



## Steel consumption and economic growth in Korea: Long-term and short-term evidence

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### ABSTRACT

This paper examines the long-term and short-term causal relationships between steel consumption and economic activity in Korea between 1975 and 2008 using vector error correction and vector autoregression models. This study disaggregates steel products and steel-consuming industries because the consumption of a specific steel product is closely linked to the output of the corresponding industry. This approach can provide a clear and reliable causal relationship between variable pairs. The results show that total steel consumption and GDP have a long-term equilibrium relationship, running from GDP to total steel consumption. However, a long-term bi-directional causal relationship exists between flat products consumption and the manufacturing GDP. Flat products consumption also demonstrates the long-term relationships between steel-consuming industries, such as automobile, shipbuilding, and fabricated metal product, but causal directions are mixed, depending on variable pairs. These results imply that the reciprocal growth between these industries has contributed to the robust competitiveness of Korean manufacturing. Because Korea has maintained its export-oriented industrial policy based on manufacturing, the steel and steel-consuming industries are expected to play a significant role in economic growth far into the future.

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### Introduction

Traditionally, the consumption of steel has been thought to be closely linked to the rate of economic growth, which influences the level of activity in steel intensive sectors, such as capital equipment, construction, transportation, and consumer durables. The quantity of steel consumed is even considered an indicator of industrial development as nations move to higher stages of industrialization. Therefore, the most typical approach for forecasting steel consumption is the use of an econometric demand equation that models steel consumption primarily as a function of some measure of economic activity, such as gross domestic product (for example, Crompton, 1999; Robert, 1996; Rehiasz, 2006, etc.). This approach implies that economic growth leads steel consumption in a country over periods.

Steel consumption is also a key factor that leads economic growth during industrialization because the steel industry, the so-called “rice of the industry,” is the core that forms the base of a national economy. Many countries’ governments have fostered the steel industry from infancy to achieve rapid growth and a balanced industrial structure. For example, promotion of the steel

industry has contributed to the growth of the entire Korean economy due to the forward and backward linkages with the steel-consuming industries. The spill-over effect of the steel industry to the output of national economy is shown in the production inducement coefficients of Table 1. Notably, production inducement coefficients demonstrate the impacts of changes in the final demand for products of one industry on the production of all industries as a whole. Table 1 demonstrates that the steel industries in Korea, Japan, Germany, and China have higher production inducement coefficients than the average manufacturing coefficient and the average coefficient of all industries. These high coefficients imply that the steel industry makes a large contribution to the output of national economy when compared to the other industries. In all of these countries, the engine of economic growth is the manufacturing sector, including the steel industry. In the U.S., however, the coefficient of the steel industry is relatively low because the growth of manufacturing is stagnant. This approach implies that steel consumption causes economic growth in a country during industrialization.

In recent years, the stability of this relationship between economic growth and steel consumption has received considerable attention. Several authors (for example, Auty, 1985; Labson and Crompton, 1993; Larson et al., 1986; Tilton, 1990) have provided conflicting views on the nature of the relationship between two variables. In contrast with the papers that analyze

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**Table 1**  
Production inducement coefficients of the steel industry.  
Source: OECD, Input–Output Table (2005).

	Korea	Japan	Germany	China	USA
Steel industry	3.451	3.102	2.729	3.193	2.347
Manufacturing	2.971	2.766	2.246	3.069	2.393
Industry Ave.	2.475	2.330	2.008	2.438	2.070

the consumption of steel (or metals) in the Organization for Economic Cooperation and Development (OECD), Ghosh (2006) attempted to show a long-term equilibrium relationship between two variables in a developing country, India, in a bivariate vector autoregression framework. The study, focusing on the years 1951 through 2004, found no long-term equilibrium relationship between steel consumption and economic growth in India, but it establishes the presence of unidirectional Granger causality that runs from GDP growth to steel consumption.

These conflicting conclusions regarding the relationship between steel consumption and economic activity may come from country-specific data, depending on the level of industrialization, thus indicating the share of manufacturing industry in the economies. Tilton found that steel consumption and economic activity had become coupled in the OECD during the period 1960–1973, when manufacturing led economic growth in these countries. The ratio of steel consumption to income, however, has declined since 1973 because the role of manufacturing weakened as an engine of growth. Even though Labson and Crompton provided little evidence to support the presence of a long-term equilibrium relationship between income and metals consumption in the OECD, they found that the Japanese economy, which is supported by competitive manufacturing, has a stable long-term relationship between two variables. The absence of a long-term relationship between steel consumption and economic growth in India on Ghosh's study may be due to a relatively low manufacturing share in the Indian economy, which has kept at most around 15% in GDP since the 1970s.

The primary purpose of this paper is to test whether steel consumption and economic growth have a long-term causal relationship in Korea, which has achieved remarkable economic growth led by the manufacturing industry. Because the share of manufacturing in GDP in Korea has remained at almost 30% continuously, Korea is an appropriate country for trying the long-term causality test between the variable pairs. In this context, it is expected that not only economic activity leads steel consumption, but also the steel industry causes economic growth in Korea. In particular, and in contrast with previous studies, this paper disaggregated steel products and industries. Because the consumption of a specific steel product is most closely linked to the output of related industry, this disaggregation of industries and steel products allows us to have more clarified causal relationships between two variables of interest. In general, finished steel products are subdivided into three groups: long products, flat products, and pipes and tubes. Because the construction industry shares more than 70% of the total consumption of long products in Korea, long products consumption is directly connected to the growth of the construction industry. Similarly, the manufacturing industry consumes almost 90% of flat products such that shipbuilding, automobile, fabricated metal product, machinery, and home appliance share, respectively, 32%, 21%, 15%, 11%, and 10% of the total consumption of flat products on an average between 2000 and 2009 in Korea. These results indicate that outcomes of causality tests may differ depending on the types of steel products and the corresponding steel-consuming industries.

Since the early 1960s, Korea has adopted a strategy of export-led industrialization by promoting infant industries. The government's selective industrial policies have contributed significantly to Korea's rapid achievement of international competitiveness in a number of industries. In particular, the steel industry has been considered as an essential component in implementing these industrial policies successfully because the industry has strong forward and backward linkages with the export-oriented steel-consuming industries, such as shipbuilding, automobile, and machinery.

In the early 1960s, the steel industry in Korea was small and inefficient, producing low quality output. However, in 1970, the Korean government set out to foster a world-class steel industry driven primarily by large-scale integrated steel mills in the public sector through the Steel Industry Development Law. Government intervention played a tremendous role in the rapid industrial development in Asian countries. The designation of mammoth steel mills as a strategic national industry and state-led development of the industry have been common, and continue to be common, in these countries because the introduction of integrated steelwork requires a large initial investment and, in general, only the state can bear the burden of such a risky enterprise. As a result, it has been argued that the government's ability to assist is the key factor affecting the outcome of these huge projects.

According to the Steel Industry Development Law, the Korean government established the Pohang Iron and Steel Company Ltd. (POSCO) in 1973.<sup>1</sup> The Korean steel industry has rapidly developed since the establishment of POSCO. Korean steel production increased more than eightfold from 8.7 million tonnes (Mt) in 1980 to 64.4 Mt in 2008.<sup>2</sup> In addition to quantitative growth, the Korean steel industry has achieved strong competitiveness in technology and product quality by expanding Research and Development (R&D).<sup>3</sup> Even though the steel industry is not export-oriented, it has contributed heavily to the growth of export-oriented steel-consuming industries, thus pushing the growth of the overall economy and stimulating steel consumption. Shipbuilding, output of automobiles, machine orders, and output of home appliances increased by multiples of 6.5, 8.5, 4.3, and 6.6, respectively, between 1980 and 1989 in Korea.

Fig. 1 demonstrates steel consumption and GDP in the years 1970–2008 in Korea. It shows that two variables have kept parallel growth over the past four decades in Korea. Fig. 2 reveals that steel consumption and outputs of steel-consuming industries are highly correlated during the period studied in Korea.

This paper adopts vector error correction and vector autoregression models to test the long-term and short-term causal relationships between steel consumption and outputs of related steel-consuming industries, employing annual data during the 1975–2008 periods in Korea. The organization of this paper is therefore as follows: Section 2 provides the hypothesis and methodology, Section 3 explains the data and furnishes the empirical results, and Section 4 draws conclusions.

<sup>1</sup> POSCO was initially a quasi-governmental firm with ownership shared among the government of the Republic Korea (30%), the government-owned Korean Development Bank (40%), and government-controlled private commercial banks (30%). In the late 1980s, the Korean government announced a plan to privatize POSCO; although sales of shares to the public progressed more slowly than expected, the privatization was completed in 2000 when the Korean Development Bank sold its remaining shares to the public.

<sup>2</sup> A second integrated steel mill was constructed at Kwangyang in the mid-1980s.

<sup>3</sup> POSCO ranked at the top in overall competitiveness among the world steelmakers in 2009, according to the World Steel Dynamics (WSD), a representative steel research institute. It exceeds its competitors in a number of key areas, such as technological innovation, productivity, skilled workers, and balance sheet.

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