

KDI *Journal of Economic Policy*

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The KDI Journal of Economic Policy (KDI JEP) is a professional journal published on a quarterly basis. The Journal publishes papers on the academic and policy issues related to the development of Korea's economy. The KDI Journal of Economic Policy welcomes innovative and insightful academic papers on all areas of economics with an emphasis on empirical analysis that contain solid policy implications. KDI JEP is published in English starting in 2015, volume 37 number 1.

The Journal aims to disseminate research outcomes and policy recommendations not only to experts at academia and research institutes but also to policy-makers and the general public. First published in March 1979, the original objective was to circulate ongoing- and past researches conducted in KDI, a leading economic think-tank of South Korea. Starting in August, 2001, the Journal has accepted manuscripts from outside in order to provide the readers more diverse perspectives on Korea's policy initiatives. The Journal now actively seeks and welcomes submissions by researchers at home and from abroad who have genuine interests in the Korean economy.

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Knowledge, Knowledge... Knowledge for My Economy[†]

By RICHARD B. FREEMAN^{*}

The creation of S&T knowledge and development of S&T- based innovation has spread worldwide from traditionally advanced countries to traditionally developing countries, often under the direction of governments. Korea is an exemplar in this new locus. Korea's burst in Science and Technology during the last three decades has made Korea a substantive player in the global production of S&T knowledge and its application to business. Although Korea still trails the US and other top countries in the quality of research, it has leaped from its 1980s standing as bit player in the knowledge economy to being among the leaders in the early 21st Century. This paper shows that Korea's advance benefited from its active participation in the global market in higher education, in international research collaborations, and its close ties to the U.S. Korea's experience offers lessons for other countries who seek to advance by becoming knowledge economies. Korea proves that a developing country can gain comparative advantage in knowledge production and use; that government policy can stimulate such a development; and that openness to the world of higher education and research is the best way to move forward and overcome the middle income trap.

Key Word: Korea, Science and Technology, Education, R&D,
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The creation and application of scientific and technological (S&T) knowledge is arguably the “one ring that rules them all” in modern economies (Freeman 2014). It is hard to imagine anything contributing more to the trend rise in living standards and longer and healthier lives than advances in S&T knowledge and its application to the production of goods and services. Once viewed as the exclusive province of advanced countries, the creation of S&T knowledge and the development of S&T-based business innovations have spread to developing countries, often under the direction of governments who view S&T as the road to economic growth and prosperity.

Korea is an exemplar of the new locus of knowledge creation and government efforts to accelerate the growth of the knowledge economy. In the 1950s, Korea was one of the world’s most impoverished countries. It had few scientists and engineers and virtually no presence in science or in the high value added industries that are the core of modern economies. Recovering from the Korean War, the government set up agencies to spur science and technology – the Korea Institute of Science and Technology (set up in 1966), the Ministry of Science and Technology (1967), and the Korea Advanced Institute of Science and Technology (1971). But R&D spending, research personnel, and contributions to knowledge through scientific papers remained negligible until the 1980s, when Korean investments in higher education and knowledge creation increased rapidly and began to pay off in terms of sizable supplies of scientists and engineers and research outcomes. From the 1980s through the 2010s, enrollments in university education grew in Korea to such an extent that the country became a world leader in the share of young persons with bachelor’s, master’s, and Ph.D. degrees. The government established research institutes to undertake basic and applied research in diverse areas, including a center on Kimchi, and experimented with new policies and laws to move research findings from labs to commercial innovations. By the mid-2010s, Korea had the highest R&D-to-GDP ratio in the world, was a major producer of scientific papers and patents relative to its population, and was an exporter of high-tech manufacturing goods. Korean firms such as Samsung were among the top business innovators in the global economy.

How did Korea become a knowledge economy? How important were international collaborations, particularly with the U.S., in Korea’s spurt in the areas of science and technology? What are the implications of Korea’s success for other countries and our understanding of modern economic growth?

I examine these questions in three parts. Section one documents the advance of Korea in science and technology. Section two shows that Korea’s advance in education and research benefited from globalization, as many Korean students obtained higher education overseas and as many Korean scientists engaged in international research collaborations, particularly with the U.S. Section three concludes with potential lessons from Korea’s success in seeking “knowledge, knowledge ... knowledge for (its) economy.”

I. Korea’s Burst in Science and Technology

Table 1 shows where Korea stood in measures of science and technology capability and production circa 2010. The measures cover science and engineering

TABLE 1— KOREA IN LEVELS, RANK IN WORLD AND TRENDS IN S&E RESOURCES AND INNOVATION, CIRCA 2010

	Level, circa 2010	Rank in World	Trend
Science/engineering Degrees	4 165 PhDs (2010)	12th	Doubled since 1996
R&D spending	65.4 billion US \$	5th	Threefold increase in real PPP \$ from 2000 to 2012
Papers	25 593 (2011)	9th	8.8 percent growth a year, second fastest to China among producers of many papers
Patents (USPTO)	13 210 (2012)	3rd	7-fold increase from 1997 to 2012
Innovation (Bloomberg 2014)	92.1 out of 100	1	--
Innovation (Global Innovation Report 2014)	55.3 out of 100	16	Up from 19 in 2007-08 but down from 6 in 2008-09
Innovation (Global Competitiveness Report 2014) Pillar 12 innovation	4.8 out of 7	17	Down from 14 in 2006-07

Source: OECD Main science and technology indicators.

http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB#

National Science Board, Science and Engineering Indicators, 2014.

<http://www.nsf.gov/statistics/seind14/content/chapter-6/at06-40.pdf>

<http://www.bloomberg.com/visual-data/best-and-worst/> Most innovative in the World 2014: countries

<http://www.globalinnovationindex.org/content.aspx?page=past-reports>

<http://www.weforum.org/reports/global-competitiveness-report-2014-2015>

Global competitiveness Index, 2007-2008, Ranks.

inputs (S&E graduates/researchers and R&D spending), outputs (papers and patents), and aggregate innovation indexes. The statistics document Korea's remarkable position as a substantive player in the global production of S&T knowledge at the outset of the 21st century, notwithstanding its modestly sized population of 50 million and standing in the middle of OECD countries in terms of total GDP.¹ Measuring Korea's commitment to national innovation primarily by the proportion of GDP spent on R&D and the proportion of workers in scientific and engineering activities, Bloomberg rated Korea as the number one innovative economy in 2014.² Looking at a broader set of indicators, including measures of the effectiveness of inputs in transforming the economy, the 2014 Global Innovation Report placed Korea as the 16th most innovative country in the world, while the Global Competitiveness Report put Korea at 17 in its innovation module.³

The principal statistic behind the Bloomberg assessment is the ratio of R&D spending to GDP. Figure 1 shows that the RD/GDP increased in Korea in the 1980s

¹In 2012, Korea was 40th in the world by GDP per capita based on PPP GDP. Korea was at \$32,400, just below the EU at \$34,500 and Japan at \$36,200. The US is 12th on the list at \$49,800. At the top of the GDP per-capita rankings were small oil states and the like. See http://www.photius.com/rankings/economy/gdp_per_capita_2013_0.html

²http://images.businessweek.com/bloomberg/pdfs/most_innovative_countries_2014_011714.pdf This is based on Korea's standing in seven indicators: 1. R&D intensity (20% of score); 2. Productivity (20%); 3. High-tech density (20%); Research concentration (20%) – Professionals, including Ph.D. students, engaged in R&D per 1 million people; 5. Manufacturing capability (10%); 6. Tertiary efficiency (5%); 7. Patent Activity (5%).

³See <https://www.globalinnovationindex.org/content.aspx?page=gii-full-report-2014>; and http://www3.weforum.org/docs/WEF_Global_Competitiveness_Report_2014-15.pdf

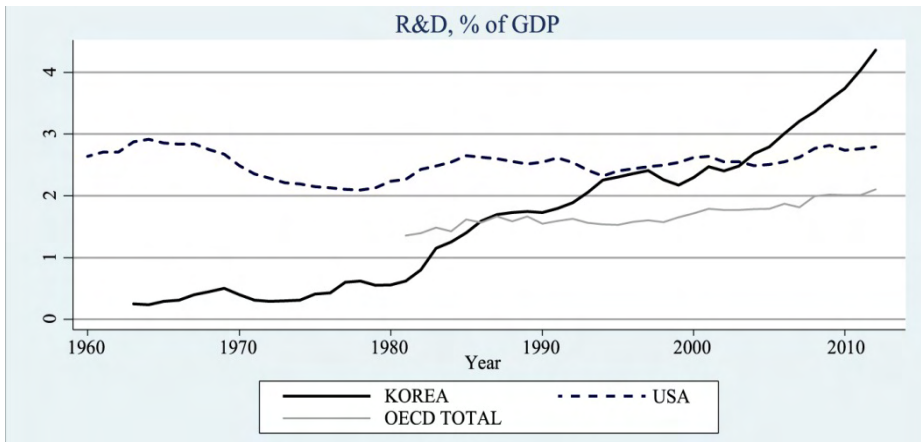


FIGURE 1. KOREA TAKE-OFF AND GROWTH SPURT IN R&D/GDP, 1963-2012

Source: OECD Main Science and Technology Indicators.

through the 2010s from far below the OECD average to far above that average. In the 1960s and 1970s, the Korean R&D/GDP was barely one-third the OECD average – 0.3% to 0.4%. Korea's investment in R&D in the ensuing decades raised the ratio to 4.36% in 2012.⁴ This put Korea at the top of the OECD, at nearly twice the average R&D/GDP ratio. Other measures of resources going to science and technology show similar increases.⁵

The contribution of a country to global knowledge production depends not on its share of GDP spent on R&D (or related science and technology activities) but on the absolute level of resources – the multiplicand of the R&D proportion of output and the total output, and the effectiveness with which the country uses its R&D to create new knowledge and/or apply research findings to the economy.

Because total resources matter in knowledge creation and application, highly populous countries such as China or India or high per capita GDP countries such as the U.S. can dominate the frontier of knowledge creation or its use while spending smaller shares of GDP on research and development than countries the size of Korea. Smaller/medium-sized countries have to find niches in which to concentrate their R&D investments (as Finland did with Nokia) or have to find ways to leverage global R&D and turn research discoveries worldwide into innovative products or processes produced at home.

To assay the connection between national resources and S&T outcomes among countries, I created a pooled time-series cross-section dataset of country observations on papers and patents, GDP, population, and R&D spending for 37 countries (the 34 OECD countries plus China, Russia, and Singapore) for the years 1981-2011. The data appendix reports the sources of the data, which are downloadable at NBER.

⁴See Lee (2010) Figure 8, p.55.

⁵Ang and Madsen (2009) document the role of R&D in the growth in the "Asian miracle economies," of which Korea is a prime exemplar, arguing that this fits a Schumpeterian model better than an endogenous growth model.

As a first step for assessing the relationship between the two S&T outcomes and GDP per capita and population, I estimated the following regression in log-log form:

$$\log \text{ of papers or patents} = a + b \log \text{ of GDP per capita} + c \log \text{ of Population} + \\ \text{Year Dummy variables} + \text{Country dummy variables.}$$

GDP per capita and Population measure a country's economic and demographic resources. If the regression of papers/patents yields coefficients on GDP per capita and Population that are roughly comparable, the regression indicates that total GDP is the primary determinant of the outcomes irrespective of whether it is generated by a high GDP per capita or by the size of the population.

Panel A of Table 2 reports the results for papers. Column (1) presents estimates of equation (1) with year dummy variables but without country dummy variables as independent explanatory variables. This means that the coefficients reflect the average cross-section cross-country relationship for the years covered. The estimated coefficients of the log of GDP per capita and the log of Population are sufficiently similar to indicate that total GDP is the predominant determinant of cross-country differences in the numbers of papers. Column (2) gives the results after adding country dummies to the regressions. With country and year held fixed the coefficients measure the average effect of changes in resources within countries on changes in papers and patents. The estimated effects of GDP on papers are larger than in the regressions that include country fixed effects, while the estimated effects of Population are larger but with such a high standard deviation that it is not significantly different from zero. Year-to-year country changes in population are modest, without enough variation to pin down a population effect.

The regressions in columns (3) and (4) of Panel A add the ratio of R&D expenditures to GDP to the regressions of column (1) and (2) as a rough measure of the extent to which a country tilts its resource allocation toward science and technology. The ratio R&D to GDP enters the equation with a large significant coefficient that makes it a major factor in the number of articles. Absent measures of specific country policies toward R&D (such as direct government R&D spending or tax deductions for private spending) or of the factors that cause R&D to vary, the regressions cannot identify the causal impact of R&D policy. These results highlight the importance of R&D as a channel for producing papers.

Panels B and C present similar regressions for patents, and obtain roughly similar results though with greater variation in the estimated coefficients of Population across the regressions. The dependent variable in Panel B is the log of patents reported under the Patent Cooperation Treaty (PCT), which allows applicants to seek protection for an invention in 148 countries simultaneously.⁶ The dependent variable in Panel C is the number of "triadic patent families" – patents filed in the United States Patent Office (USPTO), in the European Patent Office, and in the Japanese patent office (Dernis and Khan 2004). Patents filed in all three locales are potentially more valuable than patents filed in a single location, so the Panel C regressions provide a quality of patent check on the panel B regressions.

⁶<http://www.wipo.int/pct/en/faqs/faqs.html>

TABLE 2—REGRESSION ESTIMATES OF THE EFFECT OF R&D/GDP, GDP/CAPITA,
AND POPULATION ON S&E ARTICLES AND PATENTS,
POOLED CROSS-SECTION TIME SERIES OF 37 COUNTRIES, 1981~2011

A. Dependent Variable: Ln (Articles)

	(1)	(2)	(3)	(4)
Ln (GDP per capita, in 2005 \$)	1.079*** (0.105)	1.489*** (0.375)	0.772*** (0.162)	1.453*** (0.509)
Ln (Population)	1.030*** (0.096)	1.537 (0.969)	0.935*** (0.056)	0.792 (0.964)
Ln (R&D, % of GDP)			0.556*** (0.171)	0.632*** (0.189)
Constant	-19.705*** (1.812)	-31.583* (15.601)	-14.898*** (2.099)	-18.775 (18.007)
Year FE	Y	Y	Y	Y
Country FE	N	Y	N	Y
Observations	1 067	1 067	947	947
R-squared	0.819	0.971	0.887	0.975

B. Dependent Variable: Ln (Number of Patent Cooperation Treaty Patents)

	(1)	(2)	(3)	(4)
Ln (GDP per capita, in 2005 \$)	1.969*** (0.210)	2.227*** (0.337)	1.016*** (0.123)	1.888*** (0.437)
Ln (Population)	1.090*** (0.081)	4.857*** (1.495)	0.914*** (0.062)	3.060 (2.490)
Ln (R&D, % if GDP)			1.676*** (0.175)	0.840** (0.329)
Constant	-34.153*** (2.419)	-98.781*** (24.984)	-22.095*** (1.917)	-65.603 (41.908)
Year FE	Y	Y	Y	Y
Country FE	N	Y	N	Y
Observations	1 029	1 029	930	930
R-squared	0.776	0.936	0.888	0.939

C. Ln (Number of Triadic Patents), 1985~2011

	(1)	(2)	(3)	(4)
Ln (GDP per capita, in 2005 \$)	2.456*** (0.252)	2.141*** (0.499)	1.469*** (0.127)	2.155*** (0.730)
Ln (Population)	1.244*** (0.089)	2.946*** (0.646)	1.079*** (0.060)	1.491 (0.917)
Ln (R&D, % if GDP)			1.895*** (0.134)	0.853*** (0.210)
Constant	-40.301*** (3.017)	-65.796*** (11.460)	-28.183*** (2.008)	-41.840** (19.444)
Year FE	Y	Y	Y	Y
Country FE	N	Y	N	Y
Observations	935	935	847	847
R-squared	0.779	0.963	0.930	0.971

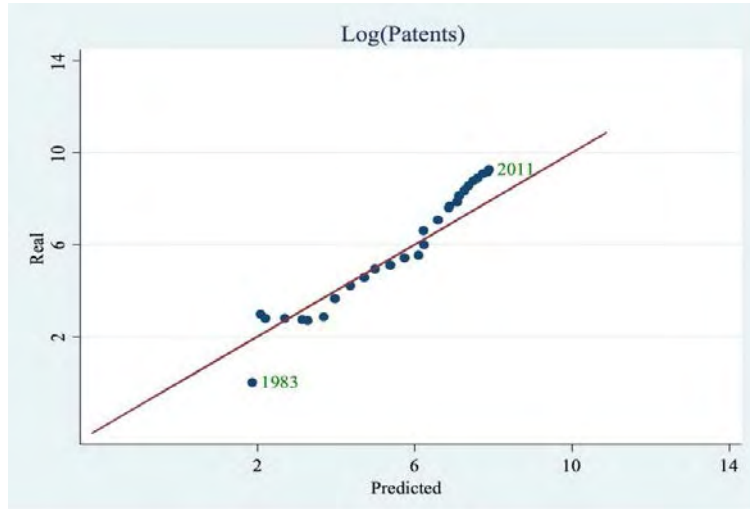
Note: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Source: See Appendix.

Both panels show that GDP and R&D/GDP are the main determinants of patents while the estimated effects of population per se vary depending on the precise specification.

Finally, Figure 2 contrasts the log of papers and PCT patents for Korea in a given year to the predicted level from the cross-sectional regression on GDP per

Panel A



Panel B

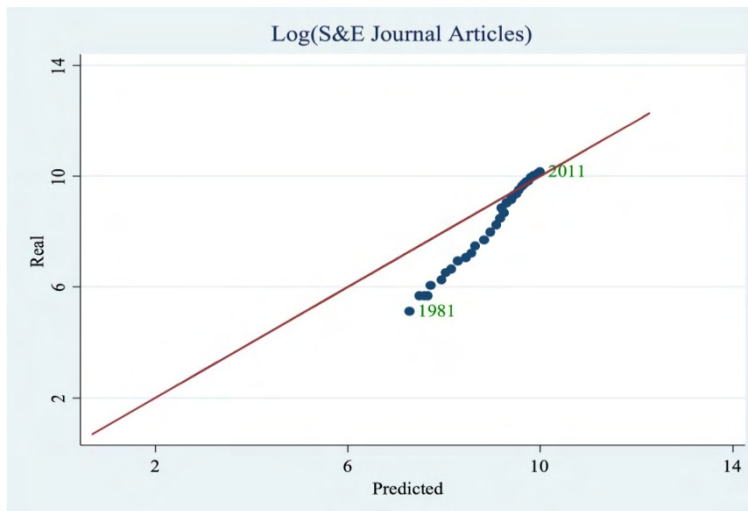


FIGURE 2. PREDICTED AND ACTUAL KOREAN PAPERS AND PATENTS
 (45 DEGREE LINE: ACTUAL = PREDICTED)
 WHERE PREDICTED IS BASED ON REGRESSIONS OF PAPERS OR
 PATENTS ON GDP PER CAPITA AND POPULATION

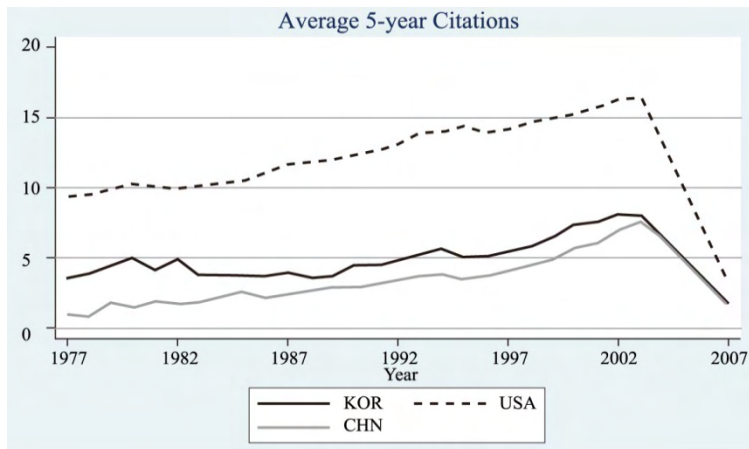
capita and population. Points on the 45-degree line in the figure indicate that a country's papers or patents are as predicted by the model. Points below the line show that the country was not keeping pace with other countries, while points above the line imply that the country produced more papers/patents than indicated by the overall country pattern. In terms of papers, Korea was considerably below the 45-degree line in 1981 but increased publications to roughly reach its expected level by 2009. In patents, Korea hugs the 45-degree line until the 2000s, when it increases its position above that expected from the cross-sectional pattern.

Quality of Papers and Patents

Both papers and patents have important quality dimensions. A paper can be widely cited because it provides valuable information or breakthrough ideas or it may be neglected by the scientific community, perhaps getting no citations at all during some specified time period. Similarly, a patent may have great technological or economic value that leads to a commercial product, or it may be an invention of little relevance.

Measuring paper quality by citations, Figure 3 shows that papers with Korean addresses average about half the number of citations as papers with U.S. addresses and only modestly more than papers with Chinese addresses. Because there is a

Panel A



Panel B

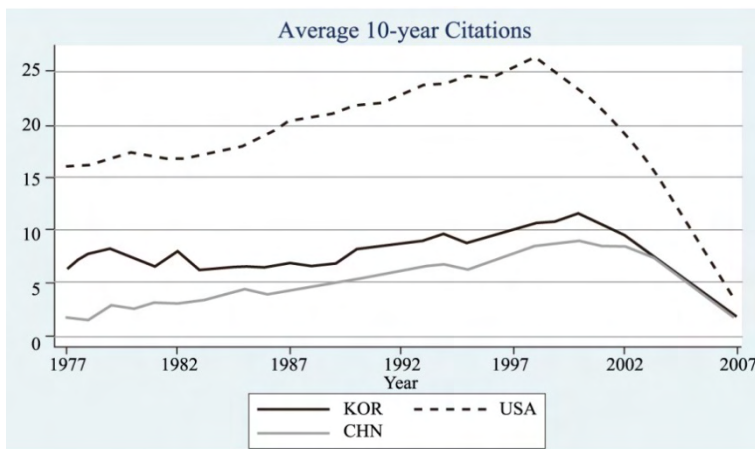


FIGURE 3. AVERAGE FIVE- AND TEN-YEAR CITATIONS OF KOREAN PAPERS, COMPARED TO US AND CHINA, 1977-2007

Source: SCI database.

tendency for persons from a given country to cite papers written in their country (National Science Board, Science and Engineering Indicators 2014, Table 5-26), the high number of citations of U.S. papers is due in part to the U.S. being the top producer of papers. But the difference in the average number of citations almost certainly reflects the intrinsic quality of the work as well.⁷ The U.S. advantage in papers is among the most highly cited papers, where citations come from a wide variety of scientists outside the authors' networks. At the other extreme, the authors of the 20% to 30% of papers that remain uncited must have some network connections with other scientists, who evidently do not view those papers as relevant or useful in their work.

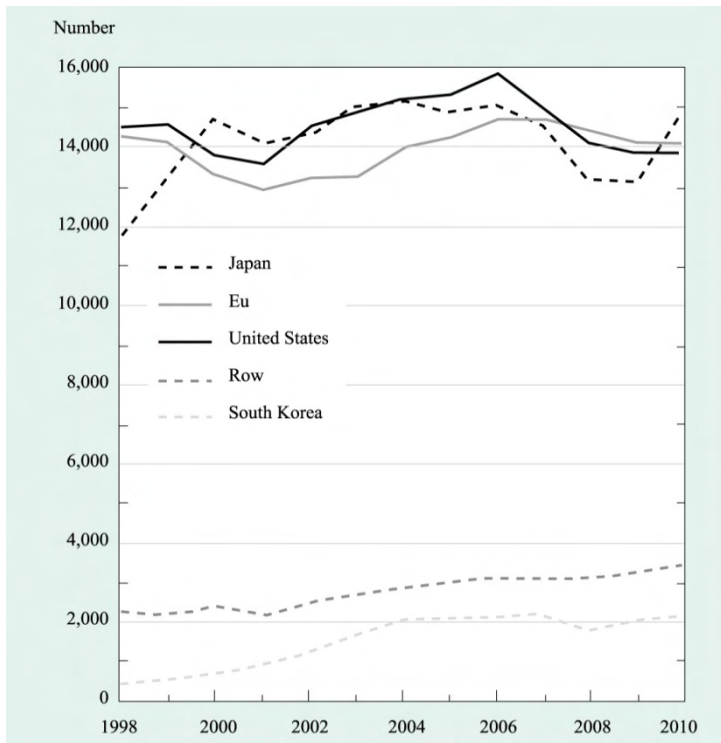


FIGURE 4. KOREA'S INCREASE IN NUMBERS OF TRIADIC PATENTS

notes: EU=European Union, ROW=Rest of World. Triadic patent families include patents applied in the U.S. Patent and Trademark Office, European Patent Office, and Japan Patent Office. Patent families are fractionally allocated among regions/countries/economies based on the proportion of the residences of all named inventors.

source: Organisation for Economic Co-operation and Development, Patents Statistics, <http://stats.oecd.org/WBOS/index.aspx>, Patents by Region database, (accessed 15 January 2011). Cited from Science and Engineering Indicators-overview, 2014, Figure O.16. Global Triadic Patent Families, by Selected Region/Country/Economy: 1998-2010.

⁷ Absent a measure of the "intrinsic science quality" of a paper, it is difficult to differentiate the effects of the tendency of scientists in a country to cite own-country research from the actual contribution of the paper. Just as Merton (1968) noted with his "Matthew Effect" that citations for similar work often go to the more famous scientist, the same may be true for scientists from countries with different numbers of scientists.

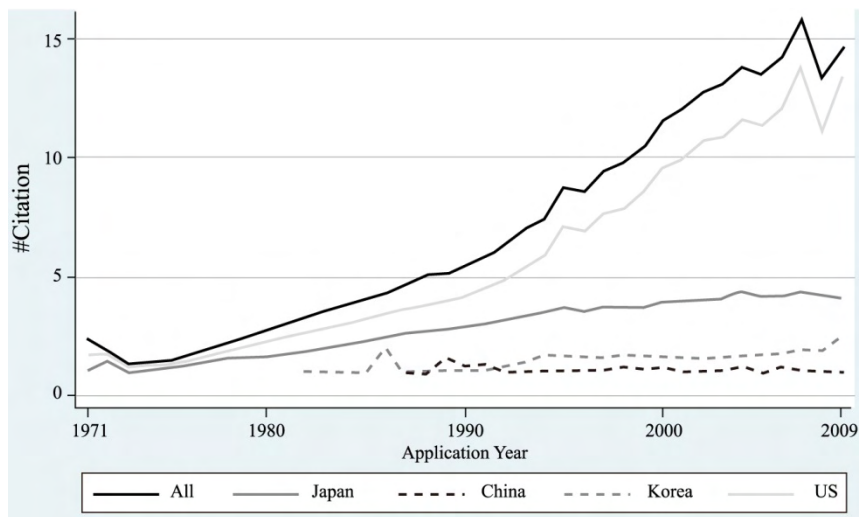


FIGURE 5. AVERAGE CITATIONS IN UPSTO TO PATENTS BY COUNTRY

Source: Kaoru Nabeshima and Kiyoyasu Tanaka (2011), Figure.5.

Indicators of the quality of patents tell a similar but more nuanced story about the potential quality of Korean patents. As noted, one indicator of patent quality is the extent to which a firm patents the same invention in different countries. Figure 4 shows that while the U.S., EU, and Japan dominate the number of triadic patent families, Korea increased its number of triadic patents nearly fourfold from 1999 to 2010. This made Korea the fifth largest country source of triadic patents, falling just short of France.

Another widely used indicator of the potential value of a patent is the extent to which other patents cite that patent.⁸ Figure 5, taken from Nabeshima and Tanaka (2011), shows that the average number of citations of Korean patents, though trending upward, falls short of the average number of citations to all patents and US and Japanese USPTO patents. Korean patents had only modestly higher numbers of citations than Chinese patents.

In short, Korea advanced in the latter part of the 20th century and in the first decade of the 21st century to become a leading country in science and engineering education and research, but the country still had some ways to go to reach the quality of research in the US and other top research countries.

II. Globalization's Contribution to Korea's Advance

The global division of the production of goods and services depends on the comparative advantage of countries in different domains. In Ricardo's famous example, Portugal had a comparative advantage in producing wine and in making

⁸Given that USPTO patent examiners enter many patent citations (Alcácer, Gittelman, and Sampat 2009) and that citations are entered largely for legal reasons, patent citations are only a crude measure of the value of a patent.

clothing over England but had a greater advantage in wine and thus produced it and imported clothing from England. Underlying comparative advantages are differences in resources and knowledge of modes of production. In the “North-South” trade model, the greater educational attainment of workers and R&D in the advanced North gives it comparative advantage in the area of high-value-added products and processes compared to the less advanced South, which allows the North to pay higher wages to its workers.⁹ This model posits that the North’s comparative advantage in human capital and in the production of knowledge was relatively permanent, generating long-term differences in income per head.

Korea’s huge investments in education and science from the 1980s to the present altered its factor endowments from the low education/ knowledge South type to the high education/knowledge North type and transformed its comparative advantage from low-value-added goods and services to high-tech knowledge-based industries. Table 3 documents Korea’s extensive reliance on the growing globalization of higher education to upgrade the university training and doctorate-level research skills of its citizens.¹⁰

Line 1 shows that Korea sent many of its best and brightest students overseas such that in 2012, Korea, with 50 million people, was the third largest source of international students worldwide, trailing only China and India, with their approximately 1.2 billion people each (see Table 3, line 1). The 2012 ratio of international students to population for Korea was .0025, i.e., 400 times the international student/population ratio of .00006 for China and 1,250 times the .00002 ratio for India.

TABLE 3—KOREA’S POSITION AMONG INTERNATIONAL STUDENTS COMPARED TO CHINA AND INDIA IN THE EARLY 2010s

	Korea	China	India
Numbers 2012			
1. Int’l Students	123 700	694 400	189 500
2. Going to US	70 000	210 452	97 120
3. % going to US	56.5%	30.3%	51.3%
4 % increase to US, 2006-2013	19.7%	276.5%	26.5%
Composition of US Int’l 2013			
5 % Undergraduate	54.0%	40.0%	13.0%
6 % Graduate	28.0%	44.0%	56.0%
7 % Other	18.0%	16.0%	30.0%
S&E Composition of Enrollments			
8 S&E % of Undergraduates	27.9%	34.5%	52.5%
9 S&E % of Graduate students	36.8%	61.0%	76.8%

Source: 1. Lines 1-3 <http://www.uis.unesco.org/Education/Pages/international-student-flow-viz.aspx> Other major destinations: China, 97,000 to Japan, 87,000 to Australia; India, 29,000 to UK; 12,000 to Australia; Korea, 24,000 to Japan, 8,000 to Australia; 2. Lines 4- 7, <http://www.iie.org/Research-and-Publications/Open-Doors/Data/Fact-Sheets-by-Country/2013/>; 3. Lines 8-9, National Science Board, Science and Engineering Indicators 2014, Appendix Tables 2-19, 2-28.

⁹See Krugman (1979) for a clear presentation of the model. Gomory and Baumol (2001) argue that loss of a comparative advantage in particular high-value or high-tech industries can reduce the well-being of the country in question. Ruffin and Jones (2007) offer additional insights and a more sanguine view.

¹⁰The number of international student increased nearly eightfold from 600,000 (1975) to 4,500,000 (2012) and more than doubled in the 2000s (OECD 2014, p.344), which exceeded the rapid growth of enrolments in institutions of higher education worldwide.

Line 2 shows that a disproportionate number of Korean (and Chinese and Indian) international students studied in the U.S. Line 3 shows that the likelihood that Korean international students enrolling in the U.S. exceeded the likelihood of Chinese and Indian international students doing so. Line 4, based on slightly different data, shows, however, that with its huge population, China increased the number of international students coming to the U.S. in the 2000s more rapidly than Korea.

Lines 5-7 record the composition of US international students, i.e. undergraduate students, graduate students, and “others” (students who come for short courses or as visitors to gain credit for degrees in their home countries) for Korea, China, and India. Korea had the highest share of undergraduates among international students coming to the U.S. This reflects the desire of many highly educated and wealthy Koreans for their children to obtain a U.S. education, often beginning with high school, to avoid the highly competitive Korean exam system.

Finally, lines 8-9 show that the share of Korean international students seeking science and engineering degrees is the lowest among the three countries at both undergraduate and graduate levels. This is possibly due to the much larger proportion of those who are international students in Korea as compared to the other countries in the table. The first set of international students from a country are likely to be studying science and engineering, which require laboratory equipment and machinery unavailable in their home country. Hence, this expansion involves persons in other fields.

Table 4 compares the numbers of U.S. doctorate graduates from Korea, China, and India with the numbers who obtained doctorate degrees in their home country. The number of PhDs trained in the U.S. are substantial relative to domestic PhD graduates in the three countries, with ratios ranging from 9% to 14% for all doctorates and ratios among science and engineering PhDs ranging from 12% to 27%. In all cases, the ratio of U.S.-educated to home-country educated is higher for Korea than for India and China.

Science and engineering PhDs from outside the U.S. often stay and work in the country for many years. Using Social Security records, Finn (2014) estimated the proportion of S&E doctorates who remain in the U.S. over time. Of the Koreans who earned U.S. PhDs in 2006, 58% were working in the U.S. in 2007 and 42% were still in the U.S. in 2011. These rates compare to stay rates for Chinese and Indian PhDs, which range from 80% to 90%. Data from the Survey of Earned

TABLE 4—COMPARISON OF PhDs IN THE US AND IN HOME COUNTRIES FOR KOREA, CHINA, AND INDIA, CIRCA 2012

	Korea	China	India
All PhDs			
US 2012	1 469	4 217	2 236
Home Country (2010 for Korea and China; 2006 for India)	10 542	48 987	18 370
Ratio of US to Home Country in percentage terms	13.9%	8.6%	12.2%
Science and Engineering PhDs			
US 2012	1 129	3 900	2 129
Home Country (2010 for Korea and China; 2006 for India)	4 165	31 410	7 982
Ratio of US to Home Country in percentage terms	27.1%	12.4%	26.7%

Source: NSF, <http://www.nsf.gov/statistics/sed/2012/pdf/tab26.pdf>

National Science Board, Science and Engineering 2014, Appendix 2-42.

Doctorates on the intention of doctorate recipients with temporary visas to stay in the United States show a similar pattern, with 64% of Koreans intending to stay compared to 87% of Chinese and 86% of Indians (National Science Foundation 2012).

An alternative way to gain insight into the locations of Korean researchers is to examine Web of Science data pertaining to the names and addresses of authors of scientific papers. To identify Korean researchers I used William Kerr's name-ethnicity matching program to assign an ethnic identity to authors (Kerr 2008; Kerr and Lincoln 2010). The identification hinges on the fact that last names such as Kim are likely to be Koreans, while names like Zhang are likely to be Chinese, and so on.

Web of Science papers show a striking change in the locations of Korean-authored papers between the 1980s and the 2000s. In the period of 1985-1998, 44% of first authors (usually the junior person on a collaboration) with Korean names were on papers with U.S. addresses compared to 36% on papers with Korean addresses, whereas in 1999-2007, only 24% had US addresses and 62% had Korean addresses. Looking at papers with Korean last authors (usually the senior person on a collaboration), in 1985-98 31% had U.S. addresses on the paper compared to 52% with Korean addresses. In contrast, during the period of 1999-2007, only 14% of Korean last authors had U.S. addresses while 75% had Korean addresses. Over time, Korea's expanded research activity shifted the locus of Korean researchers from the U.S. to Korea.

Research Collaborations

Scientific research moved in the latter part of the 20th century from individual researchers to teams, producing an upward trend in the number of authors per paper (Wuchty, Jones, and Uzzi 2007; Adams, Black, Clemmons, and Stephan 2005). Papers with more authors tend to be published in journals with high impact factors and garner relatively more citations than those with fewer authors (Wuchty *et al.* 2007; Freeman and Huang 2015), providing a potential productivity justification for increased collaborations.

In the 1990s and 2000s, the increase in scientific collaborations was accompanied by an increase in international collaborations – that is in a growing proportion of papers with coauthors from different countries (National Science Board 2014; Adams 2013).

Table 5 examines the position of Korea and its main scientific collaborators in terms of internationally co-authored papers in 1997 and 2012. The columns entitled "Share of Country S&E Articles Internationally Co-authored" record the ratio of articles with two or more country addresses relative to all articles for the specified group. The shares increase sharply for the world and for most countries, including the U.S.,¹¹ but increase only modestly for Korea and China, whose rapid growth in

¹¹The higher share of internationally co-authored papers for individual countries than for the world arises because the tabulations count an international paper with co-authors from two countries as a single paper at the world level but as two international papers at the country level, with one for each country.

TABLE 5—SHARES OF INTERNATIONAL CO-AUTHORSHIP, KOREA, US, AND MAJOR COLLABORATORS

	Shares of Country's S&E Articles Internationally Co-Authored		Country's Share of Korea's Collaborations		Korea Share of Country's International Collaborations	
	1997	2012	1997	2012	1997	2012
World	15.7	24.9	100.0	100.0	1.8	4.8
South Korea	27.6	30.8	-	-	-	-
US	19.3	34.7	61.5	53.9	2.8	6.0
Japan	16.4	30.0	21.8	15.1	4.4	9.2
China	25.7	26.7	7.4	14.5	3.6	4.7
Germany	35.5	55.5	6.9	9.1	0.07	2.3
United Kingdom	31.0	55.1	5.5	8.8	0.06	2.3
India	22.5	36.7	2.8	8.4	0.3	11.5

Source: Tabulated from Indicators, 2014, Tables 5-56 and 5-41. In 1997 1.8% of worlds 90867 had Korean, in 2012, 4.8 of 211941.

the number of articles was fueled by within-country collaborations.¹²

The columns “Country’s Share of Korean collaboration” record the ratio of papers with at least one Korean address and one address from the specified country divided by the total number of Korean international collaborations. They show that the U.S. has been a huge collaborator with Korean researchers, accounting for 61.5% of Korea’s international collaborations in 1997 and 53.9% in 2012. Japan is the second largest collaborator for Korea, though its proportion of collaborations also dropped. Given China’s huge increase in scientific papers, its share of Korean collaborations increased, but the diversification of Korean collaborations goes beyond China. Germany, the United Kingdom, and India increased their share of Korean collaborations, as did many countries with smaller scientific presence.

The columns “Korea’s Share of Country’s International Collaborations” present the ratio of the number of papers with an address for the given country along with a Korean address divided by the total number of international collaborative papers of that country. Korea’s rapid increase in the number of papers raised its share of the world’s international papers from 1.8% in 1997 to 4.8% in 2012 and also raised its share of international collaborations with the US and all other countries in the table as well. The values of “Korea shares” in the table are lower than those of “other country shares” because even after its rapid increase in the number of papers, Korea published fewer papers than more populous countries or those with longer scientific traditions.

As noted, Korea’s citation performance lags behind its production of papers and patents. One likely reason for this is that it takes time for new researchers and labs to develop the tacit knowledge that often produces better work. Another is that scientists from Korea lack the network connections of scientists from more established research countries that help produce greater rates of acceptance in prestigious journals and produce many citations. Examining Korean scientific journals included in the Science Citation Index, Park and Leydesdorff (2008) find that even though the journals are published in English, Korean authors in international journals hardly quote papers published in them, which minimizes their contribution as part of a Korean network of scientists citing each other.

¹²Looking over shorter different periods, Kim (2005) notes declines in the proportion of international collaborations in Korea associated with its growth spurt in papers.

TABLE 6—ESTIMATED RELATIONSHIP BETWEEN US AND OTHER OVERSEAS PUBLICATION EXPERIENCE ON
IMPACT FACTORS AND FIVE-YEAR CITATIONS OF
PAPERS WITH KOREAN ADDRESSES AND ALL AUTHORS WITH KOREAN NAMES

Variables	1	2	3	4
	Impact Factor	5-year Citations	Impact Factor	5-year Citations
USA experience	0.301*** (0.102)	1.077*** (0.413)	0.260*** (0.0958)	1.083** (0.437)
Other oversea experience	-0.207* (0.120)	1.325** (0.647)	-0.287** (0.113)	0.955 (0.633)
Observations	9 120	9 120	9 068	9 068
R-Squared	0.368	0.251	0.413	0.292
Author Number	No	No	Yes	Yes
Address Number	No	No	Yes	Yes
Reference Number	No	No	Yes	Yes
Publication year	Yes	Yes	Yes	Yes
Field	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. Papers are published no earlier than 1990.

*** p<0.01, ** p<0.05, * p<0.1.

Source: Tabulated from papers in PubMed with citations from Web of Science, 1990-2007.

Since international collaborations link Koreans and scientists from countries with larger and more established scientific systems, such collaborations offer a channel to increase the impact of Korean scientific work. Koreans writing papers in institutions outside the country would benefit from the tacit knowledge and the connections among persons working for the institutions. Koreans returning to the country with publication experience outside the country should be able to leverage that experience to conduct more impactful research.

Table 6 examines how Korean authors writing their papers in Korea who had overseas experience, defined as having a prior paper with an address overseas and no address in Korea, fared in the impact factor of the journal of publication and in the number of citations to their paper relative to authors in Korea with no such experience. Since it is necessary to disambiguate the names of individual scientists to determine if they have an earlier English-language paper, I use PubMed data, for which Torvik and Smalheiser (2009) have developed a sophisticated algorithm for differentiating individuals with the same name. The first two columns include covariates for the language of the journal, the country publication year and the detailed field as reported in the Web of Science. The last two columns include three variables that reflect the characteristics of the article, i.e., the number of authors, number of addresses, and the number of references on the article, all of which previous research finds are positively related to impact factors and citations (Freeman and Huang 2015). The regressions show that U.S. experience overseas pays off in higher impact factors while other overseas experience is associated with lower impact factors. This pattern could reflect that work experience in the U.S. produces better papers for Korean researchers, but it could also be due to the fact that the U.S. publishes most in impact journals, so that Koreans with only non-U.S. experience are disadvantaged on that measure. Both U.S. experience and other overseas experience are associated with greater five-year citations than are obtained by Korean researchers without overseas experience. While the magnitude of the coefficients differ somewhat, they are not statistically significantly different.

This result suggests that the impact factor difference between the papers by Koreans with U.S. experience and non-U.S. overseas experience may be more reflective of the location of high impact journals than of the quality of the actual work.

To see how Korean researchers working outside the country fare in their publications, I examine next the relationship between having a Korean first or second author on a paper with all addresses outside Korea and the impact factor of the journal of publication and the five-year forward citations of papers. To identify Korean authors, I use William Kerr's name-ethnicity matching program (Kerr 2008; Kerr and Lincoln 2010), which assigns an ethnic identity to authors based on the distribution of names by ethnicity. The identification hinges on the fact that last names such as Kim are especially likely to represent Koreans while names like Zhang are likely to be Chinese, and names like Johnson likely to be Anglo-American.

Table 7 records the regression coefficients and standard errors on the Korean ethnicity of first and last authors, with the first two columns including covariates for the language of the journal, the country publication year and a detail field as reported in the Web of Science. The last two columns include the number of authors, the number of addresses, and the number of references to the article. The regressions yield similar findings. All of the estimates for first authors having Korean names are positive, indicating that these researchers produce papers that have higher quality by the impact factor and citation indicators than first authors with names with other ethnicities. The estimates for last authors being Korean show negative effects on impact factors and positive but statistically insignificant effects on citations. One likely reason for the positive performance of first-author Koreans is that they have been positively selected from Korean researchers compared to all overseas researchers in their field who have not been so positively

TABLE 7—ESTIMATED RELATIONSHIP BETWEEN FIRST AND LAST AUTHOR HAVING KOREAN NAMES IN PAPERS WITH NON-KOREAN ADDRESSES AND THE IMPACT FACTOR OF THE JOURNAL OF PUBLICATION AND FIVE-YEAR CITATIONS

Variables	1 Impact Factor	2 5-year Citations	3 Impact Factor	4 5-year Citations
First Author Korean	0.0216 (0.014)	0.086*** (0.115)	0.0175*** (0.0137)	0.470*** (0.113)
Last Author Korean	-0.0702*** (0.0184)	0.169 (0.151)	-0.0768 (0.0181)	0.0550 (0.149)
Observations	6 036 718	6 036 718	5 937 464	5 937 646
R-Squared	0.376	0.122	0.388	0.168
Author Number	No	No	Yes	Yes
Address Number	No	No	Yes	Yes
Reference Number	No	No	Yes	Yes
Language	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Publication Year	Yes	Yes	Yes	Yes
Field	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Source: Tabulated from papers in PubMed with citations from Web of Science, 1990-2007.

selected. The lower impact factors for last-author and presumably senior Korean researchers may reflect their being more poorly connected to the network of scientists outside Korea than comparable researchers in those countries or possibly to their being not as skilled as their younger cohorts.

Finally, a number of studies show that papers for which Koreans in Korea collaborate with researchers outside the country produce are more impactful than those resulting from collaborations of researchers within the country.¹³ Since Koreans collaborate disproportionately with researchers in the U.S., which has exceptionally high impact factors and numbers of citations, it would be shocking if this were not the case.

All told, international experiences appear to improve Korean research, with Koreans generally doing well working in overseas locations, with those returning home having better research performance than researchers without overseas experience, and through international collaborations.

III. Globalization's Conclusion: Lessons from Korea's Experience

Korea's moving to the frontier of science and engineering in the 1980-2010 period was a remarkable achievement. Developing a powerful science and technology knowledge creation machine literally from scratch and using knowledge to catch up with advanced countries and transition from being a developing country with a comparative advantage in low skill low wage goods and services to an advanced country with a comparative advantage in the knowledge economy has broad implications for economic development in today's world.¹⁴ At the risk of oversimplifying a complicated process, I draw five lessons from Korea's commitment to a "Knowledge, knowledge, knowledge ... knowledge for my economy" model of economic growth.

The first and perhaps most important lesson is Korea's proof of reality that in the modern era, a developing country can transform itself and its comparative advantage in the world economy in the space of 30 or so years. Few if any development economists would have believed this to be possible three or four decades ago. With knowledge – a unique public good – at its base, the S&T based economy offers ways of telescoping economic development.

The second lesson from Korea's experience is the role played by activist governments through industrial policy. The OECD (2009, 2014), the World Bank Institute (2007), Korean government agencies (the Korea Information Society Development Institute and the Korea Ministry of Science, ICT, and Future

¹³Kim (2007) shows that Korea's Biotechnology Stimulation Plans (1994-2007) produced a burst of bio-tech papers but little increase in terms of impact factors of journals for Korean publications, while international collaborations produced more publications in mainstream journals with high impact factors than local and domestic collaborations. Chung (2002) provides a broad view of Korea's use of international links to upgrade its science and technology. Kwon et al. (2012) argue that international collaborations came at a cost of stagnation of the cross-connection within Korea among different research entities.

¹⁴Korea's share of global value added in knowledge intensive industries increased (National Science Board, 2014, Appendix Table 6-2). In technology, Korea's ICT R&D produced WiBro (<http://en.wikipedia.org/wiki/WiBro>), which is widely used in Korea and has been adopted as an ITU international standard; and DMB.

Planning 2014) and diverse researchers (Bartzukis 2008; Campbell 2012; Doh and Kim 2014; Lee *et al.* 2013; Min and Kim 2013; Lee, Son, and Om 1996; among others) have examined specific policies by which Korea sought to galvanize the country in this jump: public research institutes, support of university education and research, the setting of goals, and the support of particular industries.

A detailed study and an assessment of how Korea might have developed with different policies or through the implementation of policies is needed to determine what worked most/least effectively and what is/is not transferable to other countries. But it is difficult to gainsay that Korea succeeded through activist governments setting industrial policy and thus to maintain the shibboleth that markets alone suffice to produce modern economic growth.

The third lesson is the theme stressed in section 2 of this paper: that Korea made the jump to a modern knowledge-based economy with help from the globalization of higher education and international research collaborations, and in particular from its close ties to the U.S.

The fourth lesson is that Korea did all this with a democratic government, with citizens regularly electing presidents from competing parties or factions of parties and with open political debate in the parliament and country.

Finally, the Korean case also shows that movement to a knowledge economy does not by itself resolve economic problems. It transforms some problems, eliminates some, but leaves others festering or possibly contributes to them. Korea's economic advance to a knowledge economy has not reduced the high proportion of workers in non-regular work nor substantial gender differentials, nor has it reduced the polarization of jobs between low productivity services and high productivity manufacturing, and so on. What Korea's new position as a research power has done has given it additional tools for addressing these and other problems to improve the well-being of citizens broadly. Knowledge, knowledge, knowledge, knowledge for my economy? – Yes, yes, yes.

APPENDIX

Data Source for Table 2

- Population:
<http://data.worldbank.org/indicator/SP.POP.TOTL?display=default>
- GDP in constant 2005 dollars:
<http://data.worldbank.org/indicator/NY.GDP.MKTP.KD?display=default>
- Scientific and technical journal articles:
<http://data.worldbank.org/indicator/IP.JRN.ARTC.SC?display=default>,
- Patent applications filed under the Patent Cooperation Treaty (PCT) and Triadic Patents come from OECD, at <http://stats.oecd.org/>
- R&D expenditures as a share of GDP come from three sources a-c:
 1. NSF Science and Engineering Indicators 2014 for the United States at <http://www.nsf.gov/statistics/seind14/index.cfm/appendix/tables.htm>, table at04-01.
 2. Lee (2010) for South Korea, Figure 8, with interpolations for missing years.
 3. OECD Stat Extracts at http://stats.oecd.org/Index.aspx?DataSetCode=GERD_FUNDS#

In total we have 31 years of data for the 34 OECD countries plus China, Russia and Singapore, but our data are not sufficiently complete to have 1,147 ($= 31 \times 37$) observations. There are 50 country-year observations with article count missing, and 18 observations with zero articles. Missing values in GDP or population reduce the usable observations for Panel A column (1) down to 1,067. The data for PCT-Patent is available for every year and every country, but entirely missing for Singapore. There are 72 country-year cells with zero PCT-patent. This makes the observations in column (5) different from that in column (1). For Korea, 1981 and 1982 have PCT-PAT=0. Starting from 1983, Korea has positive patent count fast growing. The triad patent data begin in 1985, reducing the sample in Panel C.

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Why Standard Measures of Human Capital are Misleading[†]

By ERIC A. HANUSHEK*

After a long, dormant period, recent attention has turned to a variety of measurement issues surrounding the concept of human capital. The traditional approach of rely entirely on measures of school attainment, while convenient, is almost certainly misleading. The availability of cognitive skills measures greatly improves on these measurements, but there remains also concern about other unmeasured factors, including noncognitive skills. This paper considers alternative approaches to assessing the role of human capital on individual earnings and on economic growth.

Key Word: Human Capital, Returns to Skills, Cognitive Skills,
Earnings Function, Long-run Growth

JEL Code: O15, I25, I26

I. Introduction

For the last half century, economists have been largely content with both the measurement and the empirical importance of human capital. But recently, after this period of dormancy, attention to measurement issues has picked up. The ubiquitous analysis of school attainment has come to the fore, leading to a reconsideration of what skills are important and, implicitly, of what policies should be considered for skill development. This paper focuses on the role of cognitive skills in earnings determination and economic growth, and attempts to understand what might be left out of such measures of human capital.

Historically, the idea of human capital as a useful concept took a significant move forward with the demonstration that school attainment might capture many of the important aspects for empirical work. However, the ubiquitous reliance on school attainment is clearly at odds with other analyses that consider schooling as just one element of skill development.

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It is now possible to estimate both models of wage determination and of economic growth that include better measures of human capital – namely cognitive skills. In these, it is clear that differences in cognitive skills are very important in describing economic outcomes. At the same time, it is less clear whether measurement problems with these or omitted factors such as noncognitive skills are also important.

By considering alternative estimates of basic models, it is possible to put some bounds on the range of concerns about cognitive skill measures. From these, it is clear that other factors are likely to enter into the individual wage determination, although the exact nature of these other factors is less clear. It is not clear that these other factors are significant in the case of economic growth.

II. A Short History

Today, few economists recognize the conflicts and disagreements that existed in the middle of the last century. There is a long history of economists thinking about the importance of individual skills.¹ Perhaps the earliest economic analysis of skills was introduced by Sir William Petty (1676 [1899]), who thought that the costs of war and the economic power of nations should be directly related to how skilled the relevant individuals were. Adam Smith (1776 [2010]) also delved into ideas of human capital before moving into the areas of trade and specialization. But, Alfred Marshall (1898) called the whole idea into question, because he did not think it was relevant empirically since individuals could not be bought and sold. Because of his influence, Marshall essentially stopped the consideration of human capital.

The reintroduction of the concept of human capital came with Theodore Schultz (1961). His presidential address to the American Economic Association concluded that the much of the difference between growth of national income and the slower increases in labor, physical capital, and land was due to investments in human capital. While providing an overview of various investments that individuals made in human capital, he also felt compelled to address the “deep-seated moral and philosophical issues” against such considerations – a necessity that now seems quaint.

Parallel to the arguments of Schultz comes the broadening and deepening developments of Gary Becker (1964) and Jacob Mincer (1970, 1974). Becker, in a variety of works, developed ideas of individual investments in human capital. But, the most profound development arguably was the development of an empirical approach to understanding human capital investments and the returns on them.

A major obstacle in empirical work was judging the amount of skills, or human capital, that an individual possessed. For physical capital, the well-developed approach was totaling up the expenditures on capital as an indication of the investment. With various allowances for depreciation and quality improvement, the stock of human capital could be calculated from aggregating past investments. But,

¹Kiker (1966, 1968) provides a detailed history of various approaches to incorporating human capital dating back to the seventeenth century.

with human capital, it is less than obvious how individual consumption expenditure can be separated from investments. Schultz (1961) recognized this problem and observed that it might be possible to look at differences in wages as a measure of the returns on skills to an individual. This observation could not, however, adequately drive the measurement of human capital, because arguing that human capital drives wage differences and thus that wage differences indicate the difference in human capital becomes tautological.

Mincer (1974) provided a direct way to circumvent the tautological version of human capital and to proceed with meaningful empirical analysis. His motivation was to develop an empirical approach to understanding the role of human capital investments in wage determination. He made two observations. First, a major function of schools was to develop individual skills that were useful in the market. Thus, if the costs of schooling came entirely from foregone earnings, it was possible to measure the schooling component of investment simply by the time in school, or years of school attainment. Second, building on Becker's analysis about investment in on-the-job (OJT) training, plausible investment plans provided a structure to lifetime investment in OJT and allowed direct estimation of the impact of OJT on investment.²

When these ideas were combined, Mincer (1974) showed that individual wages could be characterized by relating (log) wages to years of schooling and to a quadratic function of experience that captured OJT investments. The standard version is

$$(1) \quad \ln Y_i = \alpha_0 + rS_i + \alpha_1 E_i + \alpha_2 E_i^2 + \varepsilon_i,$$

where Y_i denotes the earnings of individual i , S_i is years of schooling, E_i is experience, and ε_i is a random error.³ In the standard interpretation, r is the rate of return to schooling.⁴

This formulation of wage determination is perhaps the most successful theoretical/empirical development ever in the history of economics. The "Mincer earnings function" is so common that no reference is needed, and, if any alterations of the measures of human capital or of the functional form are made, they need to be explained.

Importantly, school attainment has been accepted fully as a legitimate and largely complete measure of human capital differences across individuals. In its standard Mincer form, the coefficient of years of schooling is a direct measure of the rate of return to schooling, and thus can summarize the investment value in schooling across time and space.⁵

²The initial development of Becker (1964) argued that while firms might invest in the specific human capital of a worker, they would not invest in general human capital because the worker could take that investment to a different firm, thus inflicting a capital loss on the original firm. This issue has subsequently been reopened by Acemoglu and Pischke (1998, 1999).

³Even more commonly, instead of actual labor market experience, E denotes potential experience equal to $S - \text{age} - 6$.

⁴See, however, Heckman, Lochner, and Todd (2006), who consider problems in the interpretation of r as the rate of return to schooling investment.

⁵Again, however, see the issues that surround such an interpretation in Heckman, Lochner, and Todd (2006,

A driving force in the acceptance of employing school attainment as a measure of human capital is clearly its ready availability. Common census data and household surveys contain all of the data needed to estimate labor market returns to human capital. For example, in the latest of a series of international estimates of Mincer earnings functions, Montenegro and Patrinos (2014) provide comparable estimates across 139 economies.⁶

From these developments, school attainment has been widely accepted as a measure of an individual's human capital. It is incorporated into a wide range of studies beyond just past wage determination, indeed virtually all analyses where it is necessary to identify differences across individuals that might affect their behavior.

Perhaps the only consistent concern with the Mincer development is whether the earnings estimates represent the causal impact of schooling. In the simplest formulation of this concern, one dating from the earliest earnings studies, it is widely accepted that higher ability individuals are likely to continue farther in school.⁷ Thus, if there is a separate return to ability, estimation of the simple Mincer earnings function will represent the combined impact of school and of ability, and not just the causal impact of schooling. These issues have led to a large amount of literature, as described and evaluated by Card (2001). A continuing literature seeks to deepen and extend this work, often introducing new strategies to identify the rate of return to schooling.

The perspective of this paper is that the Mincer formulation has been too successful in driving research. The treatment of school attainment as synonymous with human capital fundamentally distorts economic analysis of human capital and the policy implications that are drawn from this analysis. The primary concern is other omitted factors that directly affect earnings and lead to biased estimates of the return to skills.

III. Distortions in Estimating the Returns to Skills

Two closely related topics suggest a problem with the way that this research into human capital has developed.⁸ First, there has been a long and extensive line of research into educational production functions. This research has sought to investigate directly the determinants of schooling outcomes. Second, from a policy perspective, the concerns center more on the quality of schooling and the policies that might be put in place to improve schooling outcomes. Neither of these topics is compatible with the general Mincer approach to wage determination or the more general proposition that school attainment is an adequate measure of human capital.

A simplified version of a standard human capital production function would be

2008).

⁶Prior estimates in this expanding set of estimates are found in Psacharopoulos (1973) and Psacharopoulos and Patrinos (2004).

⁷See, for example, Hause (1971, 1972).

⁸Discussion of this general set of issues follows that in Hanushek and Woessmann (2008), where the issues were first set out.

$$(2) \quad H_i = \beta_1 F_i + \beta_2 (q_s S_i) + \beta_3 A_i + \beta_4 Z_i + v_i,$$

where human capital (H) is a function of family inputs (F), the quantity and quality of inputs provided by schools ($q_s S$), individual ability (A), and other relevant factors (Z) such as health or peers. Such a function has been estimated innumerable times (Hanushek, 2002). Several aspects are important. While there have been a variety of measures of H , including incomes, college attendance, and the like, the most common measure has been student achievement, or some dimension of cognitive skills. Second, family background (F) invariably affects student outcomes, a consistent finding since the first major investigation along these lines (Coleman *et al.*, 1966). Third, many common input measures – such as expenditures or pupil-teacher ratios – have somewhat surprisingly and somewhat controversially not proven to be reliable measures of school quality (Hanushek, 2003).

Putting analyses on Mincer earnings functions into the context of educational production functions immediately uncovers the fundamental problem. From eq. (2), it would not be possible simply to substitute school attainment into an earnings function and assume that it would adequately measure human capital. Moreover, it goes considerably beyond the idea of ability bias, where some indication of fixed differences among individuals, call it A , must be considered. To the extent that all of the terms in eq. (2) except for S and possibly A enter the error term in eq. (1), all of the past analyses indicate why the standard requirement for an unbiased estimation of r (i.e., $E[\varepsilon|S] = 0$) is very unlikely to hold.

It is also true from these considerations that, even with a consistent estimate of r , it is necessary to go further to understand the returns to quality of schooling. It is not possible simply to assume that the estimated return to quantity of schooling will provide a reliable estimate of the return to various approaches to improve school quality.

IV. Alternative Estimates of the Returns to Individual Human Capital

Considering eq. (1) and eq. (2) together suggests a variety of alternative approaches to the estimation of returns to skills. One appealing approach, however, is suggested by Hanushek *et al.* (2015). Consistent with the estimation of educational production functions, it would seem reasonable to use test scores as a direct measure of appropriate skills, or human capital. In other words, it would be possible to use C_i , the measured cognitive skills of the individual, in a model of earnings determination.

Schools explicitly have a goal of increasing the cognitive skills of the population. In fact, most of the accountability systems and rewards related to schools are geared toward measured student achievement. Thus, it seems natural to consider tests as a measure of human capital. Unfortunately, data on cognitive skills are not nearly as plentiful as data on school attainment, and the evidence on the returns to cognitive skills is much less available and consistent.

The most common set of estimates comes from an augmented Mincer earnings function, where a simple modification is made to add cognitive skills, as in

$$(3) \quad \ln Y_i = \alpha_0 + rS_i + \alpha_1 E_i + \alpha_2 E_i^2 + fC_i + \varepsilon_i,$$

Most of the evidence on the impact of cognitive skills from this extension of the Mincer earnings functions comes from U.S. panel data sets that record test information while the individual is a student and then follow their performance in the labor market.

The results of these estimates for the United States are shown in Table 1. Three parallel U.S. studies provide very consistent estimates of the impact of test performance on earnings (ϕ) for young workers (Mulligan 1999; Murnane *et al.* 2000; Lazear 2003). These studies employ different nationally representative data sets that follow students after they leave school and enter the labor force. When scores are standardized, they suggest that one standard deviation in mathematics performance at the end of high school translates into 10-15 percent higher annual earnings.⁹

Murnane *et al.* (2000) provide evidence from the High School and Beyond and the National Longitudinal Survey of the High School Class of 1972 (NLS72). Their estimates suggest that males obtain a 15 percent increase and females a 10 percent increase per standard deviation of test performance. Lazear (2003), relying on a somewhat younger sample from National Educational Longitudinal Study of 1988 (NELS88), provides a single estimate of 12 percent. These estimates are also very close to those in Mulligan (1999), who finds 11 percent for the normalized AFQT score in the National Longitudinal Study of Youth (NLSY) data. Note that these returns can be thought of as how much earnings would increase with higher skills every year throughout a person's working career. The estimates do, however, come

TABLE 1—EXISTING ESTIMATES OF RETURNS TO COGNITIVE SKILLS

	Data source	Age sample	Return to cognitive skills
Mulligan (1999)	NLSYa	?	0.11
Murnane <i>et al.</i> (2000)	HSBb and NLS72c	27, 31	0.10-0.15
Lazear (2003)	NELS88d	≤27	0.12
Hanushek and Zhang (2009)	IALSe	16-65	0.20
Chetty <i>et al.</i> (2011)	STARf	25-27	0.18
Hanushek and Woessmann (2012)	IPUMSg	25-65	0.14

Note: Each comes from an estimation of a Mincer earning function that adds an achievement measure in units of standard deviations.

Data sets: a. National Longitudinal Study of Youth; b. High School and Beyond; c. National Longitudinal Survey of the High School Class of 1972; d. National Educational Longitudinal Study of 1988; e. International Adult Literacy Survey; f. Project STAR; g. 2000 Census IPUMS.

Source: Hanushek and Woessmann (2015).

⁹It is convenient to convert test scores into measures of the distribution of achievement across the population. A separate review of earlier studies of the normalized impact of measured cognitive skills on earnings by Bowles, Gintis, and Osborne (2001) finds that the mean estimate is only 0.07, or slightly over half of that for the specific studies here.

early in the worker's career, suggesting that the impact may actually rise with experience.¹⁰

In a different set of estimates using data on a sample of workers of all ages within the U.S., Hanushek and Zhang (2009) provide estimates of returns (ϕ) of 20 percent per standard deviation.¹¹ One distinguishing feature of these estimates is that they come from a sample of workers throughout the career, as opposed to the prior estimates that all come from early-career earnings.¹²

Using yet another methodology that relies upon international test scores and immigrants into the U.S., Hanushek and Woessmann (2012) obtain an estimate of 14 percent per standard deviation. That analysis begins with a standard Mincer earnings model but estimates the returns to skills from a difference-in-differences formulation based on whether the immigrant was educated in the home country or in the United States. They find that skills measured by international math and science tests from each immigrant's home country are significant in explaining earnings within the United States.

Finally, Chetty *et al.* (2011) look at how kindergarten test scores affect earnings at age 25-27 and find an increase of 18 percent per standard deviation. These estimates do not control for any intervening school attainment differences but do control for a rich set of parental characteristics.

But there are two problems with this evidence. First, by referring only to young workers (except for Hanushek and Zhang 2009), the results potentially understate the returns to skills. Altonji and Pierret (2001) consider the possibility of statistical discrimination that leads to increased returns to cognitive skills over time. Specifically, when young workers first go to an employer, it is difficult for the employer to judge the skills of the worker. Over time, the employer can more accurately assess the skills of the worker, and, if worker skills are related to cognitive skills as measured by tests, the returns to test scores will rise with experience. Their analysis supports the idea that these estimated returns to skills could be an understatement, with the returns to cognitive skills rising and the returns to school attainment falling with labor market experience.¹³ Related to this, Haider and Solon (2006) show that people with higher lifetime earnings show systematically steeper earnings growth.

Second, a potentially more serious issue is the form of the earnings determination model. If in fact cognitive skills are a good measure of human capital, school attainment would just be an input to human capital (eq. (2)) and

¹⁰These estimates are derived from observations at a point in time. Over the past few decades, the returns to skill have risen. If these trends continue, the estimates may understate the lifetime value of skills to individuals. On the other hand, the trends themselves could change in the opposite direction. For an indication of the competing forces over a long period, see Goldin and Katz (2008). Haider and Solon (2006), from a different perspective, show that the earnings of individuals with higher earnings tend to rise more steeply early in their careers.

¹¹Their estimates of returns to cognitive skills actually include 13 countries, of which the U.S. had the highest estimated returns in the mid-1990s.

¹²The data from the International Assessment of Adult Literacy (IALS) provide both tests of reading and numeracy skills but also assess a range of adult workers. The estimates in Hanushek and Zhang (2009) come, like the previously mentioned studies, from adding cognitive skills to a standard Mincer earnings function, but that paper also discusses alternative ways to obtain estimates of the schooling gradient (r in equation (1)).

¹³When the model was tested across countries, however, it seemed most important for the United States but not for other countries (see Hanushek and Zhang 2009).

should not be included in eq. (3). Thus, the appropriate way to estimate earnings determination would be

$$(4) \quad \ln Y_i = \alpha_0 + \alpha_1 E_i + \alpha_2 E_i^2 + fC_i + \varepsilon_i,$$

Hanushek *et al.* (2015) provide evidence on both of these issues. They employ OECD data from the Programme for the International Assessment of Adult Competencies (PIAAC). This survey, conducted in 2011-2012, has several strengths that permit a new view of the earnings determination process. First, it uses representative samples of the population aged 16-65. Second, it provides consistent information across 23 countries. Third, in addition to labor market data for individuals, it conducted a set of three separate cognitive skills tests: literacy, numeracy, and problem solving in technology-rich environments.¹⁴

With these data, it is possible not only to estimate the returns to skills but also to consider the interpretation of various models of the role of human capital in earnings determination.

V. International Estimates of Returns to Skills

Hanushek *et al.* (2015) provide direct evidence on the range of returns to skills across countries. The most basic estimates focus on eq. (4).¹⁵ In an effort to separate skills from other factors that might enter into the earnings determination, the estimates begin with a sample of full-time workers (≥ 30 hours per week). The initial estimation employs numeracy scores, and there is substantial variation across countries. Figure 1 plots the returns to numeracy estimated by Hanushek *et al.* (2015). The scores have been normalized to mean zero and standard deviation one within each country, implying that the estimated numeracy coefficient is the percentage difference in average earnings that is associated with a one standard deviation difference in numeracy scores.

Two things stand out in this evidence. First, there are very substantial differences in the returns to skill across countries. Second, the returns to a number of countries, including Korea, are very high.

From Figure 1, the overall estimate for pooled data across all countries of the impact of numeracy is that a one standard deviation higher score corresponds to 17.8 percent higher earnings at all years of experience.¹⁶ These estimates for individual countries range from 12 percent for Sweden to 28 percent for the U.S. Six of the 23 countries – including Korea – have returns to numeracy that exceed 20 percent.

¹⁴Participation in the problem-solving domain was optional; Cyprus, France, Italy, and Spain did not participate in this domain.

¹⁵The estimation also includes an indicator variable for gender in addition to experience and experience squared. Females on average in the pooled sample earn 15 percent less than males, but there is no difference in the returns to skills. All other things being equal, females in the U.S. earn on average 18 percent less than males. For Korea, the comparable figure is 38 percent, a female difference exceeded only by Estonia at 40 percent.

¹⁶The pooled estimates include country fixed effects, implying that the returns to skills are estimated from just the within-country variance.

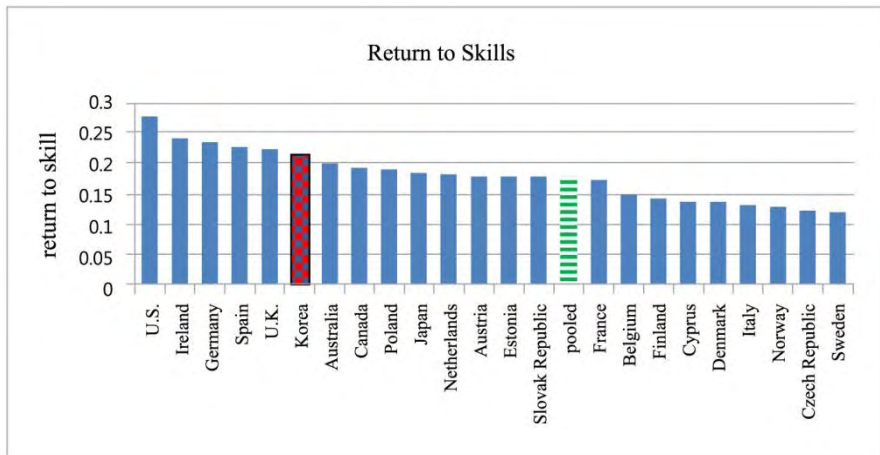


FIGURE 1. ESTIMATED RETURNS TO NUMERACY BY COUNTRY

Source: Hanushek *et al.* (forthcoming).



FIGURE 2. RETURNS TO NUMERACY SKILLS BY PORTION OF WORK LIFE

Source: Hanushek *et al.* (forthcoming).

An interesting aspect of the PIAAC data is the measurement of several dimensions of cognitive skills.¹⁷ The assessment of problem solving in technologically rich environments is an innovative attempt in PIAAC to measure the skills needed to succeed in an information-based economy where information and communication skills are required.¹⁸ Interestingly, these skills, at least as assessed by PIAAC, are systematically less strongly associated with individual earnings than more traditional cognitive skills. In conjunction with numeracy skills,

¹⁷The PIAAC data are actually modeled after the earlier data of IALS (International Assessment of Adult Literacy survey). That survey, including international data from adults in a number of countries, also had multiple tests, but they are all so highly correlated that it was not really possible to separate them. See Hanushek and Zhang (2009).

¹⁸See, for example, the description at: <http://nces.ed.gov/surveys/piaac/problem-solving.asp>.

problem solving has half the estimated return: 6.1 percent on average versus 12.2 percent for numeracy. This aggregate result holds across all countries except for the Czech Republic and Slovak Republic. Further, the point estimates for problem solving are insignificant in Australia, Japan, Korea, and Poland.

Another aspect of this analysis is the insight into the effect of just measuring skills early in the career – as commonly found in the studies shown in Table 1. If eq. (4) is modified to let the impact of skills vary across the work life, it becomes clear that skills have much less of an impact early in a career. Figure 2 show the returns pooled across all 23 countries for work force entry (age 16-34), the prime earnings period (age 35-54), and exit (age 55-65). Over the entry period, returns average 14 percent (per s.d.). They then rise to 18 percent for the remainder of the career.

The pattern for Korea mimics this, although it is everywhere higher. Entry period returns are 18 percent, and returns rise to 23 percent for the remainder of the work life.

VI. Alternative Interpretations

Most prior estimates of the return to skills have come from estimations of the augmented Mincer earnings function in eq. (3). The question from this is how to interpret the estimated impact of schooling on earnings.

Two interpretations of the schooling gradient are possible. The previous estimates of the return to skill assume not only that the tests are accurate but also that they are complete measures of the requisite skills for the labor market.¹⁹ Both of these assumptions are questionable, but consideration of them provides more on the interpretation of the estimated schooling coefficient.

Consider first the case of a simple measurement error in using the test scores to describe the human capital of the individual. In this case, the estimated returns to skills would be biased downward. But also, where school attainment is simply an input to the production of human capital, the true coefficient on schooling in the earnings model would still be zero, but the estimate would be biased upward.²⁰ Thus, estimating an augmented Mincer earnings function will produce a positive coefficient on years of schooling, but it would not have an interpretation of the returns to schooling that is common (e.g., Card 2001; or more nuanced, Heckman, Lochner, and Todd 2008).

The alternative interpretation is that cognitive skills are one proxy for human capital and school attainment is another. In this case, years of schooling is not just an input into the educational production function but is also an error-prone measure of relevant skills, or the output of the educational process. School attainment could, for example, be related to the noncognitive skills that are important for the educational process. Recent work has emphasized the importance of noncognitive skills and claims by some measures that noncognitive skills are as important if not

¹⁹The full requirement is that any unmeasured portions of skills are uncorrelated with the variables included in the model.

²⁰The bias in the simple model is actually a special case of proxy variables; see McCallum (1972) or Wickens (1972).

more important in earnings determination (e.g., Heckman, Stixrud, and Urzua 2006; Cunha and Heckman 2008).²¹ No attempt is made here to measure directly noncognitive skills. Instead we consider the potential impacts through the channel of school attainment.

It is possible to look at the range returns to measured skills from the augmented Mincer function perspective. Figure 3 provides an international comparison of returns to skills after controlling for school attainment. Four of the top six countries in terms of returns to numeracy from Figure 1 remain at the top of the world distribution in the estimates that include schooling, but returns in Spain and Korea drop to the pooled mean across countries. Countries at the low end of returns remain there, although the magnitude of the returns to cognitive skills is estimated to be lower.

The easiest way to think about these estimates is to consider that they provide a set of bounds on the importance (and in some sense usefulness) of cognitive skills measures of skills, or human capital. By any interpretation, however, it is clear that differences in cognitive skills are very important in individual earnings determination. Lacking measures of noncognitive skills, except as correlated with school attainment, implies nonetheless that it is difficult to categorize their role. The drop in the estimates of the returns to cognitive skills could reflect issues of pure measurement errors or could reflect the parallel importance of noncognitive skills.

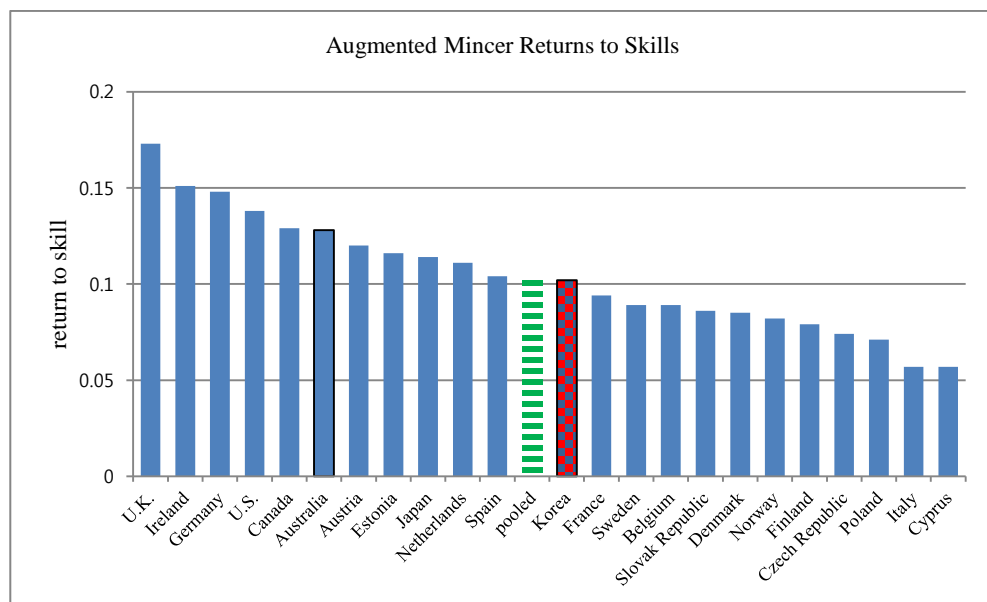


FIGURE 3. RETURNS TO NUMERACY IN AUGMENTED MINCER

Source: Hanushek *et al.* (forthcoming)

²¹Heckman, Stixrud, and Urzua (2006) develop a very general model of endogenous school choice and error-prone measures of cognitive skills and noncognitive skills. While simple regressions of cognitive skills and noncognitive skills show that cognitive skills explain much more of the earnings variation than noncognitive skills, their simulations of a factor model find larger wage impacts from going across the range of noncognitive skills as compared to the range of cognitive skills.

VII. A Different Viewpoint – Economic Growth

An alternative perspective on the measurement of human capital comes from looking at economic growth. As developed fully in Hanushek and Woessmann (2015), essentially the same measurement questions arising in the models of wage determination reappear when interest turns to empirical models of growth.

In the late 1980s and early 1990s, empirical macroeconomists turned to attempts to explain differences in growth rates around the world. Following the initial work of Barro (1991), hundreds of separate studies – typically cross-sectional regressions – pursued the question of what factors determined the very large observed differences. The widely different approaches tested a variety of economic and political explanations, although the modeling invariably incorporated some measure of human capital.

The typical development is that growth rates (g) are a direct function of human capital (H), a vector of other factors (X), and a stochastic element (v), as in

$$(5) \quad g = rH + X\beta + v,$$

where r and β are unknown parameters to be estimated. The related empirical analysis employs cross-country data in order to estimate the impact of the different factors on growth.²²

From a very early point, a number of reviews and critiques of empirical growth modeling went to the interpretation of these studies. The critiques have focused on a variety of aspects of this work, including, importantly, the sensitivity of the analysis to the particular specification (e.g., Levine and Renelt 1992). They also emphasized basic identification issues and the endogeneity of many of the factors common to the modeling (e.g., Bils and Klenow 2000).

In both the analysis and the critiques, much of the attention focused on the form of the growth model estimated – including importantly the range of factors included – and the possibility of omitted factors that would bias the results. Little attention was given to measurement issues surrounding human capital.

When growth modeling looked for a measure of human capital, it was natural to think of measures of school attainment, building on the prior labor market analyses of Mincer.²³ This initial growth work, much like the common wage determination models, simply substituted S for human capital in eq. (5) and estimated the growth relationship directly.²⁴

²²A detailed discussion of this growth model and of its variants can be found in Hanushek and Woessmann (2008).

²³Initially, even thinking of measuring human capital by school attainment faced data shortcomings, but data construction by Barro and Lee (1993) provided comparable data on school attainment, and the international growth work could proceed to look at the implications of human capital. There were some concerns about the accuracy of the data series, leading to alternative developments (Cohen and Soto 2007) and to further refinements by Barro and Lee (2010).

²⁴A variety of different issues have consumed much of the empirical growth analysis. At the top of the list is whether eq. (5) should be modeled in the form of growth rates of income as the dependent variable, or whether it

Fundamentally, however, using school attainment as a measure of human capital in an international setting presents huge difficulties. In comparing human capital across countries, it is necessary to assume that the schools across diverse countries are imparting the same amount of learning per year in all countries. In other words, a year of school in Japan has the same value in terms of skills as a year of school in South Africa. In general, this is implausible.

A second problem with this measurement of human capital, as pointed out previously, is that it presumes schooling is the only source of human capital and skills. Yet, a variety of policies promoted by the World Bank and other development agencies emphasize improving health and nutrition as a way of developing human capital. These efforts reflect a variety of analyses into various health issues relative to learning, including micro-nutrients (Bloom, Canning, and Jamison 2004), worms in school children (Miguel and Kremer 2004), malaria, and other issues. Others have shown a direct connection of health and learning (Gomes-Neto *et al.* 1997; Bundy 2005). More broadly, as reviewed in Hanushek and Woessmann (2011a), a substantial body of work has recently developed in an international context, where differences in schools and in other factors are related to cross-country differences in achievement.

The analysis of cross-country skill differences used here is made possible by the development of international assessments of math and science (see the description in Hanushek and Woessmann 2011a). These assessments provide a common metric for measuring skill differences across countries, and they provide a method for testing directly the approaches to modeling growth, as found in equation (5).²⁵ Hanushek and Woessmann (2012) show that the achievement of the population is closely related to cognitive skills as measured by international math and science assessments and, importantly, that a casual interpretation is likely warranted.

The fundamental idea is that skills as measured by achievement, C , can be used as a direct indicator of the human capital of a country in eq. (5). And, as described in equation (2), schooling is just one component of the skills of individuals in different countries. Thus, unless the other influences on skills outside of school are orthogonal to the level of schooling, S , the growth model that relies on only S as a measure of human capital will not provide consistent estimates of how human capital enters into growth.

The impact of alternative measures of human capital can be seen in the long-run growth models summarized in Figure 4. The figure presents the result of estimating a simple model of long-run growth (g) over the period of 1960-2000 for the set of 50 countries with required data on growth, school attainment, and achievement (see Hanushek and Woessmann 2015). The underlying regression relates growth to initial levels of GDP and to human capital as measured by school attainment and cognitive skills measured by international test scores.²⁶ Not only is there a

should model the level of income. The former is generally identified as endogenous growth models (e.g., Romer 1990), while the latter is typically thought of as a neoclassical growth model (e.g., Mankiw, Romer, and Weil 1992). The distinction has received a substantial amount of theoretical attention, although little empirical work has attempted to provide evidence on the specific form (see Hanushek and Woessmann 2008).

²⁵This approach to modeling growth as a function of international assessments of skill differences was introduced in Hanushek and Kimko (2000). It was extended in Hanushek and Woessmann (2008) and in a variety of other analyses identified there.

²⁶The inclusion of initial income levels for countries is quite standard in this literature. The typical

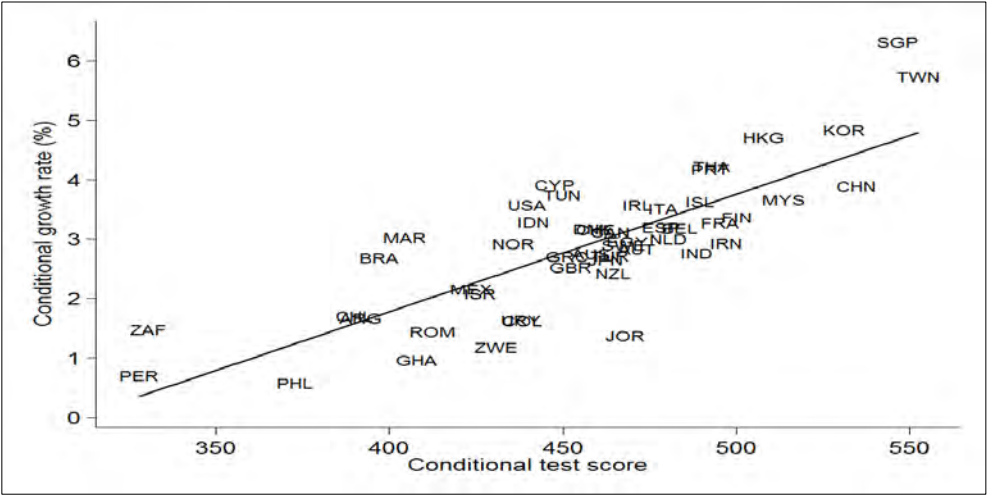


FIGURE 4. KNOWLEDGE CAPITAL AND ECONOMIC GROWTH RATES ACROSS COUNTRIES

Notes: Added-variable plot of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960-2000 on average test scores on international student achievement tests, average years of schooling in 1960, and initial level of real GDP per capita in 1960 (mean of unconditional variables added to each axis).

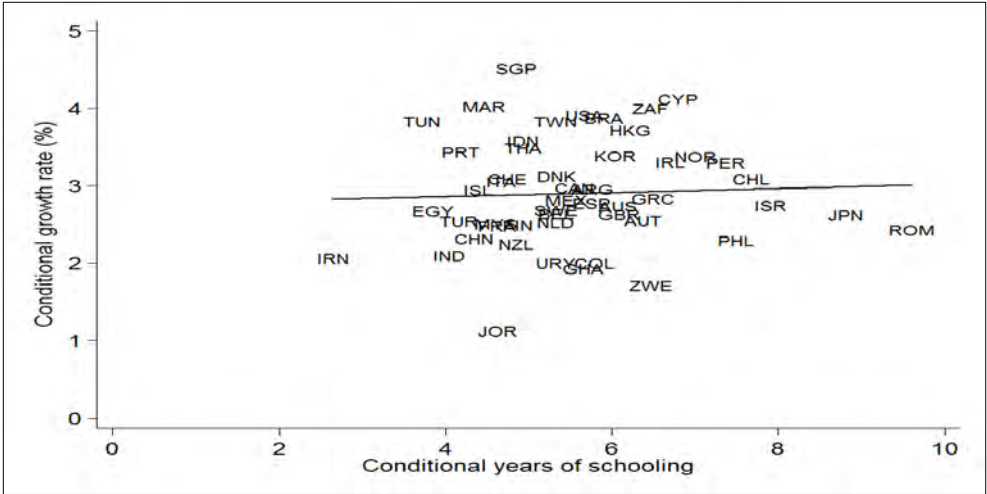


FIGURE 5. YEARS OF SCHOOLING AND ECONOMIC GROWTH RATES AFTER CONSIDERING KNOWLEDGE CAPITAL

Notes: Added-variable plot of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960-2000 on average test scores on international student achievement tests, average years of schooling in 1960, and initial level of real GDP per capita in 1960 (mean of unconditional variables added to each axis).

Source: Hanushek and Woessmann (2015).

interpretation is that this permits “catch-up” growth, reflecting the fact that countries starting behind can grow rapidly simply by copying the existing technologies in other countries, while more advanced countries must develop new technologies. Estimating models in this form permits some assessment of the differences between the endogenous and neoclassical growth models (see Hanushek and Woessmann 2011b).

significant relationship between cognitive skills and growth, but the simple model can also explain three-quarters of the variance in growth rates.

Importantly, as shown in Figure 5, once direct assessments of skills are included, school attainment is not significantly related to growth, and the coefficient on school attainment is very close to zero. Seen the other way, school attainment by itself can explain just one-quarter of the variation in growth rates across countries. These models do not say that schooling is worthless. They do say, however, that only the portion of schooling that is directly related to skills has any impact on cross-country differences in growth. The importance of skills and conversely the unimportance of schooling that does not produce higher levels of skills have a direct bearing on human capital policies for developing countries.

Finally, the estimated impacts of cognitive skills on growth are very large. The cognitive skills measure is scaled to standard deviations of achievement. Thus, one standard deviation difference in performance equates to two percent per year in average annual growth of GDP per capita.

For the measurement discussions here, two things are important, particularly as related to the prior evidence on wage determination. First, beyond cognitive skills (which in the aggregate we call the knowledge capital of nations) there is not much room for other factors to explain differences in growth rates. Second, while there was some confusion about how to interpret school attainment in the prior wage equations, there is no such confusion here – because only the portion of school attainment that is correlated with cognitive skills counts in the growth models.

VIII. Some Concluding Thoughts

Nobody doubts the role of human capital for either individuals or nations. But being able to measure the underlying skills consistently and accurately remains an issue. It is quite clear that school attainment cannot be a sufficiently accurate measure either for analysis of economic outcomes or for the development of appropriate policies. But the alternative is not fully certain.

Fairly recently there has been the development of data on cognitive skills – both for individuals and for nations – that provide one way to measure human capital. The development of various achievement tests has been going on for some time, so that many issues of internal reliability have been addressed. There still remain some questions about external validity and particularly the range of skills measured, but the prior results show that existing measures are strongly related to economic outcomes.

A parallel discussion of noncognitive skills has not moved to the same place yet. While there is considerable intuition behind the importance of noncognitive skills for individuals, and perhaps nations, there is less background in the measurement and testing of these.²⁷ Thus, for policy purposes, there is not strong guidance on when or how to consider noncognitive skill development.

²⁷See the development of these ideas in Heckman, Stixrud, and Urzua (2006). See also West *et al.* (2014) on the difficulty of measuring noncognitive skills and of understanding how they are produced.

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What Determines the DPRK's Anthracite Exports to China?: Implications for the DPRK's Economy[†]

By JONG KYU LEE*

Anthracite exports have special value within the DPRK's economy. In this paper, we focus on what determines the DPRK's anthracite exports to China. We use panel data consisting of cross-section data from 30 provinces in China and quarterly time-series data from 1998 to 2013. Controlling for all other variables that affect anthracite imports, the variable for steel production in China is robust and statistically significant. This is consistent with on-site interviews which indicate that much of North Korean anthracite is consumed by China's steel industry. This implies that the North Korean authorities need to make adjustments to the foreign trade structure, as the import demand for anthracite in China may decline further.

Key Word: DPRK Economy, Export, Economic Sanction

JEL Code: F1, F51

I. Background and Objective

It would not be an overstatement to say that the significance of China's role with regard to foreign trade by North Korea completely changed following the successive economic sanctions imposed by Japan (2006), the UN Security Council (2006, 2009, 2012 and 2013) and those of South Korea's May 24th Measure (2010), among others. As a result, China's share of North Korea's foreign trade continues to increase. According to a report by Korea Trade-Investment Promotion Agency (KOTRA), China accounted for 89.1% of North Korea's foreign trade (excluding trade with South Korea) in 2013. The UN and IMF also recorded high figures of 84.1% and 73.8%, respectively.¹ Even with the inclusion of trade with South Korea (the Kaesong Industrial Complex), China's share remained high at 77.2% according to KOTRA, 73.6% according to the UN and 65.4% according to IMF, reflecting the North's extraordinary dependence on China. A common characteristic

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[†] KOTRA's North Korean Foreign Trade Trends, the UN's Comtrade and the IMF's Direction of Trade Statistics primarily used mirror statistics for their collection of statistics. For papers that combine and compare these data, refer to Koh *et al.* (2008), Lee *et al.* (2010) and Kim (2007), among others.

of trade structures that are absolutely dependent on another country is that they are extremely vulnerable to external shocks. This is particularly true for North Korea's economy, as the basic economic structure is based on exporting underground resources (mainly anthracite and iron ore) to China to secure the foreign currency needed to import food, crude and various daily necessities from China.

From this perspective, North Korea's export of anthracite has special value within the country's economy. Although anthracite exports are not particularly competitive, it has been the main method to secure hard currency. In 2013, anthracite¹ took a 47.2% share in general exports (HS-6), far exceeding that of iron ore (10.1%), women's coats (3.5%) and squid (3.2%).² Furthermore, with an accumulated total of 1.37 billion dollars, anthracite exports outstripped other foreign currency channels, including labour dispatch and dollar absorption from the informal sector.³ Ergo, hard cash secured through anthracite exports has enabled a stable supply of commodities into North Korea. Considering that North Korea's economic structure leaves them no alternative but to rely on the outside for daily necessities, capital goods and strategic materials. It can be assessed that anthracite exports contributed significantly to the North's three consecutive years of positive growth⁴ and the stable downward trajectory of prices and exchange rates. Ultimately, anthracite exports have become the direct/indirect driving force that has maintained North Korea's economy recently.

The significance of anthracite exports is evident in the North Korean academic journal called 'Economic Research'. Kang (2012, p.55) emphasized that "there needs to be [a] balance between import and export in order to acquire the necessary goods in a timely manner without becoming indebted to other countries," while Choi (2013, p.34) wrote that "import trade is the process of buying the necessary goods through the use of foreign currency and export trade is the process of arranging the conditions needed for the development of import trade." Additionally, Kim (2010, p.40) noted that "expanding the import of foreign currency does not have a purpose within itself but is [done] to efficiently secure the foreign currency necessary for spending." Specifically, this represents reasoning that exporting is a prerequisite for the sufficient importing of required goods. Accordingly, stressing the export of competitive items, Choi (2013, p.34) emphasized the importance of exporting underground resources, stating that "extracting, processing and exporting these resources has substantial value as it will contribute to the development of the country's economy as well as enhance the people's livelihoods." Cho (2013, p.5) directly referred to the importance of coal, stating that "the development of the coal industry will lead to the development of electricity and metalworking industries, which are crucial parts of [the] people's economy."

However, despite its economic significance, there is a severe lack of quantitative

¹This paper classifies anthracite as HS270111 from the HS code 6 unit.

²Korean International Trade Association trade statistics. www.kita.net

³According to Greitens (2014), foreign currency acquired through the export of labour is about 150~230 million dollars per year, and the revenue from the mobile phone industry reached 400~600 million dollars. Also, the Ministry of Unification (2013) and Kim *et al.* (2013) estimated, respectively, that the DPRK earned 86 million dollars through the Kaesong Industrial Complex and earned 21.7 million ~ 34.6 million dollars through Chinese travelers in 2012.

⁴North Korea's real economic growth rate (Bank of Korea): 0.8% (2011), 1.3% (2012), 1.1% (2013)

research on what elements within China drive the export of anthracite.⁵ The only assessment that has been made is that North Korea's anthracite exports are influenced by China's domestic market. As such, this paper will attempt empirically analyse what elements of the Chinese market influence North Korea's anthracite exports. Sufficient empirical analysis in this area will enable South Korean policymakers to respond preemptively to changes in North Korea's foreign economic policy and establish appropriate inter-Korean policies by accurately understanding internal information on North Korea's economy.

Anthracite is mainly traded to nearby regions considering the regional industry due to its high transportation costs. North Korean anthracite⁶ is primarily exported to Shandong Province and Hebei Province via the Nampo port and the Songrim port, located in South Pyongan Province (South-North Institute, 2014 Report on North Korean Resources, p.7). Hence, this paper will examine North Korea-China anthracite trade by looking at each Chinese region separately. This will allow for an assessment of the regional factors (China) which influence the trade of anthracite between the two countries. A quantitative analysis will be conducted based on panel data pertaining to each Chinese province from 1998 to 2013, when the exporting of anthracite to China began to expand in earnest. Chapter II will examine earlier studies of China's domestic market and the literature on North Korea's foreign trade. Chapter III will present the methodologies and data mainly used in the analysis. Chapter IV will report the results of the main empirical analysis and the basic statistical analysis. Finally, chapter V will summarize the quantitative analysis results and discuss the political implications.

II. Literature Review

A. North Korea's External Trade

Research on North Korea's overseas trade can be largely divided into three categories.⁷ The most common of these are studies of the determinants of trade, wherein the 'gravity model' is applied to North Korea. Next are studies of the effects of international sanctions on North Korea's trade. Finally, there are studies of what effects the continuous expansion of overseas trade in the 2000s had on economic growth; there is a general consensus in this area.

Firstly, we review the research on the determinants of external trade. Lee (2010, p.109) used the gravity model to examine the main determinants. According to this study, four main determinants affect North Korea's trade: the income levels of North Korea and the trading country, geographical distances, whether there are North Korean residents in the trading country, and lastly whether the trading country has imposed economic sanctions on North Korea. Kim (2013, p.96)

⁵There have been diverse attempts both at home and abroad to account for North Korea's general foreign trade both quantitatively and statistically. These details will be discussed in the following chapter.

⁶25.80 million tons of coal is produced in North Korea per year, the majority of which is anthracite. Large-scale anthracite production facilities are mainly concentrated around the coal mines of South Pyongan Province.

⁷This paper will omit explanations of references pertaining to types and comparisons of North Korean trade data sources.

explained that “according to gravity theory, the rapid surge in China-North Korea trade is due to the sizable increase in China’s economic scale.” Both studies pointed to the expansion of China’s domestic demand as the most important factor causing the increase in China-North Korea trade. In the paper by Lee (2006, pp.28~29) case, he stressed the importance of institutional support, including border trade-based tax cuts in addition to factors based on the gravity model.

Upon an examination of the research on the effects of international sanctions, there is a general consensus that sanctions have almost no impact.⁸ In particular, many view that China’s loose sanctions on the North diminish the effects of international sanctions. Jeong and Bang (2009, pp.43~44) conducted an empirical analysis of panel data focused on the North Korean sanctions imposed by the international community in 2006 and found that North Korea’s overseas exports expanded even in the aftermath of the sanctions. Nanto and Manyin (2010) asserted that China did not rigidly enforce tariff regulations on dual-use products and luxury items, thus diminishing the effects of the sanctions. Sung (2009) also found that the sanctions failed to have an impact in terms of external performance, as China filled the voids of trade partners. Lee and Hong (2013, pp.94~95) also discovered via on-site investigations that China “did not want to impose harsh sanctions which could weaken the North Korean regime and cause economic chaos.”

Undoubtedly, there are studies such as that of Lee and Lee (2012, p.31), which determined that South Korea’s May 24th Measure led to North Korea’s excessive exports of strategic materials to China, which in turn negatively influenced North Korea’s economic structure in the mid- to long-term.⁹ On the other hand, upon his empirical analysis of the effects of Japan’s sanctions, Lee (2010, p.140) found that “there are implications [pertaining to] ... the probability that sanctions imposed by Japan affected North Korea’s imports rather than its exports.” This shows specifically that although sanctions imposed by individual countries had an impact, North Korea was able to avert a crisis by replacing the lack of trade with an expansion of trade with China.

There is also a general consensus with regard the fact that the expansion in North Korea’s external trade was the driving force behind its overall economic growth. Kim (2011) used time-series data from 1990 to 2009 to deduce that North Korea’s exports to China contributed to its long-term growth. Lee and Hwang (2009) also used time-series data from 1970 to 2007 to find that North Korea’s external trade contributed significantly to its economic growth.¹⁰ Kim (2013) asserted that China’s increased demand and a rise in international raw materials prices bolstered North Korea’s exports and thus contributed to the expansion of production and an influx of foreign currency, with imported industrial commodities contributing to the increase in production.

However, a new argument has recently emerged regarding the possibility of North Korea experiencing ‘immiserizing growth.’¹¹ Lee (2006) noted that China’s

⁸This can be easily inferred from the yearly expansion in the North Korean trade volume despite the sanctions imposed by the UN, Japan, US and Korea.

⁹Lee and Kim (2011) empirically demonstrated that North Korean arms exports decreased following the sanctions (UNSC resolutions 1717 in 2006 and 1874 in 2009).

¹⁰However, this research was noted for its problems in selecting estimations for the nominal GDP rather than the real GDP as the explained variables.

¹¹Bhagwati (1958) pointed out that for countries which export primary goods, the level of welfare may

rapid growth from 2000 to 2004 prevented the price of primary commodities from falling and as such deterred immiserizing growth in North Korea. However, more recently, declining prices of North Korean anthracite and iron ore have been partially witnessed despite the increase in exports, as the demand from China is unable to support the supply (Lee 2014, p.53). Moreover, it can be said that the possibility of immiserizing growth in North Korea has increased given expectations that China will be unable to sustain the rapid growth of its economy and anthracite-related industries.

In sum, research on the determinants of North Korea's external trade can be comprehensively organized as follows. North Korea's overseas trade is positively related to China's rapid growth and expansion of domestic demand, offsetting the negative effects of sanctions imposed by the UN Security Council. Furthermore, as expansion in trade ultimately leads to recovery and growth of the economy, the increased trade with China was a significant underlying contributor to North Korea's growth in the 2000s. However, there are limitations to sustainable growth in an economy that bases the expansion of exports on underground resources. Even if the economy is able to maintain exports that are heavily dependent on underground resources, it cannot be a factor for mid- to long-term sustainable growth, as it carries the possibility of immiserizing growth, in which the terms of trade deteriorate and welfare declines.

B. Demand for Anthracite Imports in China

There is a lack of research that quantitatively analyses North Korea's anthracite exports as a separate entity. Instead, research on the levels of China's coal and anthracite¹² demand can be found both domestically and internationally and can be used as a substitute for the determinants of North Korea's anthracite exports.

Currently (based on 2010 data),¹³ coal accounts for approximately 70.5% of China's energy consumption¹⁴ and it is mostly utilized in the production of electricity (56%), steel (15%), cement (13%) and chemicals (5%). Cattaneo *et al.* (2011) also noted that consumption occurred in the production of electricity, metals and chemicals, and construction. According to the EIA,¹⁵ despite being the world's largest coal producer, producing roughly 3.65 billion tons of coal (based on 2012 data), China's demand for coal has increased sharply since the early 2000s. Accordingly, China transitioned from a coal exporter to coal importer in 2008. For anthracite, China was already an importing country in 2005 on the back of the rapidly increasing imports of less expensive anthracite from North Korea and Vietnam.

To explain the cause of the increase, the majority of research points to China's increased demand, the decline in domestic production, and weakening price

decline as a result of weakening trade conditions due to a decline in export prices despite an expansion in exports.

¹²The World Coal Association stipulates that the carbon content of coal must be over 70%: peat (60%), lignite and sub-bituminous coal (70%), bituminous coal (80~90%), anthracite (95%).

¹³However, the Chinese government announced plans to cut the rate of coal consumption to 65% by 2017.

¹⁴Bae and Ahn (2012), 'Background and Implications of the Rapid Increase in China's Anthracite Import,' Global Economy Brief, Bank of Korea, 2012~22.

¹⁵U.S. Energy Information Administration (International Energy Statistics). www.eia.gov

competitiveness. Bae and Ahn (2012, pp.4~7) noted that “despite the increased demand for coal, industrial restructuring triggered a decrease in domestic production and a discrepancy in the demand and supply of high-quality coal, and imports surged on the back of the weakening price competitiveness of domestic coal.” Specifically, domestic production failed to meet the increase in domestic demand, leaving no alternative but to increase imports. Likewise, Bae (2011, pp.50~53) pointed to the repercussions of China’s rapid economic growth as the reason for the increase in coal imports and indicated that the reason China particularly focused on North Korean anthracite was because “in the midst of the heated global competition to secure resources, it was important for China to receive stable supplies from friendly nations and also, the transportation costs using ports was more efficient than the cost of transporting coal within China.”¹⁶ Tu and Johnson-Reiser (2012) also found that the “increased demand led by China’s rapid industrialization,” “limitations of China’s railway transportation” and “the restructuring of mid-size to small coal mining” operations were the reasons behind the rapid increase in China’s coal imports.

Additionally, there have been diverse attempts to estimate the increase in the demand for coal imports quantitatively. Masih and Masih (1996) used dynamic OLS based on data from 1953 to 1992 to prove that mid- to long-term prices and income flexibility were connected. Chan and Lee (1997) applied an error correction model using time-series data from 1953 to 1994 to estimate that China’s demand for coal would increase from 1.2 billion tons in 1994 to 1.48 billion tons in 2000. Moreover, in an effort to estimate China’s energy demand, Crompton and Wu (2005) utilized VAR (Bayesian vector autoregression) based on data from 1956 to 2003 and predicted that coal demand will increase by 3.3% from 2004 to 2010. From a slightly different perspective, research has also focused on efficiency rather than on the total amount of energy consumption. In some of these studies, it has been determined that the energy consumption per person or rate of increase in energy consumption compared to GDP will gradually decline as energy efficiency gradually increases. The findings of Kambara (1992), Garbaccio *et al.* (1999) and Chu *et al.* (2000) are all in good agreement with this conclusion.

In contrast to the aforementioned findings, which were the results of estimations of China’s total coal demand, work by Cattaneo *et al.* (2011) was special in that it considered provincial coal demand levels separately when estimating the differing levels of demand according to the region. Above all, because the distribution cost of coal accounts for a large portion of its price, coal trade is mainly conducted between regions that are in close geographical proximity. Reflecting this characteristic, this model attempted to reflect reality by considering regional sizes, GDPs and the weights of heavy industries as well as the spatial correlation between regions as factors that increase the demand for coal.¹⁷ Moreover, based on yearly and regional data from 1995 to 2002,¹⁸ it was found that the regional size, GDP,

¹⁶While China’s transport of coal by rail increased by 4.6% between 1980~2010, transportation by sea increased by 19.0% (Tu and Johnson-Reiser 2012, pp.5~6).

¹⁷In order to consider the influence of regions, two variables were taken into consideration. First, 1 was assigned when two regions share the same border, and 0 was assigned if not (w1). Secondly, the decay function according to distance, specifically, the Euclidean distance, was applied if the distance between the two regions was less than 600km, with 0 applied for those with distances greater than 600km (w2).

¹⁸Twenty two provinces, five autonomous regions, four municipalities, and two special administrative regions.

weight of heavy industry and the degree of spatial autocorrelation all had a strong positive (+) relationship with the coal demand level.

III. Methodology and Data

A. Methodology

Based on a quantitative model, in this research attempts are made to examine the factors that influence North Korean anthracite imports by region in China. Similar to the demand levels for other raw materials, the demand for anthracite is not important per se but is closely connected to the demand for final goods and changes with it.¹⁹ Specifically, anthracite demand is influenced by the production volume of the final goods and the share of anthracite used per final goods. Tilton (1990) used the total GDP, MCP (material composition of products), and PCI (product composition of income) to estimate the demand for steel. When similar reasoning is considered, it can be assumed that the demand for anthracite will also be affected by these factors and will be changed by them.

$$(1) \quad MCP_t = \frac{DA_t}{FP_t}$$

First, the share of anthracite in the final product (MCP) can be expressed as (1). Here, DA_t (demand for anthracite) refers to the industrial demand for anthracite, and FP_t (final product) refers to the final product of a specific industry. In MCP cases, the results may vary according to developments in science and technology, the emergence of anthracite substitutes, and discoveries of new processes.

$$(2) \quad PCI_t = \frac{FP_t}{GDP_t}$$

Next, the share of the final product in the total economy can be expressed as (2), which may vary according to changes in GDP and/or policies based on changes in consumer preferences. Based on this, the demand for anthracite in all industries (id) can be summarized by the following identical equation:

$$(3) \quad DA_{id,t} = (GDP)_t \sum_{id=1}^n (MCP)_{id,t} (PCI)_{id,t}$$

Here, if (1) and (2) are combined, the equation for anthracite demand can be expressed as (3), and it is possible to predict the demand for anthracite using GDP projections, the share of anthracite in the final product (MCP), and the share of the final product in the total GDP (PCI). Consequently, it can be deduced that one of the most important determinants of anthracite is the demand for final products.

If this is rearranged into China's provincial demand for North Korean anthracite, it can be expressed as a functional equation, as in (4).

¹⁹Refer to Ball and Loncar (1991), Roberts (1990), Tilton (1990), Cattaneo *et al.* (2011).

$$(4) \quad IMDA_{i,t} = f(Z_{i,t}, X_{i,t}, CH_i, NK_t)$$

In the equation above, $IMDA_{i,t}$ represents the demand for anthracite of a specific Chinese region (i) in each quarter (t); the demand is limited to the demand for imported North Korean anthracite. Considering that anthracite is traded between regions that are in close proximity, analyzing China's market by region is significant. First, $Z_{i,t}$ represents the demand for the final product, which influences the demand for anthracite. Anthracite is mainly used in the production of electricity, steel, cement and fertilizer. As such, these will be important determinants of the level of demand for North Korean anthracite imports. In addition, $X_{i,t}$ denotes the set of control variables. For example, the economic condition of each specific region is expected to have an indirect impact on the demand for anthracite imports. This can be estimated by the quarterly GDP of each region. Also, the unit price of anthracite imports, the traditional determinant of demand, can be a determining factor for the demand level. Additionally, as China is a producer as well as an importer of anthracite, it is highly probable that there is a close connection between the production volume of a specific region in China and the level of anthracite import demand. As such, it is possible that the regions' anthracite production volumes can also influence demand as a substitute.²⁰ Furthermore, geographical variables such as the distance between regions (CH_i) and variable specific to North Korea (NK_t) such as sanctions imposed by the international community, which reflect the trade with North Korea according to the period, should be included. The next section will examine in detail the dependent variables and independent variables that will be used in the empirical analysis.

B. Data

This paper focuses on specifically which demand factors within China affect North Korea's anthracite exports. To do so, provincial and quarterly panel data from China was used.²¹ Through this process, the effects of different variables that influence trade between China and North Korea can be understood in more detail, and the efficiency of the estimations is enhanced as the degree of freedom is increased. Moreover, the characteristics of specific regions that may be overlooked if China is examined as a whole can be reflected, thus resolving the problem of omitted variable bias (Wooldridge 2003). The panel data used in this analysis encompasses data from a total of 30 regions which consist of 22 provinces, four metropolitan cities and four autonomous regions (excluding Tibet), from 64 quarters ranging from the first quarter of 1998 to the fourth quarter of 2013. However, the actual number of observations will be much lower because there were only 17 provinces that have records of trade with North Korea. Moreover, in

²⁰There are problems in making domestic anthracite production as a substitute as production regions (mainly central regions) and consumption region (mainly eastern regions) differ from each other. As such, it may be an inappropriate variable to use in the analysis of each province. For detailed contents refer to "basic statistics" in this paper.

²¹As the import of coal of each province estimated, comparisons can be made with Cattaneo *et al.* (2011)'s research among preexisting research.

some provinces, there were only a few periods with records.

In order to determine the factors which have affected North Korea's anthracite exports, the estimation equation incorporated North Korean anthracite export amounts for each province as the dependent variable and regional and economic characteristics as control variables. Also used as the dummy variable were the periods during which the UN Security Council imposed sanctions. Specifically, which factors from among the regional economy, the demand for anthracite (e.g., production of electricity, steel), prices (price of anthracite), substitutes (domestic anthracite production), geography (the distance from North Korea) and North Korean factors (the periods of UN sanctions) had the greatest impact on North Korea's anthracite imports were examined. The estimation method used general panel model estimation techniques, including a fixed-effects model and a random-effects model. The equation used for the estimation is shown below.

$$(5) \quad \ln(ex)_{i,t} = \beta_0 + \beta_1 \ln(ep)_{i,t} + \beta_2 \ln(sp)_{i,t} + \beta_3 \ln(pgdp)_{i,t} + \\ \beta_4 \ln(price)_{i,t} + \beta_5 \ln(ap)_{i,t} + \beta_6 \ln(dist)_i + \beta_7 UN_t + \mu$$

The data used was primarily from KITA's trade statistics database and from the CEIC's (Euromoney Institutional Investor Company) China Premium database. Additionally, Globefeed was used to determine the distance between each Chinese province and North Korea. Of course, because statistical data from August to November 2009 have been omitted from KITA's data, as discussed in Lee *et al.* (2013), there is a possibility that the rapid decrease in North Korean trade may appear exaggerated.²² In order to offset this issue, this paper will use revised data to control for this effect.

After examining each variable closely, I chose to use North Korea's export anthracite volume by province at each quarter as dependent variable. The electricity production (ep) and steel production (sp) of each particular region were used as an indicator of anthracite demand. These two industries were selected, as they account for the majority of anthracite consumption. The economy of each region is expected to have a positive (+) relationship with anthracite demand, and electricity and steel production are also expected to have positive influences. Quarterly GDP (pgdp) for each province was used as the explanatory variable to reflect the economy of each region. On the other hand, domestic anthracite production (ap), which can be considered as a substitute, is expected to have a negative (-) relationship with import demand, as is the price of North Korea's anthracite. Additionally, as anthracite trade entails high transportation costs, the fact that anthracite is traded between close regions was taken into consideration, and the distance between North Korea and the each Chinese region (dist) was used as a simple indicator. Based on the fact that trade increases as distance decreases, the distance from North Korea is expected to have a negative (-) relationship in this regard. In order to control for the international community's sanctions on North Korea, which can be an obstacle to trade between North Korea and China, the

²²As it happens, Kim Jong Il prohibited the export of anthracite from North Korea starting in August 2009. Although the ban continued until August 2010, it seems that it could not be banned completely. Regardless, given this impact, North Korea's anthracite exports in 1H 2010 declined by 59% yoy (based on US dollars).

impact of UN sanctions was included as a dummy variable. Specifically, 1 was applied to quarters when UN sanctions were imposed, and 0 was applied to quarters without sanctions.²³ In particular, strict criteria are required because the researcher's discretion can influence the UN sanction dummy; as such, 1 will be applied to only UN Security Council resolutions.²⁴

IV. Empirical Analysis

A. Basic Statistical Analysis

Before presenting the results of the regression analysis, this section will examine the basic statistics and present conditions of a total of 30 regions. First, Table 1 presents the basic statistics of the data. A salient aspect is that there is a significant difference in the number of observations between the dependent and independent variables. There are only 360 observations of the dependent variable for North Korea and 335 observations for Vietnam. In fact, 17 regions recorded anthracite imports from North Korea, while not even one case was recorded in the remaining 13 regions (Table 1).

TABLE 1—DATA SUMMARY

Variables	Unit	Obs	Mean	Std. Deviation
Anthracite Import (Volume)				
Anthracite Imports from the UK	Ton	360	170,114	334,006
Anthracite Imports from Vietnam	Ton	335	531,473	863,122
Demand for Final Goods				
Electricity Production	Billion kWh	1,978	22.2	19.8
Steel Production	Thousand ton	1,556	4,656.5	6,993.1
Import Price				
NK Import Price	\$/ton	360	60.7	45.5
Vietnam Import Price	\$/ton	335	78.4	321.0
Substitute Goods				
Coal Domestic Production	Thousand ton	1,441	14,505	23,988
China's Anthracite Exports	Ton	630	122,924	213,118
Economic Condition				
Real GDP	Billion yuan	1,697	244.9	270.4
Geographical Factor				
Distance from Pyongyang	km	1,984	1,579.8	270.4
Distance from Hanoi	km			
Sanction Effect				
UN Security Council Resolution	Dummy	1,984	0.08	0.27

Source: KITA, CEIC, Globefeed.

²³For literature that primarily investigates the impact of UN sanctions, refer to Lee and Kim (2011), Jeong and Bang (2009), Lim (2013), Sung (2009), Yang and Ha (2012).

²⁴Five resolutions were observed in total, i.e., UNSC resolutions 1695 in the third quarter of 2006 (the Taepodong-2 launch); 1718 in the fourth quarter of 2006 (the first nuclear test); 1874 in second quarter of 2009 (the second nuclear test), 2087 in the fourth quarter 2012 (the Kwangmyongsong-3 launch) and 2094 in the first quarter 2013 (the third nuclear test).

TABLE 2—CHINA'S ANTHRACITE IMPORTS

Year	Imports from North Korea (thousand tons)	Imports from Vietnam (thousand tons)	Total Imports (thousand tons)
1998	27.3 (62.5%)	16.4 (37.5%)	43.7 (100%)
1999	12.2 (8.5%)	130.8 (91.4%)	143.0 (100%)
2000	8.1 (3.8%)	205.0 (96.2%)	213.2 (100%)
2001	86.4 (19.5%)	357.1 (80.5%)	443.6 (100%)
2002	406.5 (14.7%)	2,241.6 (81.0%)	2,768.8 (95.6%)
2003	745.3 (22.0%)	2,492.0 (73.7%)	3,382.8 (95.7%)
2004	1,571.3 (20.1%)	6,116.2 (78.2%)	7,819.3 (98.3%)
2005	2,804.2 (21.9%)	9,926.3 (77.6%)	12,789.6 (99.5%)
2006	2,480.7 (11.0%)	20,078.6 (88.7%)	22,625.9 (99.7%)
2007	3,740.9 (13.2%)	24,611.6 (86.6%)	28,414.2 (99.8%)
2008	2,536.6 (13.1%)	16,843.9 (86.9%)	19,387.9 (100%)
2009	2,972.2 (8.6%)	24,077.9 (70.0%)	34,388.1 (78.7%)
2010	4,603.4 (17.4%)	18,046.6 (68.2%)	26,461.2 (85.6%)
2011	11,047.6 (30.6%)	22,032.8 (61.0%)	36,130.3 (91.6%)
2012	11,807.1 (34.3%)	17,423.1 (50.5%)	34,471.0 (84.8%)
2013	16,494.5 (41.6%)	13,142.0 (33.1%)	39,646.8 (74.8%)

Note: The share of China's anthracite imports from each country is in parenthesis.

Source: KITA.

China's anthracite import market was always led by Vietnam, but as a result of the rapid increase in North Korean anthracite imports in recent years, North Korea became the largest exporter of anthracite to China,²⁵ though anthracite imports from both countries have been on a downward trajectory since 2009 owing to the increase in the imports of Australian and Russian anthracite. Nonetheless, North Korea and Vietnam account for the bulk of China's anthracite import market, taking up approximately 74.8%.

With regard to the proportion, anthracite from these two countries appears to have been considered a substitute, but in the aspect of its final destination it seems that they are not. North Korea's high-quality anthracite is mainly used in the steel and ceramics industries, while Vietnam's lower quality anthracite is mostly used in power plants.²⁶ Furthermore, the main export destinations of both countries' anthracite differ. As such, rather than regarding North Korean and Vietnamese anthracite as interchangeable, they should be regarded as substitutes for the anthracite production of each region.

For a more detailed analysis, the paper will look into the anthracite import volume of each region. The anthracite import of 17 eastern regions that are in close proximity were mainly observed, and from those it was determined that trade was mainly concentrated in the eastern coastal regions, such as Shandong, Liaoning, Hebei and Jiangsu (Figure 1). The remaining 13 regions had no trade and in two regions imports were only recorded in one quarter, once again confirming that geography is an important factor in anthracite trade. It is expected to be used in steel and ceramic industries. On the other hand, for Vietnamese anthracite, it was

²⁵In July of 2013, the Vietnamese government raised the export tariff from 10% to 15%; as such, changes are to be expected.

²⁶In order to be used by steel and ceramics companies, anthracite must essentially go through a coal-washing process, but as Vietnam has very few or no coal washing facilities, inevitably it is sold to power plants at low prices (Korea Resources Corporation, Inter-Korean Resource Cooperation Dept. Head Bhang Gyung Jin interview, July 2014).

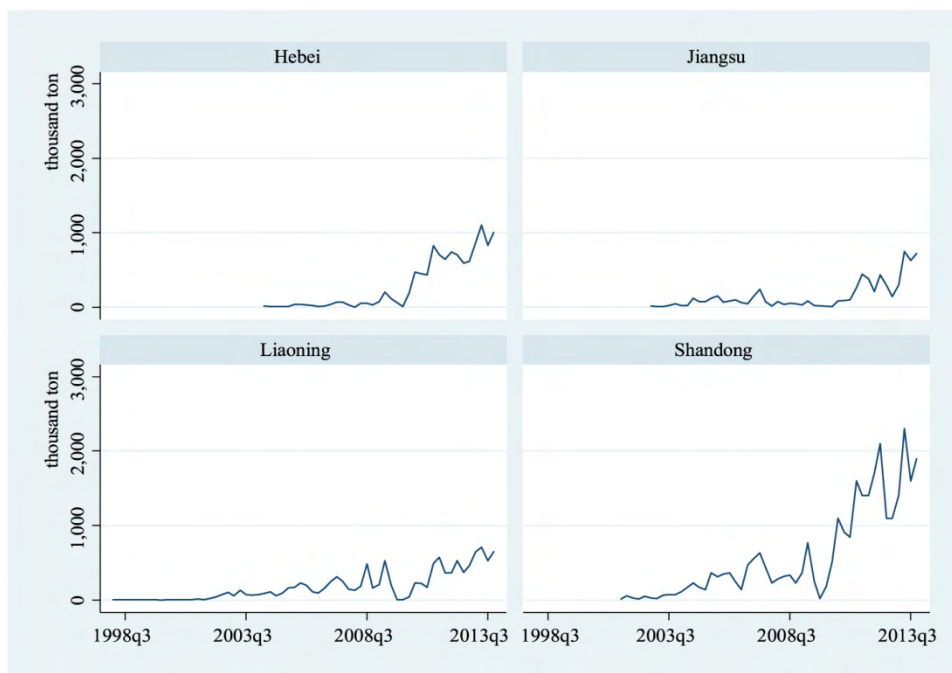


FIGURE 1. ANTHRACITE IMPORTS FROM NORTH KOREA: MAIN PROVINCES

Note: Imports for quarters are recorded in Anhui, Beijing, Fujian, Guangdong, Guangxi, Hebei, Heilongjiang, Hainan, Jiangsu, Jilin, Liaoning, Shandong, Shanghai, Tianjin, Zhejiang (15 Provinces); In the case of Shanxi and Inner Mongolia, imports were only recorded in one quarter (2 Provinces); Imports are zero for all quarters in Chongqing, Gansu, Guizhou, Hainan, Hubei, Hunan, Jiangxi, Ningxia, Qinghai, Shaanxi, Sichuan, Xinjiang, and Yunnan (13 Provinces).

Source: KITA.

mainly exported to 17 southern regions and was concentrated in the south, which is close to Vietnam. These areas include Guangdong, Guangxi, Hainan and Hunan (refer to Figure A1). It is expected to be used in power plants.

Table 3 examines the recent anthracite import volume, the weight of imports, import prices, and each region's share in North Korea's total anthracite exports for the four main recipients of North Korean anthracite. According to the table, Shandong imported the largest amount of anthracite from North Korea, at 7.2 million tons, representing 92.3% of the region's total anthracite imports and 44.1% of North Korea's total anthracite exports. In particular, the demand mainly derived from Rizhao Steel in Rizhao, ceramic and nickel smelting companies in Linyi, and ceramic companies in Zibo.²⁷ Hebei is the next largest importer, with 50.0% of the region's anthracite coming from North Korea, accounting for 23.3% of North Korea's total anthracite exports. The steel companies in Tangshan and Tianjin are the main source of demand. Liaoning imports 69.4% of anthracite from North Korea and accounts for 15.3% of North Korea's anthracite exports. Moreover, although the transportation cost is the highest for Jiangsu, as it is in the most

²⁷Korea Resources Corporation, Inter-Korean Resource Cooperation Dept. Head Bhang Gyung Jin interview (July 2014).

TABLE 3—ANTHRACITE IMPORTS FROM NORTH KOREA: MAIN PROVINCES (2013)

Province	Volume (thousand ton)	Import Share in the Province (%)	Import Price in the Province (\$/ton)	Share in DRPK's Anthracite Export (%)
Shandong	7,200	92.3	81.9	44.1
Hebei	3,800	50.0	82.4	23.3
Liaoning	2,599	69.4	89.0	15.3
Jiangsu	2,400	70.6	85.0	14.7

Source: KITA, CEIC.

southern part relative to the six eastern provinces, there is demand for anthracite there as well due to the development of the steel industry, which includes Baosteel (South-North Korea Association Report no. 3, pp. 6). The region procures 70.6% of anthracite from North Korea and accounts for 14.7% of its total anthracite exports.

As noted from the current imports of each region's and the main source of demand, North Korean anthracite imports are mainly led by steel and ceramics companies. In addition, as the price and quality is relatively high, the ratio of North Korean anthracite used at power plants which use low-quality anthracite is proportionately low.

The following paragraph will examine the characteristics of the regions that import large volumes of anthracite. When looking at China as a whole, 26 regions recorded anthracite imports least once during the period, and they were concentrated in Shandong, Hebei, Guangxi, and Guangdong Provinces. In Table 4, there appears to be no particular correlation between the import volume, electricity and steel production, and the region's economic scale. Upon an examination of the unique regional characteristics, Guangdong was the largest producer of electricity, while Hebei produced the most steel. It is presumed that Guangdong, along the southern coast, uses mainly anthracite in power plants,²⁸ while anthracite is mostly used in the production of steel in eastern coastal areas such as Hebei and Shandong.²⁹ In particular, based on the production volume, ten out of the world's top 20 steel producers are Chinese,³⁰ most of which are in eastern coastal areas such as Shandong, Hebei and Jiangsu. Furthermore, it has been determined that overlapping investment and oversupply have become major issues due to the large number of small to medium steel companies in rural areas.³¹

²⁸“In order to reduce costs in response to weakening profitability due to the rise in the procurement price of coal, thermal power generation companies prefer imported products.” (Bank of Korea 2012, p.7)

²⁹The production volume (2013) of China's steel (crude steel) took first place in the global market with 780 million tons.

³⁰World ranking (2013): Hebei Iron and Steel (3rd), Baosteel (4th), Wuhan Iron and Steel Corp. (5th), Shengang Group (7th), Angang Steel Company (8th), Shougang Corp. (9th), Shandong Steel (12th), Tianjin Boai Enterprise (15th), Maanshan Iron and Steel (17th), Benxi Iron and Steel (19th)

³¹As a response, the Chinese government recently expressed its strong will to restructure with announcements on penal provisions with regard to inefficient facilities and companies which continue to use obsolete equipment (Korea Investors Service 2014, pp.4-5)

TABLE 4—CHINA'S ANTHRACITE IMPORTS: DATA SUMMARY OF MAIN PROVINCES (2013)

Province	Import Volume (thousand ton)	Province GDP (billion yuan)	Electricity Production (billion kWh)	Steel Production (thousand ton)
Shandong	7,807	5,468	295.2	82,609
Hebei	7,650	2,830	209.1	230,485
Guangxi	6,694	1,438	101.3	29,392
Guangdong	6,290	6,216	330.6	33,763
Liaoning	3,552	2,707	101.3	67,490

Source: KITA, CEIC.

B. Regression Analysis

The empirical analysis was conducted based on the previously explained estimations. The volumes of North Korea anthracite by region/quarter were used as the dependent variables in the regression analysis. Then, the demand for anthracite in final goods (electricity and steel production), import prices, and quarterly regional GDPs were used for the independent variables. Also, other control variables such as the physical distance between North Korea and each region, and the periods of UN sanctions were used. All of the variables used natural logarithm values to estimate how much the percent change in the independent variables affected the percent change in the dependent variables in each quarter.

In order to control for the unobserved characteristics of each region, the fixed-effects model was determined to be most appropriate. In addition, the fixed-effects model was preferred according to the Hausman test. Also, by including time dummy variables, our analysis took the trend of North Korea's anthracite exports in the 2000s into consideration.

Table 5 shows the results of the regression analysis through combinational changes to electricity and steel production, which are the source of the demand for the anthracite in final goods. By including electricity production (1) in the first estimation, steel production (2) in the second estimation and both (3) in the third estimation, the significance of the combination of variables was examined.

First, as shown in (1), electricity was found to be insignificant. Rather, it can be determined that the price effect is more important in that as the price of imports increases, anthracite imports in the corresponding quarter decrease. However, when steel production is included, as in (2), the demand for final goods has a very significant positive (+) relationship, while the price variable has negative (-) significance. Finally, in (3), both factors were included, and it was determined that while North Korean anthracite exports were strongly influenced by China's regional steel production, electricity was of no particular significance. Accordingly, when China's regional steel production increased by 10%, North Korean anthracite imports into the corresponding region also increased by 17.1%. Again, the price variable proved to be significant, and when the import price increased by 10%, North Korean anthracite imports decreased by 12.8%. On the other hand, electricity production, regional economies, and UN resolutions³² seem to have no particular

³²According to Table 5 (2), during sanction periods, North Korea increased its anthracite exports to China by $100 \times (e^{0.531} - 1) = 0.7\%$. However, when considering that there was no significance in (3), the credibility of this result

TABLE 5—REGRESSION RESULTS: ANTHRACITE IMPORTS FROM NORTH KOREA³³

	(1) EP		(2) SP		(3) EP&SP	
	FE	RE	FE	RE	FE	RE
log (electricity)	0.203 (0.702)	0.904*** (0.333)			-1.058 (0.727)	0.0451 (0.321)
log (steel)			1.525*** (0.337)	1.582*** (0.228)	1.711*** (0.359)	1.537*** (0.237)
log (price)	-1.884*** (0.386)	-0.192 (0.238)	-1.235*** (0.449)	-0.188 (0.229)	-1.280*** (0.449)	-0.197 (0.228)
log (province GDP)	-0.341 (0.617)	1.075*** (0.280)	-0.544 (0.593)	-0.0494 (0.294)	-0.419 (0.598)	-0.0254 (0.294)
UN Dummy	2.286** (1.078)	-0.283 (0.250)	5.311*** (0.959)	-0.241 (0.221)	1.134 (1.005)	-0.245 (0.223)
log (distance)		-1.199* (0.666)		-0.356 (0.661)		-0.387 (0.615)
Constant	22.55*** (4.885)	16.45*** (4.539)	7.821 (5.449)	6.645 (4.730)	13.68** (5.716)	6.996 (4.439)
Time Dummies	Yes	No	Yes	No	Yes	No
Observations	330	330	325	325	325	325
R-squared	0.571	0.186	0.528	0.242	0.532	0.241
No. of Provinces	15	15	15	15	15	15

Note: Standard errors are reported in parenthesis.

*** significant at the 1 percent level.

** significant at the 5 percent level.

* significant at the 10 percent level.

TABLE 6—REGRESSION RESULTS: ANTHRACITE IMPORTS FROM NORTH KOREA (REVISED DATA)

	(4) EP		(5) SP		(6) EP&SP	
	FE	RE	FE	RE	FE	RE
log (electricity)	0.193 (0.696)	0.876*** (0.332)			-1.057 (0.721)	0.0149 (0.318)
log (steel)			1.516*** (0.335)	1.611*** (0.226)	1.703*** (0.357)	1.580*** (0.236)
log (price)	-1.850*** (0.384)	-0.177 (0.237)	-1.193*** (0.446)	-0.175 (0.226)	-1.280*** (0.449)	-0.178 (0.226)
log (province GDP)	-0.315 (0.613)	1.076*** (0.277)	-0.523 (0.589)	-0.0832 (0.291)	-0.419 (0.598)	-0.0559 (0.291)
UN Dummy	-3.824** (1.067)	-0.297 (0.247)	4.234*** (0.828)	-0.258 (0.217)	1.134 (1.005)	-0.260 (0.219)
log (distance)		-1.227* (0.679)		-0.379 (0.666)		-0.389 (0.626)
Constant	28.43*** (4.818)	16.69*** (4.630)	8.659 (5.391)	6.712 (4.762)	13.68** (5.716)	6.902 (4.505)
Time Dummies	Yes	No	Yes	No	Yes	No
Observations	332	332	327	327	327	327
R-squared	0.568	0.190	0.522	0.251	0.526	0.251
No. of Provinces	15	15	15	15	15	15

Note: Standard errors are reported in parenthesis.

*** significant at the 1 percent level.

** significant at the 5 percent level.

* significant at the 10 percent level.

is damaged. As such, it can be concluded that UN sanctions have no particular impact on North Korea-China trade.

³³Also, in order to control for the effect of the business cycle, we included real estate investments by province, finding that the overall results still hold (See Table A1).

significance.

In Table 6, we run a regression with revised statistics for the year 2009. The data for August to November of 2009 are missing in the Chinese customs statistics (KITA data). In order to augment this, we thoroughly analyzed the data and concluded that the omitted period could be classified separately under the category of 'other Asian trade'. Based on this, we added 'other Asian trade (August~November)' and 'DPRK trade (January~July, December)' for the Chinese customs statistics, finding that the sum of these two categories is similar to the amount of exports recorded for the entire year of 2009 in the UN Comtrade data (See Table A2 for details). As for most items, including crude oil, iron ore, and clothes, this trend is very consistent. Therefore, we assume that we have better data consistency. Also, the regression results with the revised data still hold: Chinese steel production matters to the export of North Korean anthracite in a positive way, whereas the import price affects the quantity negatively. Again, other variables such as economic conditions, geographical factors, and the political environment are not significant.

As the regional/quarterly data on China's anthracite production could not be obtained, the substitution variables for North Korean anthracite imports were not included in the previous estimation.³⁴ Instead, the regional anthracite exports were included as a variable for estimation (Table A3). The basic premise behind this is that as more anthracite is produced, the export capacity increases. However, there is a problem with such a variable, as there are differences between regions that import anthracite (Guangdong, Guangxi, Shandong, Liaoning, and Hebei) and those that export anthracite (Shanxi, Beijing, Inner Mongolia, and Ningxia) which as such may not affect the anthracite imports of each region. Despite this problem, substitute variables were used to obtain an estimate that was similar to previous results in Table 5 and Table 6. China's regional steel production (2.7%) and import prices (-3.0%) were found to be decisive influencing factors. However, other variables were again found to be insignificant.

Next the dependent variable was changed to the importing of Vietnamese anthracite by province. As the UN resolution dummy variable only applies to North Korean situation, it was not included in this estimation. According to the results of Table 7, in contrast to North Korean anthracite, Vietnamese anthracite was simultaneously affected by both electricity and steel production and was also negatively affected by import prices. Furthermore, in this case, the regional economy showed a positive (+) relationship.

In order to increase the rigidity of the estimation, we excluded outliers in the case of Vietnam's anthracite.³⁵ However, in this estimation, the results differed in each case, and there was no consistency to the significance of steel production, which is the main variable of interest. As such, a definite conclusion with regard to the determinants of Vietnam's anthracite imports was inconclusive.

³⁴Although regional/quarterly data on China's coal production was available, the same was not true for quarterly data on anthracite. As the demand in final goods, e.g., the demand for anthracite in final goods and bituminous coal, slightly differed, this paper did not use the domestic production of coal as a variable.

³⁵In contrast to the data on North Korean anthracite imports, where there was only one outlier (Beijing, 4Q 2012), there were ten outliers of abnormally high import prices in the data for Vietnam's anthracite imports (Beijing 1, Shanghai 6, Wuhu 1, Hebei 1, Sichuan 1)

TABLE 7—REGRESSION RESULTS: ANTHRACITE IMPORTS FROM VIETNAM

	(7) EP		(8) SP		(9) EP&SP	
	FE	RE	FE	RE	FE	RE
log (electricity)	1.649*** (0.571)	2.070*** (0.420)			1.155* (0.610)	1.457*** (0.424)
log (steel)			0.912*** (0.228)	1.076*** (0.234)	0.713*** (0.250)	0.786*** (0.247)
log (price)	-2.835*** (0.339)	-1.225*** (0.251)	-2.724*** (0.329)	-1.251*** (0.232)	-2.737*** (0.327)	-1.504*** (0.243)
log (province GDP)	3.110*** (0.867)	1.019*** (0.320)	3.105*** (0.834)	1.060*** (0.316)	2.812*** (0.844)	0.683** (0.326)
log (distance)		-3.158** (1.314)		-3.860*** (1.316)		-3.766*** (1.376)
Constant	3.627 (3.917)	30.90*** (9.310)	0.959 (3.959)	33.80*** (9.245)	1.249 (3.941)	33.93*** (9.680)
Time Dummies	Yes	No	Yes	No	Yes	No
Observations	316	316	306	306	306	306
R-squared	0.550	0.214	0.503	0.194	0.511	0.233
No. of Procode	17	17	17	17	17	17

Note: Standard errors are reported in parenthesis.

*** significant at the 1 percent level.

** significant at the 5 percent level.

* significant at the 10 percent level.

V. Summary and Policy Implications

This paper conducted an empirical analysis of the factors within China's domestic market that influence North Korea's anthracite exports. First, it can be assumed that the demand for anthracite imports in China is determined by electricity and steel production (final goods demand factor), import prices (price factor), the distance from North Korea (geographical factor) and sanctions by the international community (sanction factor). The results of the quantitative analysis, which was based on panel data constructed from quarterly cross-section data of 30 Chinese provinces from 1998 to 2013, show that the relationship between North Korea's anthracite exports and China's steel production is positive, while that with import prices is negative. The remaining variables i.e., electricity production, economic conditions and the volume of China's anthracite exports, proved to have no influence. These findings were not influenced when the variables were combined, and they remained consistent after a reexamination and the calculation of data in the third and fourth quarters of 2009. The results also coincide with the results from on-site investigations, showing that North Korean anthracite was being exported mainly to steel manufacturing companies in Rizhao (Shandong Province), Tangshan (Hebei Province) and Tianjin. As such, it can be concluded that the state of China's regional steel manufacturing industries is a determinant of North Korea's anthracite exports.³⁶ Moreover, it was found that UN sanctions had no

³⁶According to KDI's on-site investigation, all of the anthracite imported from North Korea was consumed in China. As such, there seems to be no or nearly no channels through which North Korean anthracite is exported via a third country. Accordingly, it was concluded that the economy of the steel industry, a final goods demand source of anthracite, has a significant influence on the demand for North Korean anthracite.

particular impact, even showing a positive relationship with North Korea's anthracite exports in some cases. This finding echoes preexisting research which found that international sanctions had only a short-term effect on general imports and none on general exports.³⁷ In the case of Vietnam's anthracite exports, which is exported to China at a volume similar to that by North Korea, the empirical analysis results varied depending on the precision of the data, estimations and the combination of variables. Therefore, this model was found to be inappropriate for estimating the determinants of Vietnam's anthracite exports.

If China's steel production and North Korea's anthracite exports are closely connected, as the empirical analysis in this paper suggests, the ripple effect from changes in China's regional steel industry on the demand for North Korean anthracite has great significance with regard to policy; considering North Korea's abnormally high dependence on anthracite exports, any shift in China's import demand may precipitate changes in North Korea's economy. Specifically, problems could arise in an economic structure which relies on exports to import a sufficient amount of required goods.

Prospects for China's steel industry are dim. For example, China's steel industry shows an excessive oversupply. Accordingly, steel prices and export prices have declined. Therefore, the revenue for China's steel industry fell considerably in the first half of 2014.³⁸ Notably, the Chinese central government's will to pursue pertinent policies has changed somewhat since 2005.³⁹ This shift in the policy stance is expected to have a greater impact on small to mid-sized rural steel companies with inefficient facilities, which could influence North Korea's anthracite exports. Additionally, the air pollution action plan and rebalancing policy currently being pursued by the Chinese government are also expected to have an effect. Under the current plan, the Chinese government will implement varying levels of policies to reduce environmentally related consumption according to different regions. Unfortunately, these policies are set to be aggressively pursued in the regions where the levels of demand for North Korean anthracite are highest.⁴⁰ Furthermore, it is highly probable that the consumption-based economic changes within China's economy will also affect North Korea's anthracite exports. In actuality, in countries such as Taiwan, where the growth engine has shifted from investment to consumption and the production of consumer goods has increased, there has also been a rise in exports, whereas in countries such as Australia, which exports capital goods and resources, there has been a rapid decrease.⁴¹ Considering this, Australian and Indonesian companies that export anthracite to China are

³⁷Regarding this, refer to Lee *et al.* (2013).

³⁸Korea International Trade Association (Shanghai office), Current State and Prospects for China's Steel Industry, August 2014.

³⁹"Although the central government presented a plan to streamline the steel industry in 2005, oversupply continued due to the passive attitude of local governments (the scale of excessive facilities is estimated at 300 million tons). The central government expressed its strong will to pursue aggressive policies, announcing its plan to close 100 million tons of uncompetitive facilities by 2017 at the National People's Congress in March of 2014 and imposing penal penalties on local governments (e.g., power rate penalties, restrictions on bank loans, reductions in rural subsidies)." (Korea Investors Service, *Examination of the 7 Main Issues of the Steel Industry*, 2014, pp.7)

⁴⁰The 'Air Pollution Action Plan' determined the following reduction targets for coal consumption (2012-2017): Shandong 5%, Hebei 13%, and Tianjin 19% (Greenpeace, 'The End of China's Coal Boom,' 2014).

⁴¹The Economist, 'Winners and Losers in the Great Chinese Rebalancing,' July 26th 2014.

experiencing a plunge in prices and reductions in export volumes. North Korea is predicted to be no exception.

Overall, this paper has revealed that North Korea's anthracite exports are closely connected to the state of China's steel industry. It is true that there are certain limitations to this type of empirical analysis. The exact figures pertaining to which industries and companies receive North Korean anthracite⁴² have not been presented due to statistical limitations. Also, the cement and ceramics industries, other demand bases for anthracite, were excluded from the estimation, as there were no available regional and quarterly data.

Despite this fact, this research concentrated on overcoming the fundamental limitations of research on North Korea's economy. First, efforts were made to improve the accuracy of the estimation by correcting the problem of disaggregated data. Secondly, on-site investigations were conducted to check if reality was reflected empirically in order to verify the results of the empirical analysis. Thirdly, based on the research results, it was concluded that the maintenance of North Korea's current trade structure will bring about fundamental limitations which could in turn induce changes in North Korea's foreign policy. Although changes in North Korea's foreign policy may be based on political and diplomatic factors, it has been proven that external economic factors could be a greater influence.⁴³

Given these current limitations, there is a strong possibility that North Korea's will to expand and diversify its external market will strengthen; As such, the South Korean government needs to use these internal circumstances to establish flexible inter-Korean policies that can provide economic incentives to its northern counterpart.

⁴²Through several on-site investigations, KDI attempted to analyse the exact numbers and degrees of fact relevance, finding however that there were external restrictions and limitations.

⁴³Koh *et al.* (2008, p.228) empirically proved that, unlike in the past, North Korea-China trade was commercially motivated; however, they acknowledged that these results have limitations because they are based on limited data.

APPENDIX

TABLE A1—ANTHRACITE IMPORTS FROM NORTH KOREA (INCLUDING THE BUSINESS CYCLE)

	GDP & Real Estate		Real Estate	
	(1) FE	(2) RE	(3) FE	(4) RE
log (electricity)	-1.043 (0.746)	0.0679 (0.328)	-1.412** (0.714)	0.0831 (0.300)
log (steel)	1.704*** (0.368)	1.525*** (0.243)	1.913*** (0.363)	1.336*** (0.213)
log (price)	-1.281*** (0.450)	-0.202 (0.230)	-0.934** (0.443)	-0.274 (0.194)
log (province GDP)	-0.433 (0.619)	-0.223 (0.340)		
log (province real estate investment)	0.0106 (0.119)	0.122 (0.110)	0.00937 (0.117)	0.119 (0.0947)
UN Dummy	1.123 (1.015)	-0.254 (0.223)	5.312*** (0.980)	-0.303 (0.225)
log (distance)		-0.404 (0.645)		-0.545 (0.534)
Constant	13.67** (5.727)	7.060 (4.640)	4.574 (4.555)	8.664** (3.890)
Time Dummies	Yes	No	Yes	No
Observations	325	325	341	341
R-squared	0.532	0.413	0.509	0.418
Number of procodes	15	15	16	16

Note: Standard errors are reported in parenthesis.

*** significant at the 1 percent level.

** significant at the 5 percent level.

* significant at the 10 percent level.

TABLE A2—REVISED DATA (2009)

Month	KITA				DPRK + Other Asia		UN Comtrade	
	DPRK		Other Asia		Volume (thousand \$)	Quantity (ton)	Volume (thousand \$)	Quantity (ton)
	Volume (thousand \$)	Quantity (ton)	Volume (thousand \$)	Quantity (ton)				
1	14,591	193,618	-	-	14,591	193,618		
2	16,261	209,046	-	-	16,261	209,046		
3	23,974	334,852	-	-	23,974	334,852		
4	33,736	502,404	-	-	33,736	502,404		
5	33,118	475,964	-	-	33,118	475,964		
6	45,436	646,077	-	-	45,436	646,077		
7	40,324	588,194	-	-	40,324	588,194		
8	-	-	34,195	471,267	34,195	471,267		
9	-	-	10,177	144,874	10,177	144,874		
10	-	-	485	6,745	485	6,745		
11	-	-	293	3,877	293	3,877		
12	1,189	22,027	-	-	1,189	22,027		
Total	208,632	2,972,187	45,152	626,764	253,784	3,598,951	256,186	3,598,163

TABLE A3—ANTHRACITE IMPORTS FROM NORTH KOREA (INCLUDING EXPORTS TO CHINA)

	EP		SP		EP&SP	
	(1) FE	(2) RE	(3) FE	(4) RE	(5) FE	(6) RE
log (electricity)	1.052 (1.596)	0.951* (0.513)			0.976 (1.328)	-0.383 (0.500)
log (steel)			2.721*** (0.438)	2.612*** (0.373)	2.718*** (0.439)	2.630*** (0.389)
log (price)	-4.720*** (0.582)	-0.948** (0.387)	-2.946*** (0.561)	-0.438 (0.352)	-2.947*** (0.563)	-0.371 (0.361)
log (province GDP)	-1.146 (1.021)	1.879*** (0.453)	-1.173 (0.845)	-0.118 (0.475)	-1.221 (0.850)	-0.0372 (0.477)
log (China export)	-0.117** (0.0534)	0.0170 (0.0648)	-0.0633 (0.0450)	0.0119 (0.0551)	-0.0653 (0.0452)	0.00791 (0.0556)
UN Dummy	3.476* (2.068)	-0.670 (0.431)	1.433 (1.495)	-0.508 (0.356)	3.947* (2.092)	-0.483 (0.361)
log (distance)		-2.959*** (1.076)		-1.033 (1.256)		-0.828 (1.199)
Constant	34.87*** (6.928)	26.42*** (7.251)	8.462 (6.275)	3.229 (8.921)	6.092 (7.070)	2.219 (8.573)
Time Dummies	Yes	No	Yes	No	Yes	No
Observations	142	142	141	141	141	141
R-squared	0.790	0.248	0.836	0.431	0.837	0.435
Number of procodes	12	12	12	12	12	12

Note: Standard errors are reported in parenthesis.

*** significant at the 1 percent level.

** significant at the 5 percent level.

* significant at the 10 percent level.

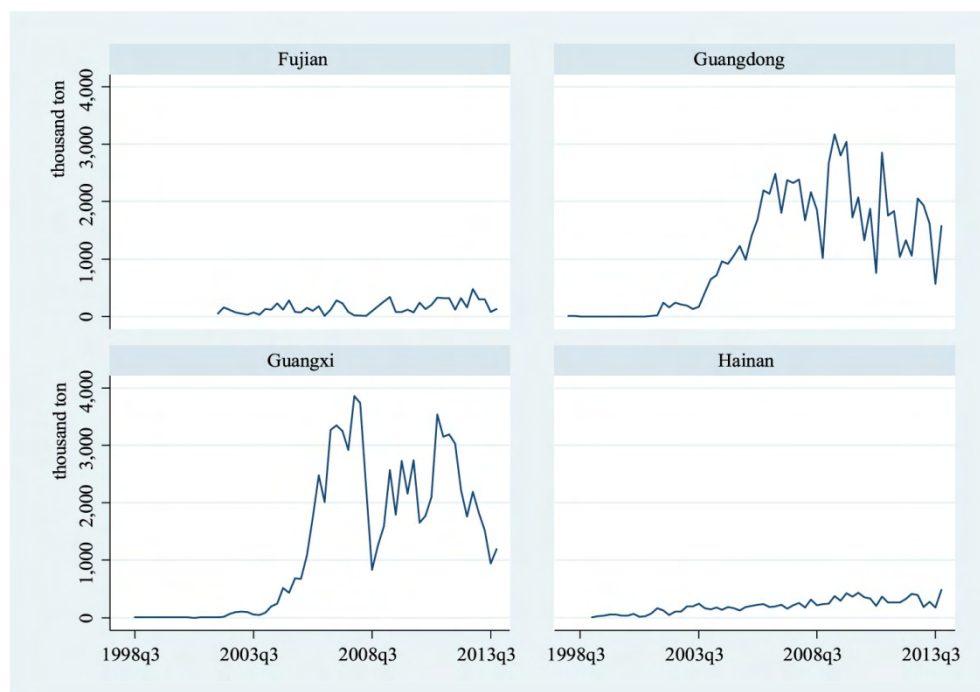


FIGURE A1. ANTHRACITE IMPORTS FROM VIETNAM: MAIN PROVINCES

Source: KITA.

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Korea's Capital Market Promotion Policies: IPOs and Other Supplementary Policy Experiences[†]

By WOOCHAN KIM*

This paper studies a series of capital market promotion policies Korea pursued over a 30-year period during its development era (1960s – 1980s). The purpose of this paper is twofold. The first purpose is to understand the policy approaches Korea took, and the second is to extract lessons that can benefit policymakers in the developing world, where capital market promotion is an important policy goal. There are two key features of Korea's capital market promotion policies. First, the government was actively involved, sometimes indirectly by giving tax incentives to encourage IPOs. However, in other times, it was directly involved by giving IPO orders and threatening those that did not comply. No stock exchange in a developed country has ever experienced such government involvement. Combined with rapid economic growth, this interventionist approach allowed the Korean stock market to experience phenomenal growth over a short period of time. Second, the capital market promotion policies had multiple objectives. One was to mobilize domestic capital for economic development. Another was to lower firms' debt-to-equity ratios. Most interestingly, however, the Korean government wanted to popularize stock ownership, thereby allowing ordinary Koreans to share in the fruits of economic growth.

Key Word: Capital market promotion, initial public offering, securities deposit and settlement systems, employee stock ownership plan, Korea

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I. Introduction

It is a great challenge for less developed countries to create a strong securities market. They lack many of the institutions that control information asymmetry and self-dealing. That is, legal and market institutions that ensure that minority shareholders (i) receive good information about the value of a company's business and (ii) allow them to have trust and confidence in a company's management and controlling shareholders. Regulators, prosecutors, and courts may not be honest or sophisticated enough to carry out this task. Accounting and financial disclosure rules may not be comprehensive or independently audited. Reputational intermediaries, such as investment bankers, accountants, and securities lawyers, may not be sophisticated enough nor subject to liability risk (Black 2001).

When the Daehan Stock Exchange was established in February 1956, none of the necessary legal and market institutions were present. At the time, the market was akin to a legalized gambling casino, often plagued with speculative bubbles and bursts. With a limited score of listed firms, the size of the primary market was very small. It hardly served as a channel through which firms raised external equity capital. In contrast, there was an enormous secondary market. The percentage of stock trading, which was marginal in the 1950s, had suddenly surpassed that of government bonds by 1961. This was, however, attributable to a high volume of speculative transactions. Because speculators made use of clearing transactions, which is similar to today's futures transactions, the trading volume often soared to unsustainable levels. On a number of occasions, this caused the Korean government to step in and rescue a stock exchange at the brink of a massive default.

By 2010, however, the market capitalization of the Korea Exchange (KRX) was 1.1 trillion USD. This ranks the KRX as the 17th largest stock exchange in the world, in terms of equity market capitalization (World Federation of Exchanges). What explains this astonishing achievement over a 50-year period? This paper seeks to answer this question in part.

This paper investigates series of capital market promotion policies Korea pursued over a 30-year period during its development era (1960s – 1980s). The purpose is to extract lessons that can benefit policymakers in the developing world, where capital market promotion is an important policy goal. Given that the Korean government's main interest was to mobilize domestic capital for economic development and to lower the debt-to-equity ratio of firms, I have left out the bond market from my analyses, and when discussing the stock market, I have put greater emphasis on its primary market policies than on its secondary market policies.

The paper is composed of two parts: primary market policies (Chapter 2) and other supplementary policies (Chapter 3). The latter includes secondary market policies (Sections 1 and 2) and policy measures taken to expand the stock market's investor base (Sections 3). They are both supplementary to the primary market policies for obvious reasons. First, no country can have a vibrant primary market without a well-functioning secondary market, where share prices are set efficiently and shares are traded with reasonably low transaction costs. It is also obvious that the primary market cannot be enlarged by simply increasing the supply of shares. Instead, there should be a commensurate increase in the investor base of the stock market.

During its development era, the mobilization of domestic capital was not the sole objective of the Korean government's capital market promotion policies. Throughout this period, policymakers emphasized that IPOs can be used as a means by which the country could share in the fruits of its economic growth. This policy stance emerged repeatedly under many different names, such as the popularization of stock ownership, the democratization of stock ownership, and the socialization of corporate ownership.

With regard to primary market policies, I cover the initial public offering (IPO) inducement measures taken during 1968-71 (Chapter 2, Section 1), the coercive IPO orders implemented during 1972-78 (Chapter 2, Section 2), and the promotion of IPOs and Seasoned Equity Offerings (SEO) in the late 1980s (Chapter 2, Section 3).

On secondary market policies, I cover the adoption of a regular transaction system in 1969 and the subsequent measure taken on June 3, 1971 (the 6.3 Measure) (Chapter 3, Section 1). I also cover a number of securities deposit and settlement systems that have been introduced since 1973.

Last but not least, I cover policy measures taken to expand the stock market's investor base. Specifically, I analyze the employee stock ownership plan (ESOP), introduced in 1968 and reinforced in 1974 (Chapter 3, Section 3). For each policy measure, I discuss its background and detailed contents, and I present its outcome and evaluation.

II. The Primary Market Policies

A. The Initial Public Offering Inducement Measures (1968-1971)

1. Background

Three points are important to note as the background surrounding the IPO inducement measures that were taken in 1968. First, firms grew rapidly during the period of the First Five-Year Economic Development Plan (1962-1966), but they also experienced a significant deterioration of their debt-to-equity ratios. Second, in order to finance the Second Five-Year Economic Development Plan (1967-1971) successfully, there was a compelling need to mobilize domestic capital from the stock market (Shin 1987). However, the stock market had been in a dismal state since a bubble burst in 1962, and it did not function well as a source for equity capital. Third, as a means of raising domestic capital, the government was planning to sell its shares in state-owned enterprises. By doing so, the government hoped to sell its shares to the general public, thereby popularizing stock ownership throughout the country.

Table 1 shows the external financing structure of Korean firms from 1963 to 1968. One notable observation is that the total amount of externally raised capital increased nearly tenfold during this five-year period, from 36.2 to 321.8 billion won. Another observation is that they were mostly raised either from foreign debt sources or from bank lending sources. Note that the figures under Others are mostly private loans. Also note that the proportion of equity financing drops from 25 percent in 1963 to 12 percent in 1966. In the following year, it would drop further to 8 percent.

TABLE 1—THE EXTERNAL FINANCING STRUCTURE OF KOREAN FIRMS, 1963-1968

(UNIT: billions of won, %)

Year	External Financing	Debt Capital				Equity Capital	
		Total	Foreign Debt	Bank Loans	Others	Amount	Percentage
1963	36.2	27.1	8.3	6.4	12.4	9.0	25
1964	26.9	19.8	2.7	6.4	10.7	7.2	27
1965	48.4	39.0	4.7	11.5	22.8	9.4	19
1966	107.9	95.0	48.8	10.4	35.8	12.9	12
1967	198.7	182.7	64.6	62.0	56.1	16.0	8
1968	321.8	296.7	108.7	107.8	80.2	25.1	8

Source: ECOS, Bank of Korea.

TABLE 2—CAPITAL STRUCTURE OF MANUFACTURING FIRMS, 1963-1968

(UNIT: %)

Year	Debt-to-Equity	Equity-to-Asset	Interest Coverage	Interest-to-Sales
1963	92.20	52.03	405.56	3.02
1964	84.98	54.06	273.66	4.89
1965	82.51	54.79	320.86	3.91
1966	106.15	48.51	236.87	5.65
1967	127.75	43.91	227.21	5.19
1968	167.37	37.40	212.65	5.90

Notes: Interest coverage ratio refers to EBIT/(interest payments).

Source: ECOS, Bank of Korea.

TABLE 3—STOCK MARKET STATISTICS, 1963-1966

(UNIT: millions of won, %)

	1963	1964	1965	1966
No. of Listed Firms	15	17	17	24
Paid-in Capital Increase	608	369	100	369
Trading Volume	26,000	27,039	9,271	11,160
Modified Average Stock Price Index	57.27	62.47	60.94	62.87
Producers' Price Index (PPI)	46.30	62.30	68.50	74.40

Notes: Modified Average Stock Price Index (1972 = 100), PPI (1970 = 100).

Source: Rhee *et al.* (2005) and Hong (2005).

Original Source: Securities Market Yearly Statistics.

With a greater reliance on debt financing, the debt-to-equity ratio deteriorated rapidly for many of these companies. Table 2 illustrates the capital structure of manufacturing firms during the same time period. One can easily see that the debt-to-equity and interest-to-sales ratios increased, while the equity-to-asset and interest coverage ratios dropped.

Table 3 shows stock market statistics from 1963 to 1966. Although the number of listed firms increased slightly during this period, the number of new equity offerings and the trading volume both dropped. The stock market index increased as well, but its growth rate was well below that of the producer's price index (PPI).¹ Moreover, a high bank deposit rate of around 30 percent discouraged people from investing in the

¹Stock market index refers to the Combined (12 issues) Index (1972=100).

stock market (Hong 1973). Also, as of 1966, most listed firms were state-owned enterprises. There were only six firms which were not.

In the second half of 1962, making stock ownership more popular emerged as a major policy objective. It served as a way to normalize the stock market, the reputation of which was significantly tarnished after the bubble burst in 1962. It was also influenced by the Japanese experience after World War II (Kyunghyang Shinmun 1962. 9. 5). When the Zaibatsu – Japanese family-controlled business groups – were dissolved during America's occupation of Japan, a significant number of shares, originally held by the family members, were sold to company employees. This greatly helped to popularize stock ownership in Japan. It also changed the perception the Japanese had towards the stock market. No longer was the stock market perceived to be a place for gambling. It was instead seen as a market where firms could raise long-term capital, as well as a place where people could invest their savings.

2. The Legislative Process

The effort to enact laws to encourage the development of the capital market started with the National Assembly. Mr. Nam-June Lee and 52 other National Assemblymen submitted a bill entitled the Stock Investment Security Act in January of 1965. Although the bill did not pass the National Assembly, it triggered other similar bills (Rhee *et al.* 2005). Eventually, on September 9, 1968, the Finance and Economy Committee – a standing committee of the National Assembly – proposed the Capital Market Development Act.

The Capital Market Development Act passed the National Assembly on November 8, 1968 and was enacted, promulgated, and took effect on November 22, 1968. This Act, together with the Securities Exchange Act, constituted the two pillars of Korea's securities market regulation: one for the primary market, and the other for the secondary market. In order to lower corporate income tax rates for those public firms subjected to these laws, Mr. Lee also submitted a bill to revise the Regulation Law on Tax Reduction and Exemption in July of 1968. This law also passed the National Assembly on November 8, 1968.

The Ministry of Finance (Minister Bong-Kyun Seo) also echoed Mr. Lee's arguments in July of 1967, by announcing the Capital Market Development Plan, which promised the sale of state-owned enterprises to the general public, as a way to raise government revenue and popularize stock ownership (DongA Daily Newspaper 1967. 7. 15). However, contrary to its original plan, the state-owned enterprises were sold to Chaebols – family-controlled Korean business groups – at bargain prices.

Although it was claimed that privatization was enacted for the general public, its laws failed to spark public interest in a meaningful way. Article 4 in the original bill provided that, for employees of central/local governments and state-owned enterprises, bonuses, pensions, severance pays, and compensations would be paid in securities owned by the government. This triggered strong resistance from labor unions. The Federation of Korean Trade Union saw the provision as an infringement of property rights and resolved to strike as a means of protesting the new bill (DongA Newspaper 1968. 7. 1). Such movements led the National Assembly to revise the bill

such that government-owned securities would be used as a means of payment only when specifically requested by the employee (DongA Newspaper 1968. 7. 4). Nonetheless, even this revision proved unsatisfactory to labor unions. As a result, Article 4 was removed in its entirety from the bill.

3. *The Details and Implementations of the Act*

Article 1 listed the Act's objectives, which included the promotion of IPOs, the greater dispersion of share ownership, people's ownership of firm shares, greater reliance on equity financing, and ultimately the development of a sound capital market. Chapter 2 of the Act covered measures to encourage dispersed share ownership and stock investment. Chapter 3 covered provisions on IPOs and Chapter 4 included provisions on the establishment of the Korea Investment Development Corporation.

3.1 Dispersed Share Ownership and Stock Investment

First, to encourage people to participate in stock ownerships, the Act guaranteed minimum dividend yields. If dividends fell short of the level established in the Enforcement Decree (i.e., 10 percent), nongovernment shareholders would have priority in receiving dividends, until their yields reached the guaranteed level. To enable this, the Act allowed firms to adjust the dividends distributed to government shareholders. Second, the Act allowed shares to be used for paying security deposits. Government and state-owned enterprises were not allowed to refuse such deposit payments.

Third, for shares held either by the government or by the Korea Development Bank (KDB), the Act allowed discounted share offerings when selling shares to the general public, civil servants, or to state-owned enterprise (SOE) employees. Such shares were subject to a mandatory holding period specified in the Enforcement Degree (i.e., until the day of the next annual shareholders' meeting). This measure obviously aimed to encourage dispersed share ownership, and was at least partly influenced by the criticism raised against the first-price auction when privatizing SOEs (Rhee *et al.* 2005). Most SOE privatizations under the first-price auction resulted in Chaebols acquiring significant ownership.

Fourth, as another method to encourage dispersed share ownership of listed firms (or non-listed public firms), the Act also allowed share offerings to company employees, with an exception to the preemptive rights of existing shareholders.² The fraction of such shares, however, could not be more than 10 percent of outstanding shares. Fifth, the Act exempted the income tax on dividends.

²The term "public firm" is defined in the Corporate Income Tax Code (Article 22-3). According to the Code, a public firm is a listed firm or a non-listed firm that meets the following three conditions. First, the percentage of holdings by minority owners (shareholders individually holdings less than 3 percent of outstanding shares) must be at least 20 percent of outstanding shares. Second, the number of minority shareholders must be at least 30. Third, the fraction of holdings by any shareholder, together with his or her relatives defined in the Enforcement Decree, must be no more than 60 percent of outstanding shares.

3.2 Initial Public Offerings

To encourage firms to go public, the Act gave tax and special depreciation benefits to listed firms (or non-listed public firms). Table 4 summarizes the corporate income tax rates applicable to public and nonpublic firms. In the highest income bracket, the two tax rates differ by 20 percentage points. With regard to depreciation, the Act permitted an extra 20 percent depreciation for listed (or non-listed public) firms.

TABLE 4—CORPORATE INCOME TAX RATES (PUBLIC VERSUS NON-PUBLIC)

Income Ranges	Public Firms	Non-public Firms
Below 1 million won	15%	25%
Between 1 and 5 million won	20%	35%
Above 5 million won	25%	45%

Source: Rhee *et al.* (2005).

Some individuals, however, raised concerns that the number of corporate blackmailers would increase with a greater number of minority shareholders.³ This led the Act to permit the chair of shareholders' meeting to have the authority to preserve and maintain order. This meant that the chair would be able to stop any person from speaking, or order him removed, if the chair were to judge that the person is intentionally disturbing the orderliness of the meeting.

3.3 Korea Investment Development Corporation

The Act established the Korea Investment Development Corporation (KIDC), to underwrite newly offered shares, promote dispersed share ownership, and stabilize share prices.⁴ Legally, the Corporation was a stock company, in which the government owned 50 percent of outstanding shares. Under its shareholders meeting, it had an Investment Review Committee that screened new offerings, underwrote government-owned shares, and set offering prices.

The Act regarded the KIDC as a securities company and required it to be registered as one. The Act also permitted KIDC a wide scope of businesses: (i) securities underwriting, (ii) securities trading, (iii) public offerings and sales arrangements, (iv) stock price stabilization, (v) sales of government- or SOE-owned securities, (vi) research and advisory services to issuing firms, (vii) securities collateral loan business, and (viii) securities investment trust business.

It is also important to note that the KIDC had the potential to mitigate the information asymmetry problem in the primary market. As a securities underwriter and agent with a mandate to stabilize newly offered shares, it had the potential to serve as a reputational intermediary.

³Corporate blackmailers are unique to Korea and Japan. They usually extort money from or blackmail companies by threatening to publicly humiliate companies and their management.

⁴In December 1972, the Korea Investment Development Corporation (KIDC) was renamed as the Korea Investment Corporation (KIC). The Korea Investment Corporation was established in July of 2005 as a sovereign wealth fund, and is not related to the KIDC established in December of 1968.

4. Outcomes and Evaluation

The KIDC was launched in December of 1968 with a paid-in equity capital of 1.5 billion won (authorized capital of 3 billion won). Shareholders include the government (500 million won), the KDB (5 million won), and other private sector participants (5 million won). Byung-June Lee was appointed as the KIDC's first President. To convey the government's strong determination to the public, it even named 1969 the "Year of Capital Market Development" and May 3rd as "Securities Day."

Despite such initial enthusiasm, the outcome was disappointing. From Table 5, one can observe that, between 1968 and 1971, market capitalization, the capital stock of listed firms, the number of listed firms, the increase in the paid-in capital, and the number of shareholders all increased, giving an impression that the government made some progress. However, the reality behind the figures was far different. First, most of the newly offered shares were acquired by banks. As a result, bank lending was merely replaced by bank equity investments, thereby perpetuating the same reliance on banks as before. Second, the firms that went public according to the definition set out in the Corporate Income Tax Code refused to be listed on the stock market. Note that the tax code did not distinguish between non-listed public firms and listed public firms when granting tax benefits, which led them to remain non-listed (Kyunghyang Shinmun 1970. 5. 2).

Third, the fraction of shares owned by small-scale investors (those holding less than 1,000 shares) increased only by 0.8 percentage points over a four-year period, suggesting that the government had failed to achieve its goal of promoting dispersed ownership. Not surprisingly, the amount of public offerings was also a merely 5.29 billion won. Fourth, there were disguised public offerings during this period. In order to meet the conditions as a public firm, controlling shareholders of two different firms mutually exchanged their shares. By periodically trading the shares, they were even able to satisfy the requirements of a listed firm (Maeil Business Newspaper 1970. 10. 15). As shown in Table 5, the trading volume was insubstantial. In 1971, the total number of shares traded accounted for only 30 percent of shares outstanding.

TABLE 5—STOCK MARKET STATISTICS, 1968-1971

	Unit	1968	1969	1970	1971
Market Capitalization	Million won	64,323	86,569	97,922	108,706
Capital Stock Listed	Million won	96,585	119,902	134,292	141,356
No. of Listed Firms	New	10	8	6	2
	Cumulative	34	42	48	50
Paid-in Capital Increase	No. of Firms	10	6	13	7
	Million won	20,317	5,983	6,225	2,090
Public Offerings	No. of Firms	2	12	9	4
	Million won	160	2,211	2,068	850
No. of Shareholders	-	39,986	54,318	76,276	81,923
Share Ownership by Small-scale Investors	%	2.03	1.91	2.74	2.83
Yearly Turnover	Yearly	0.67	0.70	0.49	0.29

Notes: Small-scale investors refer to those holding less than 1,000 shares. Yearly turnover is measured as follows: (total number of shares traded per year / total number of shares outstanding at year-end).

Source: Securities Market Yearly Statistics, 1972.

Such failure was predicted from the beginning (Kyunghyang Shinmun 1968. 11. 12), given that stock returns were well below bank deposit rates, and because high inflation rates discouraged the general public from investing in the stock market. Experts at the time predicted that the public would instead invest in the real estate market. The 10 percent dividend yield guaranteed by statute was also judged to be too low by experts. The level may have been sufficient for the controlling shareholders to produce a healthy return on their investments, but it was insufficient for outside minority shareholders.

Overall, the government's IPO inducement policy of 1968 failed to achieve its policy goals. Nevertheless, it contributed to the Korean capital market in two ways. First, it greatly dissipated the stigma of the stock market as a place for gambling. Second, it created KIDC, which would later play an important role in developing the Korean capital market.⁵

B. The IPO Promotion Act: A Coercive Approach (1972-1978)

1. Background

The Economic boom in the second half of the 1960s spread optimism among the Korean business community. The boom encouraged large Korean firms to increase their bank borrowings. Borrowing from banks, however, was not enough. To expand their businesses, these companies began to finance their activities through private loans. However, this strategy proved to be a mistake. The monthly interest rates on these private loans were very high, about 5 percent on average. Some loans were as high as 10 percent per month (Koh 2008). By 1972, many firms could no longer service their debts. The Federation of Korean Industries (FKI) asked the government to take an emergency action. The government intervened, as requested. On August 3, 1972, the government announced that it would freeze all the existing private loans to businesses, and later restructured their terms, which were greatly in favor of the borrowers.

Policymakers who were involved in this Emergency Measure of August 8, 1972 opined that Korean firms should make definitive changes to their capital structures.⁶ As a direct result, the necessity to promote public offerings received renewed interest in Korea. Public offerings were also perceived as a way to *socialize* corporate ownership in Korea (Kim 2006). The failure of the IPO inducement policy in 1968, however, led policymakers to establish a more coercive approach. Undoubtedly, the political environment under the *Yushin* Regime made such a coercive approach possible.⁷

⁵Korea Investment Development Corporation (KIDC) was the first institution that sold investment trust certificates (May 1970). When it was dissolved in 1977, its role and staff were transferred to the Securities Supervisory Board and Daehan Investment Trust Company.

⁶For details on the Emergency Measure of August 8, 1972, see Kim (2002). The paper argues that the new IPO promotion policies were already conceived when preparing for the private debt freeze measure.

⁷In October of 1972, after declaring a state of emergency, President Park dissolved the National Assembly and suspended the constitution. Soon the constitution was revised in a way that paved the way for President Park to take authoritarian and lifetime power without any limits on his power. This new regime is referred to as the *Yushin*

The much lower interest rates set after the Emergency Measure of August 8 created an environment conducive to pursue an IPO promotion policy. Relatively high stock returns also attracted people to the stock market. This renewed interest in stock investments and the initial increase in the number of IPOs, however, were temporarily interrupted by the oil shock in late 1973.

2. The Details of the Act

By the time the Emergency Measure of August 8 was fully implemented, the Ministry of Finance (Minister Duk-Woo Nam) finished its preparation of the bill which would become the IPO Promotion Act.⁸ The Act was approved by the Emergency State Council on December 30, 1972 and came into effect on January 5, 1973. The objectives set out in Article 1 of the Act were very similar to those written in the Capital Market Development Act. The Act aimed to promote IPOs, facilitate equity financing, improve the capital structure of firms, promote people's ownership of stocks, and contribute to the nation's economic development (Nam 2009).

Although the two Acts were similar in terms of their main objectives, the approaches taken to execute them were very different. The Capital Market Development Act of 1968 took a passive approach, aimed at inducing voluntary IPOs through tax incentives. In contrast, the approach taken in the IPO Promotion Act of 1972 was a coercive one, relying on government orders and penalties. Firms were unilaterally designated by the government to go public; if they did not comply, the government had the authority to penalize them by restricting bank lending. Such a coercive approach was only possible due to the new political environment under the Yushin Regime.

2.1 IPO Review Committee

The Act established the IPO Review Committee that would deliberate on and finalize policies necessary to implement the Act (Article 3). The committee was composed of 8 to 11 members. The *ex officio* members included the Prime Minister (who presided over the meetings), the Minister of Economic Planning Board (EPB), the Minister of Finance, the Minister of Industry and Trade, the Governor of the Bank of Korea, the President of the KIDC, and the President of the Korea Stock Exchange. In addition to these *ex officio* members, one to five civilians with knowledge and experience in securities matters were appointed as members by the President.⁹

Regime. The word Yushin is the Korean pronunciation of the Japanese word Ishin, which means restoration. Ishin is used in Meiji Ishin, which refers to the chain of events that restored imperial rule to Japan in 1868.

⁸In September of 1971, the Ministry of Finance established a new bureau exclusively for securities and insurance affairs. Mr. In-Kie Hong was appointed as the first Director-General of this bureau (September 1971 – August 1973). Mr. Hong was succeeded by Mr. Lee, Kun-Joong (August 1973 – May 1976).

⁹According to Byung-Woo Koh, individual IPOs were authorized by the Assistant Minister of Financial Affairs at the Ministry of Finance. Mr. Koh served as the Assistant Minister of Financial Affairs from January of 1975 to September of 1977.

2.2 Designation of Qualified Firms

According to the Act, the Ministry of Finance reviewed a set of firms (known as target firms) and designated a subset (qualified firms) that would be given order by the Minister of Finance to go public (Article 4). Target firms included (i) firms that were approved under the Foreign Capital Inducement Act to receive foreign loans or import capital goods in excess of their capital (1 billion won, if capital is greater than 1 billion won), (ii) firms that had borrowed from domestic financial institutions in amount more than 1 billion won, and (iii) firms which needed to become a public entity for the sake of Korea's economic development.

Qualified firms were those that met the following conditions: (i) equity capital in excess of 50 million won, (ii) two or more years of operation since establishment, (iii) dividend yields expected to be greater than 10 percent after an IPO, and (iv) shares expected to trade above par value. When giving IPO orders, it was also required that the Minister of Finance give instructions concerning the details of the offering. These details included (i) the number of shares that needed to be publically offered, (ii) upper ownership limit per shareholder (including related parties), (iii) offering terms, and (iv) the offering deadline. The Act set the upper ceiling of 51 percent as the restriction on ownership per shareholder.¹⁰ The Act could have set the upper limit to a lower amount, but concerns by company owners over losing corporate control resulted in the government setting it to slightly above 50 percent.

To facilitate government's document review, the Act gave Minister of Finance the power to request necessary information from subject firms, and to inspect their financial statements (Article 6). The Minister of Finance also had the authority to ask for cooperation from government agencies and other related organizations. These agencies and organizations had to oblige unless there was a clear reason not to (Article 7).

To facilitate public offerings and achieve dispersed share ownership, the Act required the establishment of an organization that would act as a stand-by underwriter, and purchase unsubscribed shares, later reselling them in installments to the general public (Article 9). To encourage participation in this operation, the Act temporarily (1973-1976) exempted participating organizations from paying corporate income taxes on capital gains obtained within six months after the offering (Article 15).

2.3 Incentives for IPO

The Act gave firms a variety of economic incentives to go public. First, the Act permitted public or designated firms the opportunity to revalue their real estate assets annually, even if they were not directly used for operations. Normally, such real estate assets had not been eligible for asset revaluations. Moreover, according to the Act, revaluation gains were subject to a special tax rate of 27 percent, well below the normal rate of 40 percent (Article 12). Second, the Act gave a 50 percent tax

¹⁰A year earlier (Dec. 28, 1971), the Corporate Income Tax Code was revised in the same direction. The upper ownership limit per shareholder was set to be 51 percent. Previously, it had been 60 percent.

exemption on dividend income to shareholders (together with related parties) who owned less than 30 percent of outstanding shares (Article 13).

Third, if a designated firm had complied with the government order and went public, it was pardoned of previous tax evasion crimes, provided that it would correct its financial statements prior to the date the Act takes effect (1973. 1. 5) (Article 14).

2.4 Penalties for Non-Compliance

The penalties established in the Act were as provocative as the incentives. If a designated firm refused to comply, it faced the following penalties during its period of non-compliance: (i) the interests on debt borrowed from shareholders or management could not be expensed, (ii) entertainment and other similar costs could be expensed at a rate only half of other compliant firms, (iii) special depreciation privileges granted to firms with honest tax filing records could not be allowed, and (iv) a 20 percent increase in corporate income tax would be required.

Second, the Act penalized not only non-complying firms, but also their shareholders. The shareholders would face a 20 percent increase in their general income tax payments. Probably the most effective tool, however, was the Minister of Finance's power to ask financial institutions to limit their lending and other assistances to non-complying firms.

3. *Implementation of the Act*

3.1 IPO Review Committee during 1973-1974

On March 10, 1973, the government formed the IPO Review Committee by appointing five civil members. The first meeting was held on March 22, presided over by Jong-Pil Kim, the Prime Minister. At this meeting, the Committee selected 110 firms to request the submission of their financial statements by April 12. These firms were either (i) firms that had foreign debt of more than 5 million dollars, (ii) firms that had restructured its debt under the Emergency Measure of August 8 in the amount of more than 500 million won, or (iii) firms that had borrowed more than 1 billion won from domestic financial institutions (DongA Daily Newspaper 1973. 5. 22). 104 firms submitted their financial statements by the deadline, with four submitting statements after the deadline, and two not complying at all.

On July 23, the IPO Review Committee meeting conducted its second meeting, and decided to add firms with restructured debt greater than 100 million won to the target list. This resulted in an additional 350 firms (Maeil Business Newspaper 1973. 7. 23). They had to submit their financial statements by the end of August.¹¹ At the same meeting, 40 out of 108 firms that had previously submitted their financial statements were identified as qualified firms. Among these 40 firms, 14 had already gone public, 12 were identified as firms for whom an IPO was feasible, and the

¹¹In 1973, the Ministry of Finance made a visit to Bovespa (Sao Paulo Stock Exchange). The visit was recommended by the head of United States Operations Mission (USOM). USOM was later renamed as USAID-K.

remaining 14 were regarded as unqualified. Public offering orders, however, were not issued at this time, with Prime Minister Jong-Pil Kim giving instructions that IPOs should be carried out voluntarily.

The IPO Review Committee met two additional times, in September and November. No additional firms were added in the target list, nor were there any firms that received a public offering order from the government. By April 26 of the following year, the Ministry of Finance had completed its due diligence of 32 firms, which were asked to submit offering details, including number of shares to be offered, terms, and the offering date.

3.2 Oil Shock of 1973 and the Slow Progress

Table 6 summarizes the stock market performance during the period of 1971-1974. Thanks to rising stock prices up to 1973 (stock prices had peaked in July of 1972 at 394), most stock market indicators were showing improvements during this time. Market capitalization, the capital stock of listed firms, the number of listed firms, the increase in the amount of paid-in capital, the number of shareholders, aggregate share holdings by small-scale investors (holding less than 1,000 shares), and turnover statistics all showed progress. This was by no means a coincidence. 1973 was also a year in which Korea grew by 14.8 percent in real terms.

This upward trend, however, was interrupted by the oil shock that hit the economy near the end of 1973. Consequently, in 1974, only 26 firms were newly listed on the stock exchange. During 1973-74, in fact, there were firms that even experienced a decrease in capital or were delisted altogether.

TABLE 6—STOCK MARKET STATISTICS, 1971-1974

	Unit	1971	1972	1973	1974
Stock Price Index	1972 = 100	-	227	311	297
Market Capitalization	Million won	108,706	245,981	426,247	532,824
Capital Stock Listed	Million won	141,357	174,339	251,620	381,343
No. of Listed Firms	New (Delist)	2	16	40 (2)	26 (2)
	Cumulative	50	66	104	128
Paid-in Capital Increase	No. of Firms	7	31	53	62
	Million won	2,090	15,175	33,617	37,052
Public Offerings	No. of Firms	4	7	47	19
	Million won	850	1,080	21,475	14,337
No. of Shareholders	-	81,923	103,266	199,999	199,613
Share Ownership by Small-scale Investors	%	2.83	3.37	5.94	4.91
Yearly Turnover	Yearly	0.30	0.43	0.53	0.39
Economic Growth Rate	Real GDP %	10.4	6.5	14.8	9.4

Notes: Small-scale investors refer to those holding less than 1,000 shares. Yearly turnover is measured as follows: (total number of shares traded per year / total number of shares outstanding at year-end).

Source: Securities Market Yearly Statistics (1975) and Bank of Korea (ECOS).

3.3 Special Presidential Order of May 29

Due to the government's measures to lower import tariffs, Korean firms endured the oil shock of 1973 without much difficulty. Firms did not make much progress in their IPOs, however, which caused President Park to intervene. Based on the advice by the Chief Secretary of Economic Affairs, President Park issued a special order to his cabinet on May 29, 1974, entitled the "Five Special Orders on Firms' Public Offerings and Corporate Culture."

Stock price soared upon the news of the President's special order, but the responses from firms were not encouraging. They were still concerned with the possibility that newly offered shares may not be fully purchased with, and the possibility of losing control over their businesses (Chosun Ilbo 1974. 5. 31).

Amidst this stalemate, the government decided to ask for cooperation from Sung-Kohn Kim, the head of the Korea Chamber of Commerce and Industry, hoping that if he decides to go public with Ssangyong Cement Industrial, it may trigger others to follow. Yong-Hwan Kim, the Chief Secretary of Economic Affairs, invited Chairman Kim to the Blue House and proposed a deal (Kim 2002). The decision to make this deal was not easy for Chairman Kim, as he had great concerns over losing corporate control. He nevertheless could not refuse the government's request. On July 8 1974, Chairman Kim called a press conference and announced his plan for Ssangyong Cement Industrial's IPO.

3.4 IPO Supplementary Measures of August 8

Despite such efforts, it remained rare for a key blue-chip firm within a group to go public. Firms that went public were mostly secondary firms within a group. To address this situation, the government on August 8 1975 announced its IPO Supplementary Measures.

The Supplementary Measures of August 8 included a new set of target firms: (i) primary firms within a Chaebol group, (ii) the top 100 firm in terms of company size, (iii) firms with more than 3 million dollars of foreign debt, (iv) the top 100 exporting firm, (v) firms classified as a qualified firm according to the KIDC, or (vi) firms in the HCI sector.¹²

3.5 Other Government Measures

Besides the Supplementary Measures of August 8, there were other government policy measures that later greatly facilitated public offerings by firms. One was the Capital Market Preparation Measures, announced in June of 1974. This measure was designed to prepare the capital market for large public offerings by forming a syndicate of financial institutions that would purchase unsubscribed shares from issuers, later reselling them to the general public. KIDC and securities firms with

¹²For the details pertaining to the promotion policy for heavy-equipment and chemical industries, see Kim (2011).

equity capital above 300 million won were the key participants. Besides underwriting, the Capital Market Preparation Measures included policies on securities savings, securities investment trusts, and employee stock ownership plans.

In December of 1976, the Securities and Exchange Act also underwent a major revision. The revisions included the establishment of: (i) the Securities Management Commission (SMC) and the Securities Supervisory Board (SSB), (ii) a 10 percent ownership limit in listed firms¹³, (iii) the *ex post* management of listed firms, (iv) supplementary measures to improve corporate disclosures, and (v) measures to prevent insider trading.

Related to corporate disclosure, the Act mandated firms to register at least one before their listings and required a number of disclosures. To prevent insider trading, the Act banned stock trading by company management and employees. The Act also mandated that company management, employees, and major shareholders (owning more than 10 percent) return their capital gains back to the company if the gains were obtained by selling (or purchasing) company shares within six month after their purchase (or sale).

4. Outcome and Evaluation

4.1 Outcome

The government made public the list of qualified firms and their public offering schedules on October 6, 1975 and July 1, 1976. In 1975, it included 105 firms, from which 30 were strongly recommended to go public before the end of the year. In 1976, the government added 101 firms to the list to go public between the second half of 1976 and the first half of 1977. Many firms, however, could not go public due to profitability - or capital structure -related reasons. Among the 46 firms designated to go public in 1976, only 20 complied. Sometimes, very profitable firms refused to go public during this time, the most noteworthy example being Hyundai Construction.¹⁴ On March 15, 1978, the Securities Supervisory Board organized a meeting with firms that were recommended to go public, strongly warning that if they did not comply, public offering orders would be issued, along with appropriate sanctions (Kyunghyang Shinmun 1978. 3. 15).

¹³According to Article 200 of the Securities and Exchange Act, no shareholder was allowed to own more than 10 percent of outstanding shares in a listed firm. Shareholders owning more than 10 percent of shares at the time of listing, however, were not subject to this rule.

¹⁴The reason behind Hyundai Construction's continued refusal to go public boils down to its offering price. Hyundai Construction, which became a global player in 1976 by winning Saudi Arabia's Jubail port contract (worth 960 million dollars), wanted to offer its shares at 7,000 won per share. This was significantly higher than the 3,000 won suggested by the government (Maeil Business Newspaper 1977. 6. 4). Despite such disagreements, in 1977, the government and Hyundai Construction struck a deal to go public. However, this decision was overturned at the last moment when Chairman Ju-Yung Chung succeeded in persuading President Park that Hyundai Construction would build five general hospitals around the country if it could remain private. Chairman Chung calculated that investors would benefit by 50 billion won if Hyundai Construction shares were to be offered below its true value. He promised that the same amount of money would be used to build hospitals. The origin of the Asan Medical Center can also be traced back to this promise. The Asan Medical Center is now one of the most prestigious hospitals in the country (Koh 2008).

TABLE 7—STOCK MARKET STATISTICS, 1974-1978

	Unit	1974	1975	1976	1977	1978
Stock Price Index	1975 = 100	105.0	139.4	146.8	178.2	207.2
Market Capitalization	Billion won	533	916	1,436	2,351	2,892
Capital Stock Listed	Billion won	381	643	1,153	2,117	2,959
No. of Listed Firms	New (Delist)	26 (2)	62	87	49	33
	Cumulative	128	189	274	323	356
Paid-in Capital Increase	No. of Firms	62	68	81	97	148
	Million won	37,052	82,929	101,941	141,859	285,201
Public Offerings	No. of Firms	19	62	87	49	33
	Million won	14,337	39,875	74,005	44,113	41,521
No. of Shareholders	-	199,613	290,678	568,105	395,275	963,049
Share Ownership by Small-scale Investors	%	4.91	5.31	3.58	3.38	6.59
Yearly Turnover	Yearly	0.39	0.51	0.51	0.71	0.56
Economic Growth Rate	Real GDP %	9.4	7.3	13.5	11.8	10.3

Notes: Small-scale investors refer to those holding less than 1,000 shares. Yearly turnover is measured as follows: (total number of shares traded per year / total number of shares outstanding at year-end).

Source: Securities Market Yearly Statistics (1979) and Bank of Korea (ECOS).

Although some firms refused to go public, overall, the government's effort was deemed a success. Table 7 shows the development of the Korean stock market during the period of 1974-1978. One can see that the number of listed firms and the amount of paid-in capital increased significantly, along with a rising stock market index. In September 1976, the government celebrated its efforts in raising more than 1 trillion won in equity capital during a one-year period. During the three-year period between 1975 and 1977, nearly 300 firms went public (Koh 2008). Low interest rates and high economic growth rate were important factors behind this growth. In 1975, dividend yields for listed firms averaged 23.3 percent, whereas the time deposit rate was only 15 percent (Rhee *et al.* 2005). Korea also experienced three consecutive years of two-digit real GDP growth rate during the period of 1976-1978.

4.2 Evaluation

Although the government threatened on a number of different occasions that it would penalize non-compliant firms, it never sanctioned any company. Nevertheless, the government made significant achievements in increasing the number of listed firms. The success factors can be summarized as follows. First, the low interest rates that prevailed during this period contributed most to this success. With relatively high stock returns and dividend yields, investors were attracted to the stock market. With a much greater investors' base, large-scaled public offerings were placed successfully without much difficulty. On top of this, the influx of dollar receipts from the construction boom in the Middle East resulted in an expansionary monetary policy and a stock market boom.

Second, rapid economic growth was also crucial. Facing increased demand, firms had to raise new capital and were motivated to go public voluntarily. As mentioned earlier, the period during which the number of listed firms increased the most overlaps Korea's two-digit real GDP growth rates for three consecutive years (1976-1978). Third, President Park's incessant and unwavering support was also crucial.

The Special Order of May 29 and occasional instructions at monthly economic development meetings were just a few examples of his support. Without his support, Korea's IPO promotion policy would not have been pursued consistently over the five-year period (1973-1978).

Fourth, the government's timely introduction of various securities-related measures also helped alleviate the concerns of company owners and investors. For example, the 10 percent ownership limit greatly alleviated the concern over losing corporate control. The underwriting syndicate, formed to provide firm-commitment underwriting, helped to absorb large-scale public offerings. Mandatory registration and the prior disclosure of financial statements alleviated investors' concerns over firms' lack of transparency.

An interesting way to understand the policy efforts in the 1970s is by looking at them from the perspective of mitigating information asymmetry, and preventing adverse selection problems. The challenge faced by the Korean government in the 1960s and '70s was to overcome these problems without a good disclosure rule or securities law. The option taken in the 1960s was to set up the KIDC, which would serve as a reputational intermediary, which did not work out as intended. The policy measures taken in the 1970s were an improvement over those in the 1960s in the sense that the government was directly involved in differentiating between high and low quality firms. By going through the financial statements and designating qualified firms, the government served as a trustworthy screening agency. However, the offering prices set by the government were too low for high quality firms. As a result, they refused to go public, as in the case of Hyundai Construction. This problem was partially resolved in the 1980s when the offering price were allowed to be set higher than the par value, which led high quality firms to offer their shares in the market voluntarily.

Another interesting question is whether this coercive and interventionist approach helped. My investigation shows that such an approach partially contributed to the IPO boom during the late 1970s. By being directly involved in differentiating between high and low quality firms, the government greatly mitigated the information asymmetry problem. Also, the incentives it offered and penalties it threatened to impose aligned the interests of both the government and the designated firms. Their effects were, however, heavily influenced by improvements in macroeconomic conditions. Before the economic boom, the number of IPOs increased only moderately. Nonetheless, when the economy boomed, the number of IPOs also accelerated.

The government's success in increasing the number of IPOs was tarnished by a bubble that formed in 1978. With the construction boom in the Middle East, construction companies became overly subscribed by investors, while other sectors experienced under-subscription (DongA Daily Newspaper 1978. 6. 7). In 1976, the portion taken up by construction firms in the total number of public offerings and the increase in capital were respectively 9.7 percent and 1.4 percent. These corresponding figures increased to 63.9 percent and 25.4 percent in 1978 (Rhee *et al.* 2005). Although many construction firms went public during the bubble years, interestingly, the top-ranked firms did not. Hyundai Construction is a good example.

The government failed to detect and correct the imbalances that emerged in the stock market by the second half of 1978. There were too many shares being offered,

compared to the size of the stock market's investor base. Coupled with the government's tight monetary policy to fight inflation and a second oil shock, the stock market soon crashed, failing to recover for many years afterward (Rhee *et al.* 2005).

C. The Equity Offering Expansion Policies in the 1980s

1. Background

1.1 Stock Market Stagnation and the Need to Expand the Role of Government

The stock market stagnated for many years after the 1978 bubble burst. Firms started to rely again on bank lending and private loans. Naturally, firms' debt-to-equity ratio deteriorated. Amidst this backdrop, in October of 1983, Man-Jae Kim became Finance Minister. Unlike his predecessors, he had a deep understanding of and keen interest in capital markets, and he was very active in developing the market during his tenure.

Government policymakers, including Minister Kim, thought that the financial sector was lagging behind the real industrial sector. Undoubtedly, this had to do with twenty years of financial repression during the period of government-led interventionist industrial policies. However, within the financial sector, the stock market was in a worse condition. The financial system was considerably bank-centered. To diversify external financing sources and to improve the capital structure, there was a strong need initially to normalize and then to expand the capital market.

It is important here to note that the nation-wide resource mobilization, which was an important policy goal behind capital market development policies in the 1970s, did not play a key role during this particular period.

1.2 The Three Lows and the Economic Boom

During the second half of 1980s, Korean economy enjoyed an extremely favorable external environment, what has been termed the Three Lows, referring to low international interest rates, a low value of the Korean won, and a low price of crude oil. With low international interest rates, the debt service burden on foreign borrowings dropped significantly. A stronger Japanese Yen against the US dollar, a result of the Plaza Accord, made Korean export goods relatively inexpensive. Lower crude oil price significantly lowered production costs as well. Consequently, Korea's current account turned in to a surplus after many years of chronic deficit. The real GDP growth rate, which was 9.9 percent and 7.5 percent, respectively in 1984 and 1985, increased to 12.2 percent, 12.3 percent, and 11.7 percent, respectively in 1986, 1987, and 1988.¹⁵

¹⁵There were two occasions when Korea experienced three consecutive years of double-digit real GDP growth rate. One occurred in the second half of the 1970s (76-78) and the other was during the second half of the 1980s (86-88).

Such an economic boom undoubtedly helped the government's policy to expand equity offerings. Faced with a greater demand for their products, firms had to increase their capital expenditures. The resulting stock market boom meant that they could raise equity at a lower cost. There were also plenty of investors willing to purchase newly issued shares. Also, with rising per capita income and wealth, a greater number of people participated in the stock market.

1.3 Market Opening and Privatization

Capital market internationalization was first contemplated in January of 1981, when government announced its Long-Term Plan on Capital Market Internationalization. In preparation for the opening of Korea's market, it became very important to enlarge the size of the stock market.¹⁶ The need to privatize SOEs also made it necessary to expand the stock market. For the government to sell shares directly in the stock market, it was deemed very important to have a well-developed primary market.

2. The Policy Details

The equity offering expansion policy in the 1980s, the subject matter of this section, refers to a series of policy measures announced and implemented during the period of 1983 to 87, either to encourage public offerings or to expand the investor base. The policymakers at the Ministry of Finance believed that they should give priority to the former over the latter, if they were forced to choose between the two. They thought that once blue-chip shares were offered, this naturally attracted investor demand, i.e., supply essentially creating demand. Following this logic, the government focused on policy measures that would either induce or coerce blue-chip firms to offer their shares in the open market.

The most comprehensive package of measures to expand equity offerings was announced in June of 1987. First, so that blue-chip firms would offer their shares, the government devised a number of incentives for them. They included (i) relaxing the market-price share offering rule, (ii) strengthening tax benefits, (iii) relaxing asset revaluation requirements, (iv) relaxing the cap on corporate bond issuances and stock dividends, (v) allowing for the issuance of exchange bonds and participation bonds, and (vi) relaxing the cap on the issuance of preferred shares.

Second, to enlarge the stock market's investors' base, the government introduced a number of measures, including (i) privileged access to IPO stocks given to holders of long-term savings accounts, (ii) strengthened regulation pertaining to insider trading, and (iii) supplementary measures to improve company disclosures. To support employee stock ownership associations, they were given 20 percent preemptive rights over publically offered shares. Previously, these associations had 10 percent

¹⁶Market opening was carried out in a gradual manner. First, foreigners were allowed to invest indirectly through country funds listed on the NYSE (e.g., Korea Fund established in August of 1984). Second, foreigners' direct equity investment in the Korea Stock Exchange was allowed in January of 1992. Finally, limits on foreign ownership were completely lifted in May of 1998.

preemptive rights. Third, the government designated firms in nationally important industries (hereafter “public interest firms”) and came up with ways to protect these entities from takeovers, including ownership limits and restrictions on foreign acquisitions.

Most of the measures announced in June were incorporated into the Capital Market Development Act, revised on November 28. Also, the IPO Promotion Act was repealed and merged into the revised Capital Market Development Act. With the repeal of the IPO Promotion Act, the term ‘IPO order’ was also replaced with the term ‘IPO recommendation’.¹⁷ The key contents of the revised Capital Market Development Act can be summarized as follows.

First, the government had the power to recommend IPO or SEO, according to the criteria (regarding size of capital and profitability) outlined in the Enforcement Decree. For non-compliant firms, the government also had the power to refuse the receipt of their public offering applications for a pre-specified period of time (Articles 3 and 5).

Second, the revised Act raised the limits on the dividends that a company could pay in the form of shares, from 50 percent to 100 percent of the total amount of dividends (Article 8). The Act also relaxed the ceiling on the issuance of convertible bonds (CBs) and bonds with warrants (BWPs). The converted shares and exercised shares were excluded from the amount of issuance (Article 11).

Third, the revised Act also introduced provisions that facilitated the sale of government-owned shares. For example, shares were allowed to be sold to the general public with no limitations, provided that doing so would help to disperse share ownership (Article 12). The Act also allowed government-owned shares to be sold to employee share ownership associations at a discount; in addition, employees would be allowed to pay for them in installments (Article 13). The Act also allowed the government to limit eligible acquirers and the maximum number of shares they would be able to acquire (Article 14).

Fourth, the revised Act introduced provisions to strengthen employee stock ownership associations. For example, dividends from firms in nationally important industries could be paid out, in full or in part, to employee stock ownership associations (Article 15). Also, the preemptive rights given to employee stock ownership associations were raised from 10 percent to 20 percent of newly offered shares (Article 17). Listed firms were allowed to hold treasury stocks for a year, if they were purchased to pay out bonuses to employee stock ownership associations.

Fifth, for firms operating in nationally important industries, the Act restricted, for national security reasons, shareholders’ book inspection rights (Article 24).

¹⁷Although the Act used a softer term, it did not mean the government was taking a softer approach. In reality, the IPO recommendations in the ‘80s were no different from IPO orders in the 1970s.

3. Outcomes and Evaluation

3.1 Outcomes

In the beginning, not all firms were enthusiastic about public offerings. For example, only 40 out of the 59 firms (11 Chaebol member firms and 44 non-Chaebol firms) that received IPO recommendations on April 29 1986 from the Securities Supervisory Board, submitted their IPO plans by the May 20 deadline (Maeil Business Newspaper 1986. 4. 29, 1986. 5. 21). Nineteen firms refused to comply, despite threats of bank loan restrictions. By October of 1988, only five out of 59 firms designated in 1986, 16 out of 77 firms designated in 1987, and six out of 15 firms designated in 1988 went public (Kyunghyang Shinmun 1988. 10. 24).

TABLE 8—STOCK MARKET STATISTICS, 1985-1989

	Unit	1985	1986	1987	1988	1989
KOSPI	1980 = 100	139.53	161.40	264.82	532.04	919.61
Market Capitalization	Billion won	6,570	11,994	26,172	64,543	95,477
Capital Stock Listed	Billion won	4,665	5,649	7,591	12,212	21,212
No. of Listed Firms	New (Delist)	11 (5)	17 (4)	35	115	124
	Cumulative	342	355	389	502	625
Paid-in Capital Increase	No. of Firms	60	110	178	298	274
	Billion won	260	798	1,656	6,721	11,125
Public Offerings	No. of Firms	11	16	44	112	135
	Billion won	35	43	244	1,049	3,545
No. of Shareholders	-	772	1,410	3,102	8,541	19,013
Share Ownership by Small-scale Investors	%	9.76	13.27	20.12	24.21	23.74
Yearly Turnover	Yearly	0.72	1.11	1.30	1.54	1.12
Economic Growth Rate	Real GDP %	7.5	12.2	12.3	11.7	6.8

Notes: Small-scale investors refer to those holding less than 1,000 shares. Yearly turnover is measured as follows: (total number of shares traded per year / total number of shares outstanding at year-end).

Source: Securities Market Yearly Statistics (1989) and Bank of Korea (ECOS).

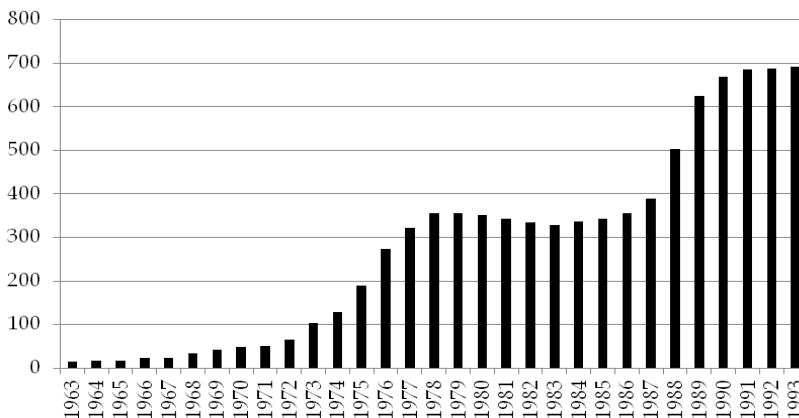


FIGURE 1: THE NUMBER OF LISTED FIRMS, 1963-1993

Source: Securities Market Yearly Statistics.

Occasionally, the Securities Supervisory Board summoned executives from non-complying firms in order to pressure them to go public.

The situation changed in later years. As shown in Table 8, the number of newly listed firms, which was only 35 in 1987, jumped to 115 in 1988 and 124 in 1989. Figure 1 shows the number of listed firms from 1963 to 1993. One can easily visualize that there were two IPO waves, one during the late 1970s and the second during the late 1980s.

There were also increases in paid-in capital and public offerings. As shown in Table 8, there were increases of approximately 4.9 trillion won of public offerings and 20.6 trillion won increase of paid-in capital during the period of 1985-1989. The introduction of market-price share offering greatly contributed to this increase. Other stock market indicators improved as well. During the four-year period between 1985 and 1989, the number of stock investors, the KOSPI, and the amount of listed capital stocks increased respectively by 24.6, 6.6, and 4.5 times. During the same time period, turnovers of listed shares ($0.72 \rightarrow 1.12$) and the percentage of shares held by small-scale investors (holding less than 1,000 shares) increased respectively by 9.76 and 23.74 percent.

The composition of external financing also improved over time. In 1988, the fraction of equity financing accounted for 39 percent. This was in great contrast to the level of only 8 percent in 1968. With the increase in equity financing, the capital structure also improved. Debt-to-equity ratio which was 462 percent in 1980 dropped to 260 percent by 1989. Also, the interest coverage ratio, which was less than 100 percent in 1980 jumped to 162 percent in 1986.

In 1988 and 1989, it was not uncommon to see firms offering shares at high premiums. For example, Saehan Media and Daeduck Industrial offered their shares respectively at 500 and 300 percent premiums. These shares were also correspondingly oversubscribed by 10.5:1 and 45:1 (Rhee *et al.* 2005). Facing favorable market conditions, firms went public and increased their paid-in capital voluntarily, and there was no need for the government to exert any pressure. In contrast, the government had to become stricter in its screening process of firms that had applied to go public.

The second half of 1980s also witnessed an increase in preferred share issuances. Preferred shares became popular among firms that did not want to dilute the shares held by their controlling families. Stock investors also did not object to investing in them, as they did not prioritize voting rights. The very first preferred share issuance was accomplished by Oriental Brewery in June of 1986. The issuance of preferred shares, which accounted for only 1 percent of all paid-in capital increases in 1987 jumped to 36 percent by 1989 (Rhee *et al.* 2005).

However, preferred shares issued in those years differed from those that have been allowed since 1996. Pre-1996 preferred shares had dividend yields which were one percent higher than those of common shares. Although dividend yields were higher than those of common shares, these figures fluctuated over time. Post-1996 preferred shares, on the other hand, provided a fixed dividend yield. In some sense, pre-1996 preferred shares were similar to non-voting common shares. With the revision of the Commercial Code in 1996, the issuance of such preferred shares is now banned.

3.2 Evaluation

The success in expanding share offerings in the second half of 1980s is, to a large extent, attributable to the aforementioned 'Three Lows' and the resulting economic boom. Firms, facing increased demand for their products and recognizing the need to raise more capital, became more inclined to go public or increase their paid-in capital. With higher income and wealth, a greater percentage of the population became stock investors, thereby expanding the stock investor base as well.

The government also played an important role. Two measures were noteworthy in particular. The first of these was the liberalization of offering prices at the time of an IPO. The second was the introduction of market-price share offerings for listed firms. The regulations on IPO offering price, on which restrictions had been considerably relaxed in April of 1987, were completely liberalized in June of 1988 (Rhee *et al.* 2005). Given this degree of liberalization, many firms were able to offer their shares at premiums. As a result, the cost of equity capital fell significantly, from 24.3 percent during the period of 1982-1983 to 9.3 percent during the period of 1986-1990 (Rhee *et al.* 2005).

The rise in paid-in capital was attributable to market-price share offerings, which were, in return, attributable to increasing demand for stocks. Firms also benefited by retaining the difference between market price and par value. This difference was classified as a part of book equity referred to as capital surplus reserves.

In the beginning, the government allowed market-price share offerings only under limited circumstances. However, soon thereafter, it began to require it for all firms, provided that their share price was 10 percent above par value (February 1987). This action was prompted to combat distortion in the market, arising when investors preferred to purchase distressed firms that were offering shares at par value over blue-chip firms offering shares at market price. In September 1989, the government removed all of the remaining restrictions on market-price share offerings (Rhee *et al.* 2005). The maximum discount rate applied to market price was also lowered from 50 percent in 1987 to 10 percent in 1989. Market-price share offering, as a percentage of total paid-in capital, increased from 4-6 percent during the period of 1984-1985 to 100 percent by 1989. The average premium (over par value) also increased from 11 percent in 1986 to 340 percent by 1989.

Overall, the government's share offering expansion policy was a success, but was not without problems. First, share offerings increased in the late 1980s, disproportionately exceeding their demand. KOSPI, which peaked around the period of March-August 1989, nosedived continuously until it hit the bottom in July of 1992. A number of individuals who had invested with borrowed money committed suicide out of despair. Of course, it was somewhat inevitable for share prices to drop after public offerings, as firms generally offer shares when their share prices are peaking. This, however, does not mean that the government is helpless and should not be held accountable. To prevent a hard landing, it should closely monitor the market, and if necessary, preemptively intervene in the primary market by limiting the amount of share offerings, or inducing greater demand for stocks. This was what the government did when it announced a stock market stabilization plan in November of 1989. However, it was too late to prevent the downfall.

Second, controlling shareholders were criticized for intentionally diluting the value

of their company shares before their IPOs, thereby reaping capital gains afterwards. This scheme worked in the following way. First, controlling shareholders significantly increases the number of shares they hold, e.g., by reclassifying asset revaluation reserves as capital stock. The number of new shares existing shareholders receive equals the amount of reserves that had been reclassified divided by par value. If per share net asset value is greater than the par value, existing shareholders make a capital gain. However, per share net asset value itself falls after the reclassification. This is so because the total number of outstanding shares increases without any new capital injection. This results in a capital loss for the existing shareholders exactly offsetting the initial capital gain. In other words, reclassification *per se* does not result in any net gain to the existing shareholders.

It makes a major difference, however, when the post-IPO share prices remain high, regardless of how many pre-IPO share issuances there were. With a stock-buying spree, this was the market environment in the late 1980s. Firms were able to offer shares at 300-400 percent premiums, regardless of their pre-IPO share issuances. As a result, the existing shareholders, mostly Chaebol families, reaped huge capital gains. A numerical example can make this point clear.

Suppose there is a private firm with a net asset value of 1 billion won. If there are 100 thousand outstanding shares, the per-share net asset value is 10 thousand won. For simplicity's sake assume that the founder owns 100 percent of these shares. Par value per share is fixed at 5 thousand won.

Suppose now this firm revalues its assets and the net asset value of this firm increases to 1.5 billion won. On the right-hand side of the company's balance sheet, the shareholder equity is now divided into capital stock (1 billion won) and reserves (0.5 billion won). The per-share net asset value is now 15 thousand won. The total value of shares held by the founder is 1.5 billion won ($15,000 \times 100,000$).

Now suppose the firm increases the number of outstanding shares by reclassifying asset revaluation reserves as capital stock. Capital stock now has a value of 1.5 billion won and the number of outstanding shares reaches 200 thousand (= existing 100 thousand + 0.5 billion divided by par value, 5 thousand won). This means that the per-share net asset value is 7,500 won (= 1.5 billion divided by 200 thousand shares). The share value is diluted from 15,000 won to 7,500 won, but the total value of the shares held by the founder remains at 1.5 billion won.

However, let us suppose now there is a bubble in the market and that the IPO offering price will be set at 20,000 won regardless of the pre-IPO share issuance. In the absence of pre-IPO share issuance, the post-IPO value of the shares would be worth 2 billion won (= $20,000 \times 100,000$). However, with a pre-IPO share issuance, the post-IPO value of shares would be worth 4 billion won (= $20,000 \times 200,000$).

Third, the introduction of preferred shares was a violation of one-share, one-vote principle, as the preferred shares that were introduced were more akin to non-voting common shares. In effect, the government approved a *de facto* dual class equity system. Consequently, chaebol families were able to have control rights well above their cash flow rights. However, surprisingly, there was hardly any opposition to the concept of preferred shares initially. Problems with this system, however, gradually emerged. In late 1989, controlling shareholders dumped their preferred share holdings, which triggered a further share price drop of these shares (Rhee *et al.* 2005). These shareholders did not, however, dump common shares, in an obvious attempt to

retain control. Incidents of preferred shares being used for stock price manipulation also later emerged. Any new issuance of problematic preferred shares was finally outlawed in 1996, through the revisions to the Commercial Code in November of 1995.

4. Implications for Developing Countries

The lessons that can be drawn from the second half of the 1980s are very similar to those mentioned in the previous section. As before, the macroeconomic situation was the most decisive factor. Massive public offerings would not have been possible without the Three Lows, and the resulting economic boom. If policymakers from developing countries wish to induce more equity offerings, they should concentrate their efforts during a stock market boom.

Second, it should be noted that an economic boom alone is not sufficient in and of itself. The government must take timely measures to remove obstacles that may be hindering equity offerings. In Korea, there were two important measures that served such a purpose: the liberalization of IPO offering prices and the introduction of market-price share offerings by listed firms.

Third, in order to change firms' perception of the stock market, it is important to engage in continuous education and public campaigns. In the 1960s and '70s, the stock market was perceived as a place for gambling. By the second half of 1980s, capital market was well-recognized by firms as a source for the raising of long-term capital.

Fourth, it is important ensure that the magnitude of public offerings does not exceed their demand. If it does, the government should abandon their yearly listing targets and try to restrict share offerings. To a certain extent, an economic boom is not unlike a double-edged sword. It induces new share offerings while concurrently, bringing a stock price bubble that attracts inexperienced and naïve investors into the stock market. When the bubble inevitably bursts, it leaves many damaged investors behind, some deep in debt.

Fifth, the government's coercive approach did not make much of a difference either way.¹⁸ As discussed earlier, the number of newly listed firms closely followed real GDP growth rate or the stock price index. During a recessionary economy, however, firms refused to go public even in the presence of government pressure.

III. Other Supplementary Policies

The primary market, in which firms offer shares, is closely intertwined with the secondary market, where those shares are traded among investors. If share prices are set inadequately or transaction costs are too high in the secondary market, firms will

¹⁸Although the political system had been democratized in the second half of the 1980s, the government was able to use coercive measures, such as restricting bank loans, because most financial institutions were still under government control.

have difficulty discovering favorable offering prices, and investors will face liquidity constraints. An advanced capital market is one in which both markets are well-developed. In Sections 1 and 2 of this Chapter, a number of policies that shaped the secondary market in the 1970s and 80s are outlined.

It is also clear that the primary market cannot be enlarged simply by increasing the supply of shares. There should be a commensurate increase in the investor base of the stock market. In the absence of a wide investors' base, the supply of, and the demand for, shares would show a great imbalance, ultimately hindering the development of the stock market. Since the 1960s, the Korean government has made a series of efforts to expand the stock market's investor base. In Section 3 of this Chapter, I cover the employee's stock ownership plan.

A. The Introduction of Regular-Way Transaction and the June 3rd Measure

1. Background

Up until 1969, the most popular means of share transaction was the clearing transaction system. This was the case during the Daehan Stock Exchange years and even after the Korea Stock Exchange was established in 1963.¹⁹ Clearing transactions were like today's futures transactions. A buyer (seller) promises to pay (receive) a certain price today but makes the actual payment (delivery) at a later date within one or two months. Also, the buyer and the seller can enter opposite transactions, thereby canceling their initial positions (two-sided orders). In this case, there would be no actual delivery of shares. The transaction was settled by paying or receiving the difference between the two contracted share prices. The exchange required margins from both parties. As opposed to clearing transactions, a cash transaction requires all aspects of a trade, including the delivery of payments, to be finalized on the same date.

Because the transaction required only a small margin, clearing transactions were often used for speculative reasons, sometimes resulting in speculative bubbles. Two episodes during this era are noteworthy, one in 1959 and the other in 1962. In those years, clearing transactions accounted for 80-90 percent of all trading volume.

The 1959 incident took place when speculators amassed Daehan Stock Exchange shares, betting on the possibility that it would be reorganized as a stock company, and that investment certificates would be exchanged with shares. The stock price jumped from 39 chon in February to 90 chon in May of 1959. Chon was the currency unit used before the introduction of won by the June 1962 currency reform.

¹⁹The Daehan Stock Exchange existed from March of 1956 to December of 1962. The Korea Stock Exchange (KSE) existed from January of 1963 to December of 2004. It is important to note the nature of their legal entities. The Daehan Stock Exchange was initially not a stock company, but was able to issue investment certificates that were traded like stocks in the secondary market. Three months after the enactment of the Securities and Exchange Act in January of 1962, the Daehan Stock Exchange became a joint stock corporation. However, a speculative bubble, which burst during the first half of 1962, led Daehan to be reorganized into a government-run, non-profit corporation in 1963. It was also renamed as the Korea Stock Exchange. In 1988, it was privatized and reorganized again as a membership organization. Its successor, the Korea Exchange (KRX) is a joint stock company.

During the period of March-May of 1962, speculators again amassed Daehan Stock Exchange shares. This time, it was triggered by rumors that the stock exchange would complete a massive capital increase. The share price of 9.2 hwan (equivalent to 100 chon) in March jumped to 42.5 hwan in April. The trading volume of Daehan Stock Exchange shares also increased dramatically, representing 52.7 percent of the total trade volume by April. The Daehan Stock Exchange was criticized for its lack of timely intervention. A conflict of interest problem was also noted because Daehan Stock Exchange managers were also its shareholders, which made them unenthusiastic about stabilizing the stock market.

With a rising stock price, investors that took a short position were unable to make their payments. The stock exchange was also unable to make the required payments on behalf of the sellers. Ministry of Finance stepped in and pressured the Bank of Korea to extend securities loans to the stock exchange. Chang-Soon Yoo, governor of the BOK, refused to cooperate, and resigned on May 26. The BOK ended up extending a loan of 33 billion hwan by June 1.

The stock market speculation in 1962, however, cannot be solely attributed to the clearing transaction system. Investigations in later years revealed that Jong-Pil Kim, then serving as the head of the Korean CIA, created the speculative environment in order to fund and launch the Democratic Republican Party (Hankyoreh 2005. 3. 1). Kim instructed Korean CIA to give 980 million hwan to Eung-Sang Yoon, who, in return, established three securities firms that purchased massive amounts of Daehan Stock Exchange shares, which in turn triggered the bubble. Yoon was able to provide 6.7 billion hwan to Jong-Pil Kim from these investments.

2. Detailed Contents

2.1 The Adoption of Regular-Way Transactions

On February 1 1969, the Ministry of Finance (Minister: Jong-Yeul Hwang) repealed the clearing transaction system, adopting the regular-way transaction system. Under the new system, a trade had to be settled on the following day. One day after the contract, the buyer had to complete payments and the seller had to deliver the shares. Certain exceptions were allowed, some of which resembled the old clearing transaction system. If one party failed to settle on the following day, the settlement period was allowed to be extended, provided that both parties pay margins, and the party which failed to complete the transaction pays a small postponement fee (Kyunghyang Shinmun 1971. 2. 4).²⁰

This delayed settlement option, coupled with a 30 percent margin requirement, enabled investors to replicate futures trading, even without entering opposite transactions (Kyunghyang Shinmun 1971. 2. 4).²¹ As an example, consider two investors, A (buyer) and B (seller), who wish to trade 2,000 shares of the Korea Securities Finance Corporation (KSFC) on January 1 at 800 won per share. Once

²⁰In the beginning, the settlement period was allowed to be extended for 30 days. Later in July 1969, as a measure to boost up the stock market, it was relaxed to 60 days.

²¹In October 1969, the government lowered the margin requirement from 40 percent to 30 percent for Korea Securities Finance Corporation shares.

they deposit a margin of 480,000 won ($= 0.3 \times 800 \times 2,000$) at the Korea Stock Exchange, they can enter a *de facto* futures position. If share prices were to rise to 1,000 won by January 10, investor B would receive 80,000 won ($= 480,000 - 400,000$) from the Exchange, while investor A would receive 880,000 won ($= 480,000 + 400,000$).

Sometimes positions escalated to alarming levels. A good example of this excess was speculation involving the shares of Korea Securities Finance Corporation (KSFC) in November of 1969. One group of investors took a long position, while the other took a short position. Each party tried to enlarge its position to influence the share price in its favor (Maeil Business Newspaper 1970. 1. 24). When the size of the position increased, even more investors joined the herds. Share prices fluctuated with high volatility, during which investors who were not involved in speculative trading were harmed. These investors staged a demonstration to express their anger and frustrations (Maeil Business Newspaper 1970. 2. 6). With the sheer size of the position increasing to new levels, there was great concern that one of the two parties would default on payment obligations.

2.2 The Measure of June 3rd

The Ministry of Finance (Minister: Duck-Woo Nam), which had shown reluctance to intervene, finally devised a measure on June 3, 1971. First, it required all stock transactions be settled on the fifth day, beginning on August 5, 1971. Second, it also banned two-sided trading, also beginning on August 5. Third, as an interim provision, it ordered all existing and unsettled positions be liquidated within 60 days (Maeil Business Newspaper 1971. 6. 8).

The new measure, however, had to be suspended as securities firms filed injunctions against it. They claimed that the measure infringed upon their property rights. They also pointed out that the measure was based on the Enforcement Regulation, which was in breach of the Securities and Exchange Act. Article 79 of the Act delegated the choice of transaction systems to the Enforcement Decree, but not to the Enforcement Regulation. According to this logic, the administrative order based on the Enforcement Regulation was invalid.

They filed two injunctions, one against the Ministry of Finance at the appellate court on the new transaction system, and the other against the Korea Stock Exchange at the civil district court of Seoul on the interim provision (Maeil Business Newspaper 1971. 6. 16). On June 23, the civil district court of Seoul accepted the injunction against the Korea Stock Exchange. According to the court's verdict, the liquidation order had to be suspended until August 4. In July, speculative positions on the Korea Securities Finance Corporation shares grew even larger. To end the legal dispute, on July 29 1971, the government revised the Enforcement Decree and stipulated that stock transactions must be settled on the fifth day of the contract. The effective date was set to December 1.

Thanks to the Ministry's continuous persuasion and pressure, on August 16, the two parties reached an agreement (Maeil Business Newspaper 1971. 8. 17). Nonetheless, this was not without resistance. For example, the management of Sambo Securities strongly criticized the government and refused to comply, stating

that they were forced by the government to give in with substantial monetary losses (Maeil Business Newspaper 1971. 8. 17).

B. The Introduction of Securities Deposit and Settlement Systems

1. Background

With the June 3rd Measure of 1971, stock transactions had to be settled with the actual delivery of shares, which proved to be very inconvenient. There was the risk that share certificates would be lost, as well as the costs which would be incurred to keeping them. To alleviate such inconveniences, the government decided in 1972 to adopt a securities settlement system similar to those adopted in the US and Japan (Rhee *et al.* 2005). To replicate the U.S. model, the government received technical assistance from USAID during the period of October-November 1972. The key result of this technical assistance was the establishment of a securities settlement system.

2. Detailed Contents

2.1 The Establishment of Korea Securities Settlement Corporation (KSSC)

Korea's first securities settlement system was introduced in February 1973, when the Securities and Exchange Act was revised. Initially, securities settlements were carried out within the stock exchange (November 1973 – December 1974). However, the function was soon transferred to the newly established Korea Securities Settlement Corporation (KSSC) on December 6, 1974.²² The new system, however, made slow progress, which prompted the government on July 7, 1975 to make it mandatory to settle all secondary market transactions by book-entry transfers (Korea Securities Depository 2003).

2.2 Centralized Securities Deposit

With the establishment of the KSSC and its book-entry transfer system, incidents of actual share delivery dropped considerably. But, there was no centralized depository institution, and stocks were kept in many securities firms. As a result, shares had to be delivered from one securities firm to another (Maeil Business Newspaper 1979. 9. 13). There were even incidents of shares being stolen (Maeil Business Newspaper 1980. 6. 13).

Against this backdrop, on December 20 1979, the Korea Securities Dealers Association decided that it would adopt a centralized depository system. This system required that securities firm headquarters deposit at the KSSC 100 percent of the

²²It was renamed the Korea Securities Depository (KSD) in 1994.

shares they administered, and that regional branches deposit at the KSSC at least 70 percent of the shares they administered (Maeil Business Newspaper 1979. 12. 21). Shares deposited at the KSSC, however, did not increase immediately. This led the government to intervene. In January of 1983, the government made it mandatory to deposit at least 90 percent of shares at the KSSC by no later than June 30 (Maeil Business Newspaper 1983. 1. 10). Related to this, on March 31 1983, the Securities Supervisory Board required all institutional investors to settle their transactions through the book-entry transfer system, which was administered by the KSSC.

2.3 Continued Depository System

A problem related to the centralized deposit system emerged early on. Whenever one provided shares as collateral, or transferred shares to a different name, the shares had to be withdrawn from the KSSC. In fact, near the fiscal year-end, securities firms had to withdraw a large number of shares from the KSSC, transfer the shares to another name, and then re-deposit them at the KSSC. In response to this inconvenience, industry experts called for the adopting of a continued depository system (Maeil Business Newspaper 1980. 1. 19). This refers to a system, in which all shares are kept under the name of the depository agency, and shareholder rights are exercised indirectly through the agency. As a result, shareholders no longer had to withdraw their shares when providing them as collateral or transferring them to another name.

Although its need was well-recognized, the continued depository system could not be introduced immediately. This has to do with the fact that Commercial Code did not allow split votes, or voting in disunity, and that under the continued depository system, all shares are kept under the KSSC's name. This gives rise to a situation, where shares held by the same person (KSSC) are voted in opposite directions. But, this is illegal under the Commercial Code. To resolve this problem, the government revised the Commercial Code in April of 1984 and allowed voting in disunity. In September, it was also decided that the voting rights of shares under KSSC's name will not be exercised, unless requested by the beneficial owner (Maeil Business Newspaper 1984. 9. 22).

The continued depository system was launched in June of 1985, but it took some time for the new system to be commonly accepted. For firms with fiscal years ending in June of 1985, only 30 percent of shareholders had transferred their shares to the KSSC's name (Maeil Business Newspaper 1985. 7. 4).

2.4 Beneficial Owner System

The continued depository system was adopted in 1985, based on a decision made by the Securities Management Commission, and not as a result of the Securities and Exchange Act. To stave off any legal dispute, the government revised the Securities and Exchange Act (promulgated on November 28), and introduced provisions on the continued depository system and the beneficial owner system. The latter system gives beneficial owners the shareholder rights equivalent to those held by

shareholders in the registry. The key provisions in the revised Act are summarized below.

First, for securities deposited at the KSSC, the person who is stated in the account book shall be considered to hold the respective securities. Also, if there is a transfer between accounts for the purpose of transferring securities or establishing the right of pledge, the securities shall be considered delivered (Article 174-3). Second, for securities deposited at the KSSC, the depositor and the KSSC shall be presumed to have co-ownership over the deposited securities (Article 174-4). Third, for deposited securities, the KSSC can transfer them to its name and exercise its rights as a shareholder (Article 174-6).

Fourth, if the issuing firm closes the shareholder registry to determine the list of shareholders that can exercise shareholder rights, such as voting rights, the KSSC should immediately notify the issuer the registry of beneficial shareholders (Article 174-7). Fifth, the issuing firm must keep the registry of beneficial shareholders received from the KSSC. This registry shall have the same effect as the registry in the Commercial Code (Article 174-8).

3. Evaluation and Implications for Developing Countries

The securities settlement system, the concentrated deposit system, the continued depository system, and the beneficial owner system all made significant contributions in advancing the secondary market. However, they also made contributions to the primary market. If not for the reductions in trading and settlement costs in the secondary market, large public offerings during the second half of 1980s would not have been possible.

One regretful point was the delay in adopting the continued depository system. The necessity was raised in 1980, but this measure was not adopted until 1985. The delay is attributable to the existing Commercial Code, which prohibited split votes. It took much too long to revise the Code.

It is also worth noting that Korea actively benchmarked other countries when adopting its securities deposit and settlement systems. For the securities settlement system, the government received technical assistance from the experts dispatched from USAID. For the continued depository system, the government was influenced by precedents in the U.S., U.K., and Japan (Maeil Business Newspaper 1979. 9. 6, 1979. 9. 21). Considering the case in Korea, other developing countries should also actively benchmark systems in advanced countries when adopting securities deposit and settlement systems.²³

²³ Since 1995, Korea has offered its own technical assistance on securities systems. The first case was designed and implemented for Vietnam. Some other recent examples include the assistance with a securities IT system (Uzbekistan) and the establishment of a joint stock exchange (Laos and Cambodia).

C. The Employee Stock Ownership Plan

1. Background

In 1968, the government was criticized for allowing shares of state-owned enterprises to be acquired by a small number of Chaebols, a move clearly against the government's stated goal of popularizing stock ownership. As a way of promoting dispersed share ownership, business and labor alike proposed to the government the introduction of an employee stock ownership plan (Maeil Business Newspaper 1968. 6. 8). The proposal was accepted by the government, and the Capital Market Development Act was enacted in November of 1968, with provisions legalizing employee stock ownership plans (Kyunghyang Shinmun 1968. 11. 9).

The Act had a provision which allowed discounted share offerings to SOE employees (Article 5) and a provision giving company employees preemptive rights to purchase newly offered shares (Article 6). This was clearly a step forward, yet it remained incomplete in the sense that such provisions applied only to listed firms or non-listed public firms.

The employee stock ownership plan was pursued to achieve many goals, such as popularizing stock ownership, building employee wealth, establishing peace between labor and management, instilling company loyalty, motivating workers' willpower, and expanding the stock investors' base.

Despite such enthusiasm, employee stock ownership plans were not widely utilized by firms in the beginning for many reasons. Dividend yields were too low to attract employers to hold shares. Salary levels were also too low to warrant any extra savings through shares. There were no tax benefits for these plans, and top management understood little about them (DongA Daily Newspaper 1972. 12. 28). The government tried to promote employee stock ownership plans in 1972 when it revised the IPO Promotion Act. The Act introduced a provision that allowed company employees a 10 percent preemptive right to buy newly-offered shares (Article 8).

2. The Supporting Measures of 1974

The employee stock ownership plans became widely accepted only after July of 1974, when the Ministry of Finance (Minster: Duck-Woo Nam) announced a package of supporting measures. The package was prompted by the May 29th Special Order from the President (see section II.B.3, for details). President Park believed that the employee stock ownership plan, coupled with the factory-level Saemaeul Movement, could greatly promote peace between labor and management (Kim 2006).

Supporting measures can be summarized as follows (DongA Daily Newspaper 1974. 7. 13). First, they introduced a loan program for employees who wished to purchase company shares. Provided that an employee covers 50 percent of stock purchasing costs from his own salary, the company was required to give a loan (no interests during the first year of the loan) to finance the remaining amount. To induce companies to cooperate, interest earnings were excluded from taxable income in later

years. If employees purchased old shares, it was also possible for loans to be extended by the controlling shareholder. Again, no interest was charged during the first year.

Second, it encouraged firms to give bonuses and severance payments through company shares. In such payments, a significant portion was exempt from labor income tax obligations. Third, it encouraged nonpublic firms to allocate 10 percent of IPO stocks to employee stock ownership associations.²⁴ As an inducement measure, shares owned by employee stock ownership associations were regarded as publicly-owned shares.

Fourth, it encouraged firms to sell company shares at a discount. Moreover, to alleviate the employee tax burden, the resulting labor income or gift tax burden was partially exempted. Dividend income received by employees of nonpublic firms was also partially exempted from dividend income tax obligations.

To prevent such tax benefits from being abused, the government made it clear that benefits do not apply to employees owning more than three percent of outstanding shares. Also, to prevent controlling shareholders from disguising their share ownership as employee owned shares, the Ministry required shares held by employees be deposited at the Korea Investment Development Corporation (KIDC) for at least one year for public firms, and multiple years for nonpublic firms until their IPO.²⁵

3. Evaluation and Implications for Developing Countries

Two years after the announcement of these supporting measures, the number of firms with employee stock ownership associations reached 249 (217 public firms and 32 nonpublic firms) by July of 1976. The number of enrolled employees also reached 91,497 by this time. Among the 249 firms, 202 (including 17 nonpublic firms) were firms which deposited shares at the KIDC. The most exemplary firm was Daewoo Corporation, with all of its 691 employees enrolled owning 6.55 percent of company shares (DongA Daily Newspaper 1976. 7. 10). In 1987, the number of firms with employee stock ownership associations grew to 455.

As mentioned earlier, employee stock ownership plans were introduced to popularize stock ownership, build employee wealth, establish peace between labor and management, instill company loyalty, motivate the will to work, and expand the stock investor base. Among these various goals, two objectives were clearly achieved: popularizing stock ownership and expanding the stock investor base. The employee stock ownership plan played a key role in absorbing newly offered shares during the 1970s and 80s.

Despite such benefits, employee stock ownership plan was not without problems. Enrolled employees would lose both their jobs and their stock wealth, if the company were to go bankrupt. Employee stock ownership plans therefore may not be the most desirable option for someone who simply wishes to diversify one's wealth.

²⁴The 10 percent upper limit was raised to 15 percent in September of 1987.

²⁵Since 1977, KSFC became the depository institution for ESOA held shares. During 1988 and 1993, MoF imposed a restriction that employees cannot sell their shares until they retire.

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