentally different from vertical integrations of privately owned firms. In particular, the motive behind the vertical integration of KEPCO and its subsidiaries in the nuclear power and electricity

[1] One needs to distinguish between Old KEPCO and KEPCO. Old KEPCO is the SOE that had existed before 2001 that monopolized each of the generation, transmission, distribution, and retail stages. It also was the holding company of its subsidiaries such as KEPCO E&C and KEPCO Fuel. Restructuring of the electricity industry in 2001 resulted in the break-up of the Old KEPCO into 8 units, KHNC, 5 other generation companies, and KEPCO. KEPCO operates only in transmission, distribution, and retail stages and is not in the generation stage. KEPCO is also the holding company of the 6 generation companies created by the break-up of Old KEPCO as well as other subsidiaries.

markets may not be the maximization of the joint profit.

The objective of this paper is to analyze the structure of the nuclear power industry and the ownership and governance of major players in Korea as a first step to understand the factors that hinder effective competition and to develop policy measures that can increase competition and improve the efficiency in the industry. This paper is the first such attempt as there is no paper or report that studied the structure of the nuclear power industry or the ownership and governance structure of major firms in Korea. In this paper, we describe the structure of the nuclear power industry of Korea as well as the ownership and governance of major firms based on the data we collected from the government, SOE, and other sources including Korea Atomic Industry Forum. We also analyze the effect of the current structure of the market and the governance of major firms on the effectiveness of competition and the efficiency of the market outcome.

Studies on the structure of the markets for goods and services relevant to nuclear power generation in other countries are also rare. Most previous work on nuclear power industry was on the costs of nuclear power plants or comparison between nuclear power generation with generation using fossil fuel or renewable resources[2]. There also are studies that investigated the effects of restructuring on the production efficiency of nuclear power generation[3]. However, they generally focus on the effects of competition in the wholesale electricity market and the size of nuclear generation capacity on the costs of nuclear power generation.

There is only one previous work that is publicly available on the whole structure of the

[2] There is a huge and growing literature on the cost of nuclear power generation. For instance, Joscow and Parsons (2008) and Du and Parsons (2009) estimated the costs of nuclear power generation and compared it with the costs of coal-fired and gas-fired generation. There are other studies that compare the costs of nuclear power generation with other forms of generation when the cost of carbon emission is included. Serious efforts at estimating the costs of treating and storing radioactive wastes and of decommissioning and decontamination recently started.

[3] For instance, Davis and Wolfram (2009) estimated the effects of restructuring and the subsequent consolidation of nuclear power plants on the costs of nuclear power generation.

nuclear power industry, from the reactor design to the decommissioning which includes the stage of nuclear power generation as one of several stages that constitute the vertical structure of the nuclear power industry. OECD-NEA (2008) estimated the market share distribution of each of the horizontal stages that constitute the world nuclear power industry, calculated HHI, and assessed the degree of competition.

However, it does not provide information on the structure of the nuclear power industry in Korea or other countries. Nor does it discuss the governance of major firms and the implication of the difference in the governance of firms in the nuclear power industry. The structure of the nuclear power industry in some countries, including Korea, France, China, Russia, and possibly Japan, are heavily influenced by the policies of the national governments on the nuclear and electricity industries that suppress competition from abroad and sometimes domestically too. As a result, many stages of the nuclear power industry in Korea that are not integrated into the world market, making the Korean market a distinct one separate from the world market. Ownership and governance of firms also plays an important role in Korea as most of the major firms in the nuclear power industry are SOEs and as they are run based on a principle that deviates from profit maximization in a fundamental way.

This paper proceeds as follows.

In chapter 2, we briefly summarize the market structure of the world markets for the goods and services related to nuclear power generation and describe the main economic issues in the world nuclear power industry, focusing on competition and allocative efficiency. In chapter 3, we analyze the market structure of the nuclear power industry in Korea, and in chapter 3, we analyze the governance of major firms in the nuclear power industry in Korea. Chapter 5 analyzes the effectiveness of competition in the nuclear power industry, and chapter 6 draws conclusion.

2. Competition in the world nuclear power industry

The world nuclear power industry consists roughly of the following stages; reactor design,

reactor construction, supply of parts, equipment, software, and services used by nuclear power plants, nuclear fuel supply, nuclear waste treatment, decommissioning, and decontamination. The world nuclear power industry is characterized by a small number of large firms that are vertically integrated in several stages.

At the top of the vertical structure is the market for reactor design[4]. This market is a tight oligopoly in which a small number of firms from a handful of countries compete. After a series of mergers and acquisitions that have gone on in the last couple of decades, there emerged 3 dominant firms in the world market, Areva NP, GE Energy, and Westinghouse-Toshiba. Atomenergoprom of Russia and AECL of Canada have sold reactors based on the technologies they developed. In addition, there are a small number of firms that sold reactors in both domestic and international markets based on licensed technologies or technologies they developed further from licensed technologies. KEPCO E&C, Mitsubishi Heavy Industry, and the Chinese state nuclear company are the most visible ones.

The world market for new nuclear reactors is divided into two groups, protected markets and markets open for competition. Protected markets are the markets in the countries that have strong domestic vendors listed in the above, except China, which has been purchasing some reactors from foreign vendors while at the same time purchased reactors manufactured by its state monopoly over nuclear industry. The rest of the world market for new nuclear reactors is open for competition. 34 countries currently constitute the open market[5]. Vietnam and Turkey recently joined the open market[6].

While concentration in the historical market that spans half a century is not high, concentration in the current market appears to be quite higher than in the historical market.

---

[4] Following explanation on the state of competition in the world nuclear power industry is a summary of OECD-NEA (2008), which is the only study that analyzes competition in the world nuclear power industry to this day. No update of the study has been done since 2008. But the landscape of the industry has not changed greatly from the one described by OECD-NEA (2008).

[5] There are 8 countries other than France that operate nuclear power plants in Western Europe, 3 in Asia other than Japan, Korea, China, India, and Pakistan, 4 in former Soviet Union other than Russia, 7 in Eastern Europe, 3 in Latin America, 2 in Africa, and 5 in Middle East.

[6] U.K. also announced a plan to build new nuclear power plants using a generation 3 model developed by Areva.

In the global market for generation 3 reactors, Areva NP and Westinghouse-Toshiba appear to be dominant, although Atomenergoprom, Mitsubishi, and KEPCO – KEPCO E&C are active too[7].

The market for parts, equipment, and services demanded by nuclear power plants is by and large fairly competitive.

The market for manufacturing nuclear fuel consists mainly of mining, conversion, enrichment, and fabrication stages. Of the four stages, mining is fairly competitive, and entry barrier is low while the other stages are significantly less competitive. Conversion and enrichment are allowed in only a small number of countries. In fuel fabrication stage, there are quite a few firms in the world that provide the fuel fabrication services. However, they are mostly vertically integrated by the firms in nuclear power generation or the vendors. As a result, competition in this stage seems weaker than is apparent from the market share distribution.

Vertical integration is wide-spread in the industry. All vendors of reactors operate in some stages of fuel supply. Some vendors are integrated with firms in nuclear power generation. Firms in nuclear power generation are also responsible for treating and storing nuclear wastes, decommissioning, and decontamination and are involved in these activities quite heavily.

The ultimate question about the nuclear power industry is whether there exists sufficient competition that would eventually lead to lower costs of generation of electricity. An efficient outcome means the following;

- Reactors that are more efficient than others are chosen.

- Prices of reactors purchased are reasonably close to the costs of designing and building them.

[7] For detailed information on all of the vendors and the reactors they sell, see for instance Korea Atomic Industrial Forum (2013A).

- Firms producing parts, equipment, software, and services needed for building and operating nuclear reactors more efficiently are selected to supply them at prices that are reasonably close to their production costs.

- Costs of production in each of the stages constituting the fuel supply stage are minimized, and the prices of various services are reasonably close to the costs of providing them.

- Costs of providing services in each of the back end of the fuel cycle are close to the level that are potentially achievable, and the prices of the services are reasonably close to their costs.

- In each stage constituting the vertical structure of the nuclear power industry, necessary standards on safety and quality are met.

The performance of the nuclear power industry depends on the degree of actual and potential competition in each stage. There are reasons to believe that the outcome in the world nuclear power industry has significant room for improvement in efficiency as follows;

- A large part of the world market for reactor design and construction is protected from competition by the policies of the governments of the countries that have strong domestic vendors. They are U.S., France, Japan, Korea, and Russia. Also, Chinese market for reactors is not completely open to international competition.

- The rest of the world market for reactor design is an open market in which all vendors can participate. However, there is a high entry barrier to this market in that designing and building reactors requires the acquisition of sophisticated technology, vast experience in design and construction over a long period of time, continued R&D and construction of reactors not interrupted by long hiatuses, large capital, and exposure to high risks.

- There are entry barriers to conversion and enrichment stages due to non-proliferation.

- Fuel fabrication often has reactor specific characteristics that give the original vendor an advantage.
- There is entry barrier to the market for the treatment of spent fuel services due to non-proliferation.

As a result of the above factors, competition in the markets for reactor design and construction, conversion, enrichment, fuel fabrication, and treatment of spent fuel can be limited. Further, the widespread vertical integration can work as an additional entry barrier to each of the stages by a potential entrant, which may find it difficult to sell its goods or services to customers unless it enters in other stages as well. The foreclosure effect of vertical integration could lead to higher prices in downstream markets.

Nuclear power generation, one of the two stages that are central to the nuclear power industry along with reactor design and construction, underwent a fundamental change in the last two decades in many countries that have nuclear power plants as a result of liberalization of the electricity industry. Competition in the wholesale and retail markets and privatization of former SOEs increased the risks of investment in generation capacities overall significantly. Risks from the exposure to competition and change in the ownership are larger for nuclear power plants than other types of generators as nuclear power plants required a larger amount of capital to be invested and a longer payback period.

The risks involving investment in nuclear power generation capacities increased further due to increased safety standards imposed by many countries that entailed a significant increase in costs of building and operating nuclear power plants.

Competition in the world nuclear power industry is further complicated by the heavy intervention of the government in many parts of the industry.

In Russia and China, all key activities in the industry are performed by the state. In other words, all major firms in nuclear power generation, reactor design and construction, and in every stage in the front and back ends of the fuel cycle are owned and run by the state. Their domestic markets are monopolized by the relevant state agency, which obviously

operate not based on profit incent.

In France, nuclear power generation and the rest of the nuclear power industry are each monopolized by different SOEs, EDF and Areva NP. While the French government is the dominant shareholder of both EDF and Areva NP, the ownership and governance structures of the two SOEs are different form the state monopolies in China or Russia and allow a much stronger profit incentives. EDF also operates in the competitive wholesale market in France and other countries in Europe, unlike the state generation companies in China or Russia. Still, EDF and Areva NP are believed to operate in their markets based in part on the industrial policies of the French government, which can conflict with the profit maximization of each of the two firms.

Korea presents yet another different model of ownership and governance as well as the industrial policies of the government. The government's ownership in KEPCO and its subsidiaries is smaller than in the case of EDF and Areva in France as KEPCO. However, the government uses KEPCO and its subsidiaries in nuclear power industry as direct policy instruments and does not acknowledge their profit incentives. One consequence of the industrial policy of the Korean government is the emergence of Doosan Heavy, a privately owned firm, as the increasingly dominant firm in the design and construction of reactor design and construction and manufacturing of generators. Korean government has also intervened freely in the wholesale electricity market to manipulate the market price of electricity and capacity and used the resources of KHNC in achieving its policy objectives in the electricity market.

In Japan, nuclear power and electricity industries are both private, and there is no statutory entry barrier to them. However, Japanese government appears to have pursued an industrial policy of promoting domestic nuclear power industry and promoting exports of nuclear power plants of Japanese vendors in foreign markets.

Competition in the nuclear power industry is significantly affected by the strong presence of the governments of countries listed in the above and their intervention in their domestic markets as well as in the world market. It is not clear how the interaction between a small number of firms, which have diverse ownership and governance structures and face

different degree of government intervention, affect the equilibrium in each of the markets belonging to the nuclear industry. The crucial question is whether the industrial policy of the governments of some countries aimed at promoting domestic vendor industry will have an effect similar to that of predatory pricing in the world nuclear industry in the long run.

Another important issue that can affect competition and the efficiency of the outcome in the industry is standardization. One of the conspicuous characteristics of the nuclear power industry is the low degree of standardization for various reasons. Lack or low degree of standardization increases the costs of producing intermediate goods and services and hamper competition in the markets for intermediate goods and services.

Safety standards are another important factor that can potentially affect competition in various related markets. It is important to set safety standards that ensure a given level of safety that is deemed desirable and enforce them vigorously. But excessively demanding standards will limit competition and lead to an inefficient outcome in relevant markets. Thus, setting standards that allows as much competition as possible while meeting the desired level of safety is crucial.

Enforcement of safety standards is complicated as it needs to be done at the firm level. In many cases, it is done as a part of the procurement process of nuclear power plants operators or vendors. It was revealed that KHNC failed seriously in the enforcement of safety standards in its procurement process even though it is subject to laws governing procurement of the government agencies and SOEs in Korea, which led to the stopping of the operation of several nuclear power plants and huge costs.

3. Market structure in Korea[8]

In the upstream, the market for the design of nuclear reactors in Korea is monopolized by KEPCO E&C, which is 74.9% owned by KEPCO. The monopoly at this stage is a result of the policy of the Korean government. There are a handful of firms in the world countries that

[8] Much of the facts about the nuclear power industry included in this section have been borrowed from Korea Atomic Industrial Forum (2012, 2013A, 2013B).

can design and build nuclear reactors. It is the industrial policy of the Korean government of promoting a national champion in the reactor design stage of the industry that led to the monopoly of KEPCO E&C in this stage. Korean government also made a decision to establish the national champion in this market as an SOE, more specifically as a subsidiary of KEPCO. The government also forced Old KEPCO before the restructuring and KHNC after the restructuring, to purchase the reactors designed by KEPCO E&C.

Construction management of nuclear power plants, including nuclear islands, is an oligopoly. Several large construction and engineering firms participate in this market as well as many smaller firms that participate as subcontractors.

The market for parts, equipment, software, and services needed to build and operate nuclear power plants is huge and complex. The most important part of this market is the market for parts and equipment that can be produced only by a small number of firms that have high level of technical skills, experience, and large capital, such as specialized equipment used in building nuclear islands and large generators customized for nuclear power plants. This part of the Korean market is monopolized by Doosan Heavy Industry[9]. Again, it is a result of the industrial policy of the Korean government of promoting a national champion in this market. Doosan is a privately owned firm now but had been a subsidiary of KEPCO for a long period of time before being privatized in the early 2000s. There is no other firm in Korea that has the technology and experience sufficient to compete effectively with Doosan. However, Hyundai Heavy Industry has been trying to enter this market, exposing Doosan to potential competition.

KHNC imports some of the parts and equipment from the world market. Korean government has pursued the industrial policy of promoting domestic firms in this market. Domestic industry producing relevant goods and services developed rapidly partly as a result of the expansion in the nuclear power generation capacity and partly due to the industrial policy of the Korean government. The following [Table 3-1] summarizes the revenues of the domestic

[9] Note that quite a few construction companies participate in the market for building nuclear power plants. But Doosan is the only firm that has been given the role of the main contractor that oversees the construction processes.

manufacturers of parts and equipment used by nuclear power plants in Korea since restructuring.

[Table 3-1 Data on parts and equipment manufacturing industry in Korea]

section / year	Manufacturing of parts and equipment
2002	4,812
2003	4,981
2004	5,066
2005	3,930
2006	5,716
2007	6,415
2008	16,429
2009	11,852
2010	15,596
2011	18,618

The market for nuclear fuel in Korea is monopolized by a subsidiary of KEPCO Fuel, which imports enriched uranium to fabricate the fuel for use by KHNC. In other words, KEPCO Fuel is not in mining, extraction, conversion, or enrichment stages and provides only the fuel fabrication services[10]. KEPCO Fuel is 96.4% owned while KHNC is 100% owned by KEPCO. Thus, while there are quite a few competitors in the world market for uranium fuel, they are excluded from competition in the Korean market, and KEPCO Fuel is in a monopsonistic position in purchasing inputs it uses to fabricate fuel. It too faces a monopsonist in the domestic market as KHNC is the only firm that operates a nuclear power

[10] KEPCO Fuel purchases around 5,000 tons of uranium concentrate (U_3O_3) from foreign suppliers. KEPCO Fuel hires foreign firms that will provide conversion and enrichment services as there is no domestic firm that provides conversion or enrichment services currently. KAERI built and operated a conversion facility for fuel to be used by heavy water reactors in the late 1980s but stopped operation in the early 1990s due to high costs compared to those of foreign competitors.

plant and demands uranium fuel in Korea.

KHNC can easily break the monopoly of KEPCO Fuel by resorting to other sources of fuel in the international market if it wants. Thus, KHNC can limit the ability of KEPCO Fuel to charge a high price for the fuel by taking advantage of the potential competition between KEPCO Fuel and its competitors in the international market. It should be noted that KEPCO Fuel and KHNC are not under a unified control by a single party that uses them as instruments in maximizing its profit as a consequence of the governance structures Korean government installed in them[11]. It is not clear what determines the terms of transactions between KEPCO Fuel and KHNC in the bilateral monopoly situation.

Disposal and treatment of radioactive wastes that are created during nuclear power generation had been handled exclusively by KHNC before 2008. Act on the Management of Radioactive Wastes of 2008 made it possible for other entities to provide the services. Korea Nuclear Safety Corporation (KNSC) was created to handle medium and low level radioactive wastes. Disposal and treatment of spent fuel is still handled by KHNC. There also emerged a fairly large private industry that operates as subcontractors of KHNC, KNSC, and other public institutions in the markets for nuclear waste management and disposal. The following [Table 3-2] summarizes the revenues of the firms in this market and the breakdowns according to their ownership.

[Table 3-2 Revenues of firms various services in the domestic nuclear power industry]

year \ section		design	construction	operation & maintenance of NPPs	safety
2002	SOE	1,781	-	2,067	502
	private firms	32	5,584	506	189
2003	SOE	1,775	-	2,487	541
	private firms	189	594	370	444
2004	SOE	1,324	-	2,224	764

[11] More detailed information on the governance structures of KEPCO and its subsidiaries is given in the next section.

	private firms	724	5,183	1,409	406
2005	SOE	1,577	-	2,314	914
	private firms	690	3,330	1,712	414
2006	SOE	2,156	-	2,614	1,089
	private firms	343	3,520	1,201	258
2007	SOE	2,090	16	3,117	864
	private firms	201	3,724	1,750	131
2008	SOE	2,416	-	3,332	1,010
	private firms	513	6,084	1,187	215
2009	SOE	3,039	-	3,343	2,090
	private firms	489	8,517	1,941	217
2010	SOE	4,542	0	3,462	3,179
	private firms	590	8,668	2,630	781
2011	SOE (%)	4,658 (88.3)	0	3,929 (58.0)	3,351 (79.4)
	private firms	619	12,025	2,847	869

The market for decommissioning and decontamination has not emerged yet as no nuclear reactor has been decommissioned thus far[12].

To sum up, among the stages that constitute the vertical structure of the nuclear power industry, nuclear power generation, reactor design, reactor construction, fuel fabrication, treatment of radioactive wastes are all monopolies. Successive monopolies are not an outcome of market forces but are results of the industrial policy of the Korean government in the last 40 years or so. Markets for of parts, equipment, and services needed to build and operated nuclear power plants are generally competitive as the relevant Korean markets are

[12] We did not include the markets for nuclear power plants operation and maintenance, services related to managing safety of radioactive material, and certification services in this paper due to the difficulties with obtaining reliable data.

parts of the world markets. However, for some of the parts and equipment, competition is severely limited as a result of the industrial policy of promoting domestic firms.

In the nuclear power generation stage, KHNC is the monopolist due to the policy of the government to maintain an SOE monopoly in nuclear power generation. There is no law that prohibits private firms or other SOES from building operating nuclear power plants. But the government has maintained the policy of not allowing any other firm to build a nuclear power plant. The official instrument of the government to implement the policy is the licensing procedure for new power plants to be built that the line ministry controls[13]. KHNC's share in the total capacity in the wholesale market is around 25%, and its share in the electricity generated is around 30% in 2012[14]. Its market share in terms of the revenue is difficult to calculate and is not available for 2012[15].

Monopoly of KEPCO E&C in the reactor design stage is probably inevitable as long as the Korean government maintains the industrial policy of promoting domestic vendor industry as it is extremely difficult for other Korean firms to enter this market profitably.

Monopoly of Doosan Heavy in the construction engineering and manufacturing generators for nuclear power plants is due partly to its efficiency but also partly to its past relationship with the Old KEPCO and to the industrial policy of the Korean government of promoting a

[13] Korea has maintained the Supply and Demand Plan for the Electricity Industry even after the restructuring. The nature of the Plan is very unclear as the restructuring was supposed to allow free entry into the generation stage. A generation company needs to get its plan to build a new generator included in the Demand and Supply Plan that the government announces every 2 years in order to build a new power plant. At least one private firm showed a strong interest in obtaining a license to build and operate a nuclear power plant while the government was preparing for the 6th Supply and Demand Plan for the Electricity Industry announced in 2013, but dropped its plan after it became clear that the government was not willing to allow a private firm to build and operate a nuclear power plant.

[14] See Korea Power Exchange (2012).

[15] Data on revenue that KHNC received from the wholesale market in 2012 is available, but it reflects a large discount of the price KHNC receives for the electricity it sells forced by an ad hoc intervention of the government in the wholesale market and does not provide good information about true market share of KHNC. See Nam (2012) for a detailed account of the ad hoc intervention and how it affects competition in the wholesale electricity market in Korea.

national champion in the industries of manufacturing of generators and construction engineering for nuclear power plants[16]. Its monopoly will not be challenged seriously in the short and medium term as the other firms do not possess the technology and experience necessary for them to compete effectively with it. However, if Korean government decides to build a substantially large number of new nuclear power plants in the next 10 ~ 20 years, Hyundai Heavy Industry can emerge as a competitor.

The bilateral monopoly between KHNC and Doosan Heavy is different from the bilateral monopoly between subsidiaries of KEPCO in some stages in that Doosan operates based on profit incentives while KHNC does not. It is not clear why KHNC deals exclusively with Doosan, what determines the terms of transactions between KHNC and Doosan, and how the pressure of potential competition from foreign competitors affects the terms of transactions.

The relationship among the subsidiaries of KEPCO and between KEPCO and them is extremely complex and difficult to understand clearly. While KEPCO E&C, KEPCO Fuel, and KHNC are owned by KEPCO and are vertically integrated in ownership, they are not tightly controlled by KEPCO. Further, KEPCO does not try to maximize the sum of the profits from the relevant stages and is not allowed to maximize profit. Thus, traditional economic theory on vertical integration does not apply, and one needs to look into the governance of KEPCO and its subsidiaries and the industrial policy of the Korean government in order to understand the performance of KEPCO's subsidiaries in those stages.

4. Governance of major players

The major players in the nuclear power industry are KEPCO, KHNC, KEPCO Engineering, KEPCO Fuel, and Doosan Heavy Industry. KEPCO is owned by a large number of shareholders that include the Korean government, SOEs, and private investors. The Korean government controls more than 50% of shares of KEPCO as it and other SOEs under its

[16] Doosan Heavy had been a subsidiary of the Old KEPCO before being privatized in the aftermath of the financial crisis in the late 1990s. One can see that the KEPCO group was both the monopolistic vendor as well as the monopolistic service provider before the restructuring.

control collectively own 51.1% based on which it controls KEPCO quite freely. The government also controls all subsidiaries of KEPCO through its control over KEPCO even though it owns no or few shares of them. Thus it can control KEPCO E&C, KEPCO Fuel, and KHNC.

KEPCO is a listed joint stock company that has a large number of private shareholders from Korea and abroad and is subject to the company law and securities related laws, which generally require that directors make decisions that are in line with the maximization of the economic value of shareholders. However, the Act on the Management of Public Institutions allows the government to intervene in the management of KEPCO and its subsidiaries quite freely in order to pursue a wide range of policy objectives, many of which conflict with the firm value maximization of KEPCO. Consequently, the government has been able to force KEPCO and its subsidiaries to take actions that it wants even if they entail losses to KEPCO or its subsidiaries.

The law has also been used by the government to deprive KEPCO of its control rights over the 6 generation companies it owns and to exercise control rights itself instead. Thus KEPCO has been prohibited from making key decisions of the 6 generation companies and as a result has been unable to run them in ways that are consistent with the maximization of the sum of the profits of KEPCO and the generation companies. The 6 generation companies have weak profit incentives as their holding company. While the government exercises control over the 6 generation companies and KEPCO, it lacks the expertise or resources to run them efficiently. Further, it appears that managerial efficiency or efficiency of investment are given a low priority by the government which cares mostly about achieving the objectives that are set based on policy or political considerations. Under such an environment, it is reasonable to expect the executives and managers of KHNC to make decisions that promote their interests while meeting the demands of the bureaucrats and politicians.

The Act on the Management of Public Institutions officially allows KEPCO to exercise the control right over KEPCO E&C and KEPCO Fuel. However, unofficially, the dominant role of the government in the governance of KEPCO allows the government to intervene in the management of KEPCO E&C and KEPCO Fuel in an arbitrary way. It is not clear whether KEPCO exercises control of them or if it does what objective it tries to achieve in making

key decisions of the two subsidiaries. It is clear that it is not simple profit maximization of KEPCO Fuel or KEPCO E&C as it means excessively high prices for the services they sell to KHNC. It does not appear to be the profit maximization of KHNC or maximization of the joint profits of KHNC, KEPCO E&C, and KEPCO Fuel as none of them have strong profit incentives and as KEPCO has a weak profit incentive and is unable to coordinate the actions of the four subsidiaries because it is prohibited from making key decisions of KHNC.

On the other hand, it is reasonable to expect Doosan Heavy, affiliated with a *chaebol* group, to make decisions based primarily on profit incentives in most cases. But it is subject to the common problem that plagues all *chaebol* affiliated firms in Korea, namely investment decisions that are optimal for the dominant shareholder but are sub-optimal to other shareholders.

5. Efficiency of the outcome under the market structure and governance structure

Current structure of the nuclear power industry in Korea has been heavily influenced by the policies of the past and current administrations on the nuclear power and electricity industries and is a legacy of the old system that had prevailed before the restructuring of the electricity industry in 2001. Successive monopoly in reactor design, fuel fabrication, nuclear generation, and waste management and disposal is unusual in several respects.

First, KEPCO owns the subsidiaries in the nuclear power industry but are not control them effectively due to the governance structure imposed by the Act on the Management of Public Institutions and the intervention of the government in its management. In particular, KHNC is run by a management that is independent of KEPCO.

Second, KEPCO has a very low profit incentive and is not allowed to seek profit even though it is nearly 50% owned by private shareholders. KEPCO's subsidiaries also lack proper profit incentives and are not allowed to seek profit.

Third, KEPCO's objective behind its dealings with the subsidiaries is unclear.

Fourth, the objectives of the government behind its intervention in KEPCO and its

subsidiaries are not unclearly known.

Fifth, the objectives of the government in its intervention in the electricity and nuclear industries are also unclear.

Domestic market for reactor design seems to be a natural monopoly, given the economies of scale and absence of other firms that can possibly compete effectively with KEPCO E&C. But it's not clear whether keeping it as a subsidiary of KEPCO is the most efficient way considering the above listed facts. The loss of internal efficiency of KEPCO E&C due to the inefficient governance structure can be substantial in the long run. Bilateral monopoly between KHNC and KEPCO E&C, both suffering from low profit incentives, can also lead to inefficiency in this market.

Domestic market for fuel fabrication may not be a natural monopoly even if we take for granted the industrial policy of forcing KHNC to purchase fuel from domestic suppliers. In addition, transactions between KHNC and KEPCO Fuel are less transparent compared to the situation in which KHNC and fuel suppliers each seek their respective profits.

Nuclear power generation is not a natural monopoly. While KHNC has the largest market share of around 25 ~ 30%, it is not in a dominant position that can affect competition adversely as concentration in the market is relatively moderate. However, there are reasons to be concerned about the internal efficiency of KHNC.

First, inefficiency within KHNC appears to be very large as revealed by a string of incidents that occurred in the last several years. It became clear that it is extremely difficult to even obtain information needed to regulate KHNC properly as there are few outside of KHNC who have the expertise, information, and incentives to find relevant facts about the operation of KHNC and to use them to improve the efficiency and the safety of the operation of KHNC.

Second, the link between the efficient operation of KHNC and its financial performance is very weak. KHNC can earn profits that significantly higher than normal profits easily due to the entry barrier to the nuclear generation stage set by the Korean government if the Korean government does not implement the market rules in the wholesale market properly. Alternatively, Korean government can intervene in the wholesale market in an ad hoc way to

transfer the money that KHNC could earn as its normal profit to other participants in the wholesale market.

Third, it is possible that the government abuses its control over KHNC to cross subsidize the firms in the front and back ends of the fuel cycle in a way that adversely affects the total welfare of the consumers and tax payers in Korea.

In short, current monopoly of KHNC in the nuclear generation stage and its opaque governance structure are likely to lead to large inefficiency.

6. Conclusion

This paper analyzes the nuclear power industry of Korea from the perspective of competition. It is first such attempt as all previous works on the economics of nuclear power industry in Korea have been focused exclusively on the comparison of total costs of generating electricity of nuclear power plants and other fuel types. We found out that nuclear power industry in Korea is characterized by successive monopolies, dominance of KEPCO in terms of the ownership of major firms, and low degree of accountability and transparency in the management of SOEs. We also found out that the government, in particular the line ministry of the nuclear and electricity industries, plays a crucial role in determining the market structure and governance of firms and hence the outcome of competition in the market.

Vertical integration of the monopolies in fuel fabrication, nuclear power generation, and waste treatment and disposal are likely to work as an entry barrier to each of the three horizontal markets and reduce competition in the long run. Vertical integration of these subsidiaries of KEPCO coupled with the unusual governance structure imposed on them by the government are also likely to lower efficiency in the relevant markets. The fact that KEPCO is the monopsonist in the retail stage of the electricity industry makes it more difficult to induce effective competition in each of the horizontal stages that constitute the nuclear power industry.

It is too early to draw a definite conclusion about the concrete form of the market structure and the ownership and governance structure of KEPCO and its subsidiaries that will induce

an efficient outcome. However, based on the findings of this paper, it is clear that a change in the policy of the Korean government that unbundles various horizontal stages, lowers of entry barriers, and strengthens the profit incentives of SOEs as well as transparency and accountability of them will improve the efficiency of the industry and ultimately increase welfare of consumers of electricity in Korea.

References

Joscow, Paul and John Parsons, “The Economic Future of Nuclear Power” (2008) Daedalus, 138(4): 45-59

Lucas, Davis and Catherine Wolfram, “Deregulation, Consolidation, and Efficiency: Evidence from U.S. Nuclear Power”, (2011) Energy Institute at Haas Working Paper

Nam, Ilchong, *Competition Policy for the Electricity Market in Korea* (2012) KDI Press

OECD-NEA, *Market Competition in the Nuclear Industry* (2008) OECD

Ministry of Education, Science, and Technology, *17th Survey of the Status of Nuclear Industry in 2011* (2013)

Korea Atomic Industrial Forum, *Korea Vendors for Nuclear Industry* (2012)

Korea Atomic Industrial Forum, *2013 Developments and Operations in the Nuclear Power Generation in the World* (2013A)

Korea Atomic Industrial Forum, *2013 Nuclear Industry Year Book I and II* (2013B)

Korea Power Exchange, Statistics on Generation Facilities in Korea 2012 (2013)

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	99-01	Se-Il Park	Labor Market Policy and The Social Safety Net in Korea: After 1997 Crisis
Working Paper	99-02	Sang-Woo Nam	Korea's Economic Crisis and Corporate Governance
Working Paper	99-03	Sangmoon Hahm	Monetary Bands and Monetary Neutrality
Working Paper	99-04	Jong-Il You Ju-Ho Lee	Economic and Social Consequences of globalization: The Case of South Korea
Working Paper	99-05	Sang-Woo Nam	Reform of the Financial Sector in East Asia
Working Paper	99-06	Hun-Joo Park	Dirigiste Modernization, Coalition Politics, and Financial Policy Towards Small Business: Korea, Japan, and Taiwan Compared
Working Paper	99-07	Kong-Kyun Ro	Mother's Education and Child's Health: Economic Anlaysis of Korean Data
Working Paper	99-08	Euysung Kim	Trade Liberalization and Productivity Growth in Korean Manufacturing Industries: Price Protection, Market Power, and Scale Efficiency
Working Paper	99-09	Gill-Chin Lim	Global Political-Economic System and Financial Crisis: Korea, Brazil and the IMF
Working Paper	99-10 (C99-01)	Seung-Joo Lee	LG Household & Health Care: Building a High-Performing Organization
Working Paper	00-01	Sangmoon Hahm Kyung-Soo Kim Ho-Mou Wu	Gains from Currency Convertibility: A Case of Incomplete Markets
Working Paper	00-02	Jong-Il You	The Bretton Woods Institutions: Evolution, Reform and Change
Working Paper	00-03	Dukgeun Ahn	Linkages between International Financial and Trade Institutions: IMF, World Bank and WTO
Working Paper	00-04	Woochan Kim	Does Capital Account Liberalization Discipline Budget Deficit?
Working Paper	00-05	Sunwoong Kim Shale Horowitz	Public Interest "blackballing" in South Korea's Elections: One-Trick Pony, or Wave of the Future?
Working Paper	00-06	Woochan Kim	Do Foreign Investors Perform Better than Locals? Information Asymmetry versus Investor Sophistication
Working Paper	00-07	Gill-Chin Lim Joon Han	North-South Cooperation for Food Supply: Demographic Analysis and Policy Directions
Working Paper	00-08 (C00-01)	Seung-Joo Lee	Strategic Newspaper Management: Case Study of Maeil Business
Working Paper	01-01	Seung-Joo Lee	Nokia: Strategic Transformation and Growth
Working Paper	01-02	Woochan Kim Shang-Jin Wei	Offshore Investment Funds: Monsters in Emerging Markets?
Working Paper	01-03	Dukgeun Ahn	Comparative Analysis of the SPS and the TBT Agreements
Working Paper	01-04	Sunwoong Kim Ju-Ho Lee	Demand for Education and Developmental State: Private Tutoring in South Korea
Working Paper	01-05	Ju-Ho Lee Young-Kyu Moh Dae-Il Kim	Do Unions Inhibit Labor Flexibility? Lessons from Korea
Working Paper	01-06	Woochan Kim Yangho Byeon	Restructuring Korean Bank's Short-Term Debts in 1998 - Detailed Accounts and Their Implications -
Working Paper	01-07	Yoon-Ha YOO	Private Tutoring as Rent Seeking Activity Under Tuition Control

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>. You may get additional copy of the documents by downloading it using the Acrobat Reader.**

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	01-08	Kong-Kyun Ro	경제활동인구 변동의 요인분석: 선진국과의 비교분석
Working Paper	02-01	Sangmoon Hahm	Restructuring of the Public Enterprise after the Crisis : The Case of Deposit Insurance Fund
Working Paper	02-02	Kyong-Dong KIM	The Culture of Industrial Relations in Korea : An alternative Sociological Approach
Working Paper	02-03	Dukgeun Ahn	Korean Experience of the Dispute Settlement in the world Trading System
Working Paper	02-04	BERNARD S. BLACK Hasung Jang Woochan Kim	Does Corporate Governance Matter? (Evidence from the Korean Market)
Working Paper	02-05	Sunwoong Kim Ju-Ho Lee	Secondary School Equalization Policies in South Korea
Working Paper	02-06	Yoon-Ha YOO	Penalty for Mismatch Between Ability and Quality, and School Choice
Working Paper	02-07	Dukgeun Ahn Han-Young Lie	Legal Issues of Privatization in Government Procurement Agreements: Experience of Korea from Bilateral and WTO Agreements
Working Paper	02-08	David J. Behling Kyong Shik Eom	U.S. Mortgage Markets and Institutions and Their Relevance for Korea
Working Paper	03-01	Sang-Moon Hahm	Transmission of Stock Returns and Volatility: the Case of Korea
Working Paper	03-02	Yoon Ha Yoo	Does Evidentiary Uncertainty Induce Excessive Injurer Care?
Working Paper	03-03	Yoon Ha Yoo	Competition to Enter a Better School and Private Tutoring
Working Paper	03-04	Sunwoong Kim Ju-Ho Lee	Hierarchy and Market Competition in South Korea's Higher Education Sector
Working Paper	03-05	Chul Chung	Factor Content of Trade: Nonhomothetic Preferences and "Missing Trade"
Working Paper	03-06	Hun Joo Park	RECASTING KOREAN *DIRIGISME*
Working Paper	03-07	Taejong Kim Ju-Ho Lee Young Lee	Mixing *versus* Sorting in Schooling: Evidence from the Equalization Policy in South Korea
Working Paper	03-08	Naohito Abe	Managerial Incentive Mechanisms and Turnover of Company Presidents and Directors in Japan
Working Paper	03-09	Naohito Abe Noel Gaston Katsuyuki Kubo	EXECUTIVE PAY IN JAPAN: THE ROLE OF BANK-APPOINTED MONITORS AND THE MAIN BANK RELATIONSHIP
Working Paper	03-10	Chai-On Lee	Foreign Exchange Rates Determination in the light of Marx's Labor-Value Theory
Working Paper	03-11	Taejong Kim	Political Economy and Population Growth in Early Modern Japan
Working Paper	03-12	Il-Horn Hann Kai-Lung Hui Tom S. Lee I.P.L. Png	Direct Marketing: Privacy and Competition
Working Paper	03-13	Marcus Noland	RELIGION, CULTURE, AND ECONOMIC PERFORMANCE
Working Paper	04-01	Takao Kato Woochan Kim Ju Ho Lee	EXECUTIVE COMPENSATION AND FIRM PERFORMANCE IN KOREA

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	04-02	Kyoung-Dong Kim	Korean Modernization Revisited: An Alternative View from the Other Side of History

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	04-03	Lee Seok Hwang	Ultimate Ownership, Income Management, and Legal and Extra-Legal Institutions
Working Paper	04-04	Dongsoo Kang	Key Success Factors in the Revitalization of Distressed Firms : A Case of the Korean Corporate Workouts
Working Paper	04-05	Il Chong Nam Woochan Kim	Corporate Governance of Newly Privatized Firms: The Remaining Issues in Korea
Working Paper	04-06	Hee Soo Chung Jeong Ho Kim Hyuk Il Kwon	Housing Speculation and Housing Price Bubble in Korea
Working Paper	04-07	Yoon-Ha Yoo	Uncertainty and Negligence Rules
Working Paper	04-08	Young Ki Lee	Pension and Retirement Fund Management
Working Paper	04-09	Wooheon Rhee Tack Yun	Implications of Quasi-Geometric Discountingon the Observable Sharp e Ratio
Working Paper	04-10	Seung-Joo Lee	Growth Strategy: A Conceptual Framework
Working Paper	04-11	Boon-Young Lee Seung-Joo Lee	Case Study of Samsung’s Mobile Phone Business
Working Paper	04-12	Sung Yeung Kwack Young Sun Lee	What Determines Saving Rate in Korea?: the Role of Demography
Working Paper	04-13	Ki-Eun Rhee	Collusion in Repeated Auctions with Externalities
Working Paper	04-14	Jaeun Shin Sangho Moon	IMPACT OF DUAL ELIGIBILITY ON HEALTHCARE USE BY MEDICARE BENEFICIARIES
Working Paper	04-15	Hun Joo Park Yeun-Sook Park	Riding into the Sunset: The Political Economy of Bicycles as a Declining Industry in Korea
Working Paper	04-16	Woochan Kim Hasung Jang Bernard S. Black	Predicting Firm's Corporate Governance Choices: Evidence from Korea
Working Paper	04-17	Tae Hee Choi	Characteristics of Firms that Persistently Meet or Beat Analysts' Forecasts
Working Paper	04-18	Taejong Kim Yoichi Okita	Is There a Premium for Elite College Education: Evidence from a Natural Experiment in Japan
Working Paper	04-19	Leonard K. Cheng Jae Nahm	Product Boundary, Vertical Competition, and the Double Mark-up Problem
Working Paper	04-20	Woochan Kim Young-Jae Lim Taeyoon Sung	What Determines the Ownership Structure of Business Conglomerates? : On the Cash Flow Rights of Korea’s Chaebol
Working Paper	04-21	Taejong Kim	Shadow Education: School Quality and Demand for Private Tutoring in Korea
Working Paper	04-22	Ki-Eun Rhee Raphael Thomadsen	Costly Collusion in Differentiated Industries
Working Paper	04-23	Jaeun Shin Sangho Moon	HMO plans, Self-selection, and Utilization of Health Care Services
Working Paper	04-24	Yoon-Ha Yoo	Risk Aversion and Incentive to Abide By Legal Rules
Working Paper	04-25	Ji Hong Kim	Speculative Attack and Korean Exchange Rate Regime
Working Paper	05-01	Woochan Kim Taeyoon Sung	What Makes Firms Manage FX Risk? : Evidence from an Emerging Market
Working Paper	05-02	Janghyuk Lee Laoucine Kerbache	Internet Media Planning: An Optimization Model

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	05-03	Kun-Ho Lee	Risk in the Credit Card Industry When Consumer Types are Not Observable
Working Paper	05-04	Kyong-Dong KIM	Why Korea Is So Prone To Conflict: An Alternative Sociological Analysis
Working Paper	05-05	Dukgeun AHN	Why Should Non-actionable Subsidy Be Non-actionable?
Working Paper	05-06	Seung-Joo LEE	Case Study of L'Oréal: Innovation and Growth Strategy
Working Paper	05-07	Seung-Joo LEE	Case Study of BMW: The Ultimate Driving Machine
Working Paper	05-08	Taejong KIM	Do School Ties Matter? Evidence from the Promotion of Public Prosecutors in Korea
Working Paper	05-09	Hun Joo PARK	Paradigms and Fallacies: Rethinking Northeast Asian Security
Working Paper	05-10	WOOCHAN KIM TAEYOON SUNG	What Makes Group-Affiliated Firms Go Public?
Working Paper	05-11	BERNARD S. BLACK WOOCHAN KIM HASUNG JANG KYUNG-SUH PARK	Does Corporate Governance Predict Firms' Market Values? Time Series Evidence from Korea
Working Paper	05-12	Kun-Ho Lee	Estimating Probability of Default For the Foundation IRB Approach In Countries That Had Experienced Extreme Credit Crises
Working Paper	05-13	Ji-Hong KIM	Optimal Policy Response To Speculative Attack
Working Paper	05-14	Kwon Jung Boon Young Lee	Coupon Redemption Behaviors among Korean Consumers: Effects of Distribution Method, Face Value, and Benefits on Coupon Redemption Rates in Service Sector
Working Paper	06-01	Kee-Hong Bae Seung-Bo Kim Woochan Kim	Family Control and Expropriation of Not-for-Profit Organizations: Evidence from Korean Private Universities
Working Paper	06-02	Jaeun Shin	How Good is Korean Health Care? An International Comparison of Health Care Systems
Working Paper	06-03	Tae Hee Choi	Timeliness of Asset Write-offs
Working Paper	06-04	Jin PARK	Conflict Resolution Case Study: The National Education Information System (NEIS)
Working Paper	06-05	YuSang CHANG	DYNAMIC COMPETITIVE PARADIGM OF MANAGING MOVING TARGETS; IMPLICATIONS FOR KOREAN INDUSTY
Working Paper	06-06	Jin PARK	A Tale of Two Government Reforms in Korea
Working Paper	06-07	Ilho YOO	Fiscal Balance Forecast of Cambodia 2007-2011
Working Paper	06-08	Ilho YOO	PAYG pension in a small open economy
Working Paper	06-09	Kwon JUNG Clement LIM	IMPULSE BUYING BEHAVIORS ON THE INTERNET
Working Paper	06-10	Joong H. HAN	Liquidation Value and Debt Availability: An Empirical Investigation
Working Paper	06-11	Brandon Julio, Woojin Kim Michael S. Weisbach	Uses of Funds and the Sources of Financing: Corporate Investment and Debt Contract Design
Working Paper	06-12	Hun Joo Park	Toward People-centered Development: A Reflection on the Korean Experience

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	06-13	Hun Joo Park	The Perspective of Small Business in South Korea
Working Paper	06-14	Younguck KANG	Collective Experience and Civil Society in Governance
Working Paper	06-15	Dong-Young KIM	The Roles of Government Officials as Policy Entrepreneurs in Consensus Building Process
Working Paper	06-16	Ji Hong KIM	Military Service : draft or recruit
Working Paper	06-17	Ji Hong KIM	Korea-US FTA
Working Paper	06-18	Ki-Eun RHEE	Reevaluating Merger Guidelines for the New Economy
Working Paper	06-19	Taejong KIM Ji-Hong KIM Insook LEE	Economic Assimilation of North Korean Refugees in South Korea: Survey Evidence
Working Paper	06-20	Seong Ho CHO	ON THE STOCK RETURN METHOD TO DETERMINING INDUSTRY SUBSTRUCTURE: AIRLINE, BANKING, AND OIL INDUSTRIES
Working Paper	06-21	Seong Ho CHO	DETECTING INDUSTRY SUBSTRUCTURE: - Case of Banking, Steel and Pharmaceutical Industries-
Working Paper	06-22	Tae Hee Choi	Ethical Commitment, Corporate Financial Factors: A Survey Study of Korean Companies
Working Paper	06-23	Tae Hee Choi	Aggregation, Uncertainty, and Discriminant Analysis
Working Paper	07-01	Jin PARK Seung-Ho JUNG	Ten Years of Economic Knowledge Cooperation with North Korea: Trends and Strategies
Working Paper	07-02	BERNARD S. BLACK WOOCHAN KIM	The Effect of Board Structure on Firm Value in an Emerging Market: IV, DiD, and Time Series Evidence from Korea
Working Paper	07-03	Jong Bum KIM	FTA Trade in Goods Agreements: 'Entrenching' the benefits of reciprocal tariff concessions
Working Paper	07-04	Ki-Eun Rhee	Price Effects of Entries
Working Paper	07-05	Tae H. Choi	Economic Crises and the Evolution of Business Ethics in Japan and Korea
Working Paper	07-06	Kwon JUNG Leslie TEY	Extending the Fit Hypothesis in Brand Extensions: Effects of Situational Involvement, Consumer Innovativeness and Extension Incongruity on Evaluation of Brand Extensions
Working Paper	07-07	Younguck KANG	Identifying the Potential Influences on Income Inequality Changes in Korea – Income Factor Source Analysis
Working Paper	07-08	WOOCHAN KIM TAEYOON SUNG SHANG-JIN WEI	Home-country Ownership Structure of Foreign Institutional Investors and Control-Ownership Disparity in Emerging Markets
Working Paper	07-09	Ilho YOO	The Marginal Effective Tax Rates in Korea for 45 Years : 1960-2004
Working Paper	07-10	Jin PARK	Crisis Management for Emergency in North Korea
Working Paper	07-11	Ji Hong KIM	Three Cases of Foreign Investment in Korean Banks
Working Paper	07-12	Jong Bum Kim	Territoriality Principle under Preferential Rules of Origin
Working Paper	07-13	Seong Ho CHO	THE EFFECT OF TARGET OWNERSHIP STRUCTURE ON THE TAKEOVER PREMIUM IN OWNER-MANAGER DOMINANT ACQUISITIONS: EVIDENCE FROM KOREAN CASES

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	07-14	Seong Ho CHO Bill McKelvey	Determining Industry Substructure: A Stock Return Approach
Working Paper	07-15	Dong-Young KIM	Enhancing BATNA Analysis in Korean Public Disputes
Working Paper	07-16	Dong-Young KIM	The Use of Integrated Assessment to Support Multi-Stakeholder negotiations for Complex Environmental Decision-Making
Working Paper	07-17	Yuri Mansury	Measuring the Impact of a Catastrophic Event: Integrating Geographic Information System with Social Accounting Matrix
Working Paper	07-18	Yuri Mansury	Promoting Inter-Regional Cooperation between Israel and Palestine: A Structural Path Analysis Approach
Working Paper	07-19	Ilho YOO	Public Finance in Korea since Economic Crisis
Working Paper	07-20	Li GAN Jaeun SHIN Qi LI	Initial Wage, Human Capital and Post Wage Differentials
Working Paper	07-21	Jin PARK	Public Entity Reform during the Roh Administration: Analysis through Best Practices
Working Paper	07-22	Tae Hee Choi	The Equity Premium Puzzle: An Empirical Investigation of Korean Stock Market
Working Paper	07-23	Joong H. HAN	The Dynamic Structure of CEO Compensation: An Empirical Study
Working Paper	07-24	Ki-Eun RHEE	Endogenous Switching Costs in the Face of Poaching
Working Paper	08-01	Sun LEE Kwon JUNG	Effects of Price Comparison Site on Price and Value Perceptions in Online Purchase
Working Paper	08-02	Ilho YOO	Is Korea Moving Toward the Welfare State?: An IECI Approach
Working Paper	08-03	Ilho YOO Inhyouk KOO	DO CHILDREN SUPPORT THEIR PARENTS' APPLICATION FOR THE REVERSE MORTGAGE?: A KOREAN CASE
Working Paper	08-04	Seong-Ho CHO	Raising Seoul’s Global Competitiveness: Developing Key Performance Indicators
Working Paper	08-05	Jin PARK	A Critical Review for Best Practices of Public Entities in Korea
Working Paper	08-06	Seong-Ho CHO	How to Value a Private Company? -Case of Miele Korea-
Working Paper	08-07	Yoon Ha Yoo	The East Asian Miracle: Export-led or Investment-led?
Working Paper	08-08	Man Cho	Subprime Mortgage Market: Rise, Fall, and Lessons for Korea
Working Paper	08-09	Woochang KIM Woojin KIM Kap-sok KWON	Value of shareholder activism: evidence from the switchers
Working Paper	08-10	Kun-Ho Lee	Risk Management in Korean Financial Institutions: Ten Years after the Financial Crisis
Working Paper	08-11	Jong Bum KIM	Korea’s Institutional Framework for FTA Negotiations and Administration: Tariffs and Rules of Origin
Working Paper	08-12	Yu Sang CHANG	Strategy, Structure, and Channel of Industrial Service Leaders: A Flow Chart Analysis of the Expanded Value Chain
Working Paper	08-13	Younguck KANG	Sensitivity Analysis of Equivalency Scale in Income Inequality Studies
Working Paper	08-14	Younguck KANG	Case Study: Adaptive Implementation of the Five-Year Economic Development Plans

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	08-15	Joong H. HAN	Is Lending by Banks and Non-banks Different? Evidence from Small Business Financing
Working Paper	08-16	Joong H. HAN	Checking Accounts and Bank Lending
Working Paper	08-17	Seongwuk MOON	How Does the Management of Research Impact the Disclosure of Knowledge? Evidence from Scientific Publications and Patenting Behavior
Working Paper	08-18	Jungho YOO	How Korea's Rapid Export Expansion Began in the 1960s: The Role of Foreign Exchange Rate
Working Paper	08-19	BERNARD S. BLACK WOOCHAN KIM HASUNG JANG KYUNG SUH PARK	How Corporate Governance Affects Firm Value: Evidence on Channels from Korea
Working Paper	08-20	Tae Hee CHOI	Meeting or Beating Analysts' Forecasts: Empirical Evidence of Firms' Characteristics, Persistence Patterns and Post-scandal Changes
Working Paper	08-21	Jaeun SHIN	Understanding the Role of Private Health Insurance in the Universal Coverage System: Macro and Micro Evidence
Working Paper	08-22	Jin PARK	Indonesian Bureaucracy Reform: Lessons from Korea
Working Paper	08-23	Joon-Kyung KIM	Recent Changes in Korean Households' Indebtedness and Debt Service Capacity
Working Paper	08-24	Yuri Mansury	What Do We Know about the Geographic Pattern of Growth across Cities and Regions in South Korea?
Working Paper	08-25	Yuri Mansury & Jae Kyun Shin	Why Do Megacities Coexist with Small Towns? Historical Dependence in the Evolution of Urban Systems
Working Paper	08-26	Jinsoo LEE	When Business Groups Employ Analysts: Are They Biased?
Working Paper	08-27	Cheol S. EUN Jinsoo LEE	Mean-Variance Convergence Around the World
Working Paper	08-28	Seongwuk MOON	How Does Job Design Affect Productivity and Earnings? Implications of the Organization of Production
Working Paper	08-29	Jaeun SHIN	Smoking, Time Preference and Educational Outcomes
Working Paper	08-30	Dong Young KIM	Reap the Benefits of the Latecomer: From the story of a political, cultural, and social movement of ADR in US
Working Paper	08-31	Ji Hong KIM	Economic Crisis Management in Korea: 1998 & 2008
Working Paper	08-32	Dong-Young KIM	Civility or Creativity?: Application of Dispute Systems Design (DSD) to Korean Public Controversies on Waste Incinerators
Working Paper	08-33	Ki-Eun RHEE	Welfare Effects of Behavior-Based Price Discrimination
Working Paper	08-34	Ji Hong KIM	State Owned Enterprise Reform
Working Paper	09-01	Yu Sang CHANG	Making Strategic Short-term Cost Estimation by Annualized Experience Curve
Working Paper	09-02	Dong Young KIM	When Conflict Management is Institutionalized: A Review of the Executive Order 19886 and government practice
Working Paper	09-03	Man Cho	Managing Mortgage Credit Risk: What went wrong with the subprime and Alt-A markets?
Working Paper	09-04	Tae H. Choi	Business Ethics, Cost of Capital, and Valuation

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>. You may get additional copy of the documents by downloading it using the Acrobat Reader.**

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	09-05	Woochan KIM Woojin KIM Hyung-Seok KIM	What makes firms issue death spirals? A control enhancing story
Working Paper	09-06	Yu Sang CHANG Seung Jin BAEK	Limit to Improvement: Myth or Reality? Empirical Analysis of Historical Improvement on Three Technologies Influential in the Evolution of Civilization
Working Paper	09-07	Ji Hong KIM	G20: Global Imbalance and Financial Crisis
Working Paper	09-08	Ji Hong KIM	National Competitiveness in the Globalized Era
Working Paper	09-09	Hao Jiang , Woochan Kim , Ramesh K. S. Rao	Contract Heterogeneity, Operating Shortfalls, and Corporate Cash Holdings
Working Paper	09-10	Man CHO	Home Price Cycles: A Tale of Two Countries
Working Paper	09-11	Dongcul CHO	The Republic of Korea's Economy in the Swirl of Global Crisis
Working Paper	09-12	Dongcul CHO	House Prices in ASEAN+3: Recent Trends and Inter-Dependence
Working Paper	09-13	Seung-Joo LEE Eun-Hyung LEE	Case Study of POSCO - Analysis of its Growth Strategy and Key Success Factors
Working Paper	09-14	Woochan KIM Taeyoon SUNG Shang-Jin WEI	The Value of Foreign Blockholder Activism: Which Home Country Governance Characteristics Matter?
Working Paper	09-15	Joon-Kyung KIM	Post-Crisis Corporate Reform and Internal Capital Markets in Chaebols
Working Paper	09-16	Jin PARK	Lessons from SOE Management and Privatization in Korea
Working Paper	09-17	Tae Hee CHOI	Implied Cost of Equity Capital, Firm Valuation, and Firm Characteristics
Working Paper	09-18	Kwon JUNG	Are Entrepreneurs and Managers Different? Values and Ethical Perceptions of Entrepreneurs and Managers
Working Paper	09-19	Seongwuk MOON	When Does a Firm Seek External Knowledge? Limitations of External Knowledge
Working Paper	09-20	Seongwuk MOON	Earnings Inequality within a Firm: Evidence from a Korean Insurance Company
Working Paper	09-21	Jaeun SHIN	Health Care Reforms in South Korea: What Consequences in Financing?
Working Paper	09-22	Younguck KANG	Demand Analysis of Public Education: A Quest for New Public Education System for Next Generation
Working Paper	09-23	Seong-Ho CHO Jinsoo LEE	Valuation and Underpricing of IPOs in Korea
Working Paper	09-24	Seong-Ho CHO	Kumho Asiana's LBO Takeover on Korea Express
Working Paper	10-01	Yun-Yeong KIM Jinsoo LEE	Identification of Momentum and Disposition Effects Through Asset Return Volatility
Working Paper	10-02	Kwon JUNG	Four Faces of Silver Consumers: A Typology, Their Aspirations, and Life Satisfaction of Older Korean Consumers
Working Paper	10-03	Jinsoo LEE Seongwuk MOON	Corporate Governance and International Portfolio Investment in Equities
Working Paper	10-04	Jinsoo LEE	Global Convergence in Tobin's Q Ratios
Working Paper	10-05	Seongwuk MOON	Competition, Capability Buildup and Innovation: The Role of Exogenous Intra-firm Revenue Sharing

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	10-06	Kwon JUNG	Credit Card Usage Behaviors among Elderly Korean Consumers
Working Paper	10-07	Yu-Sang CHANG Jinsoo LEE	Forecasting Road Fatalities by the Use of Kinked Experience Curve
Working Paper	10-08	Man CHO	Securitization and Asset Price Cycle: Causality and Post-Crisis Policy Reform
Working Paper	10-09	Man CHO Insik MIN	Asset Market Correlation and Stress Testing: Cases for Housing and Stock Markets
Working Paper	10-10	Yu-Sang CHANG Jinsoo LEE	Is Forecasting Future Suicide Rates Possible? - Application of the Experience Curve -
Working Paper	10-11	Seongwuk MOON	What Determines the Openness of Korean Manufacturing Firms to External Knowledge?
Working Paper	10-12	Joong Ho HAN Kwangwoo PARK George PENNACCHI	Corporate Taxes and Securitization
Working Paper	10-13	Younguck KANG	Housing Policy of Korea: Old Paradigm, New Approach
Working Paper	10-14	Il Chong NAM	A Proposal to Reform the Korean CBP Market
Working Paper	10-15	Younguck KANG	Balanced Regional Growth Strategy based on the Economies of Agglomeration: the Other Side of Story
Working Paper	10-16	Joong Ho HAN	CEO Equity versus Inside Debt Holdings and Private Debt Contracting
Working Paper	11-01	Yeon-Koo CHE Rajiv SETHI	Economic Consequences of Speculative Side Bets: The Case of Naked Credit Default Swaps
Working Paper	11-02	Tae Hee CHOI Martina SIPKOVA	Business Ethics in the Czech Republic
Working Paper	11-03	Sunwoo HWANG Woochan KIM	Anti-Takeover Charter Amendments and Managerial Entrenchment: Evidence from Korea
Working Paper	11-04	Yu Sang CHANG Jinsoo LEE Yun Seok JUNG	The Speed and Impact of a New Technology Diffusion in Organ Transplantation: A Case Study Approach
Working Paper	11-05	Jin PARK Jiwon LEE	The Direction of Inter-Korean Cooperation Fund Based on ODA Standard
Working Paper	11-06	Woochan KIM	Korea Investment Corporation: Its Origin and Evolution
Working Paper	11-07	Seung-Joo LEE	Dynamic Capabilities at Samsung Electronics: Analysis of its Growth Strategy in Semiconductors
Working Paper	11-08	Joong Ho HAN	Deposit Insurance and Industrial Volatility
Working Paper	11-09	Dong-Young KIM	Transformation from Conflict to Collaboration through Multistakeholder Process: Shihwa Sustainable Development Committee in Korea
Working Paper	11-10	Seongwuk MOON	How will Openness to External Knowledge Impact Service Innovation? Evidence from Korean Service Sector
Working Paper	11-11	Jin PARK	Korea's Technical Assistance for Better Governance: A Case Study in Indonesia
Working Paper	12-01	Seongwuk MOON	How Did Korea Catch Up with Developed Countries in DRAM Industry? The Role of Public Sector in Demand Creation: PART 1
Working Paper	12-02	Yong S. Lee Young U. Kang Hun J Park	The Workplace Ethics of Public Servants in Developing Countries
Working Paper	12-03	Ji-Hong KIM	Deposit Insurance System in Korea and Reform

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>.**
You may get additional copy of the documents by downloading it using the Acrobat Reader.

Working Paper Series

Category	*Serial #*	*Author*	*Title*
Working Paper	12-04	Yu Sang Chang Jinsoo Lee Yun Seok Jung	Technology Improvement Rates of Knowledge Industries following Moore's Law? -An Empirical Study of Microprocessor, Mobile Cellular, and Genome Sequencing Technologies-
Working Paper	12-05	Man Cho	Contagious Real Estate Cycles: Causes, Consequences, and Policy Implications
Working Paper	12-06	Younguck KANG Dhani Setvawan	INTERGOVERNMENTAL TRANSFER AND THE FLYPAPER EFFECT – Evidence from Municipalities/Regencies in Indonesia –
Working Paper	12-07	Younguck KANG	Civil Petitions and Appeals in Korea : Investigating Rhetoric and Institutional settings
Working Paper	12-08	Yu Sang Chang Jinsoo Lee	Alternative Projection of the World Energy Consumption -in Comparison with the 2010 International Energy Outlook
Working Paper	12-09	Hyeok Jeong	The Price of Experience
Working Paper	12-10	Hyeok Jeong	Complementarity and Transition to Modern Economic Growth
Working Paper	13-01	Yu Sang CHANG Jinsoo LEE Hyuk Ju KWON	When Will the Millennium Development Goal on Infant Mortality Rate Be Realized? - Projections for 21 OECD Countries through 2050-
Working Paper	13-02	Yoon-Ha Yoo	Stronger Property Rights Enforcement Does Not Hurt Social Welfare -A Comment on Gonzalez' "Effective Property Rights, Conflict and Growth (JET, 2007)"-
Working Paper	13-03	Yu Sang CHANG Changyong CHOI	Will the Stop TB Partnership Targets on TB Control be Realized on Schedule? - Projection of Future Incidence, Prevalence and Death Rates -
Working Paper	13-04	Yu Sang CHANG Changyong CHOI	Can We Predict Long-Term Future Crime Rates? – Projection of Crime Rates through 2030 for Individual States in the U.S. –
Working Paper	13-05	Chrysostomos Tabakis	Free-Trade Areas and Special Protection
Working Paper	13-06	Hyeok Jeong	Dynamics of Firms and Trade in General Equilibrium
Working Paper	13-07	Hyeok Jeong	Testing Solow's Implications on the Effective Development Policy
Working Paper	13-08	Jaeun SHIN	Long-Term Care Insurance and Health Care Financing in South Korea
Working Paper	13-09	Ilchong Nam	Investment Incentives for Nuclear Generators and Competition in the Electricity Market of Korea
Working Paper	13-10	Ilchong Nam	Market Structure of the Nuclear Power Industry in Korea and Incentives of Major Firms

*** The above papers are available at KDI School Website <http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>. You may get additional copy of the documents by downloading it using the Acrobat Reader.**