

## Statistical analysis of welding industry of South Korea

C. Kim <sup>a</sup>, M. Kang <sup>a</sup>, S. Bae <sup>b,\*</sup>

<sup>a</sup> Advanced Welding and Joining R&D Department, Korea Institute of Industrial Technology (KITECH), 7-47, Songdo-Dong, Yeonsu-Gu, Incheon 406-840, South Korea

<sup>b</sup> Dept. of Industrial & Management Engineering, HANBAT National University, 373-1 Duckmyoung-Dong, Yusong-Gu, Daejeon 305-719, South Korea

\*Corresponding author. E-mail address: loveiris@hanbat.ac.kr

Received 12.04.2009; published in revised form 01.10.2009

### Analysis and modelling

#### ABSTRACT

**Purpose:** This paper represents the current status of welding industry of South Korea - how much the welding industry accounts for in monetary terms in the manufacturing industry of South Korea.

**Design/methodology/approach:** We classify welding industry into welding equipment industry and materials & the welding engineering sub-industry. To decide the portion of the welding industry in other engineering industry, we adopt the Welding-Related Expenditures, Investments, and Productivity Measurement in U.S. Manufacturing, Construction, and Mining Industries, a report published by AWS in 2002. The statistical analysis was performed based on the NSO and KITA data.

**Findings:** In South Korea, the welding-related portion in the engineering industry showed much higher figures - about 9 times higher in production amount and over 5 times in export amount - than the welding equipment and materials industry. In addition, the total production of the welding industry amounted to 2.6 billion \$, indicating that the welding industry holds a very important place in the entire domestic industries.

**Research limitations/implications:** The welding industry of South Korea was statistically analyzed using the welding related expenditure of the manufacturing industries.

**Research limitations/implications:** This research quantitatively showed the relative importance of the welding industry in South Korea.

**Originality/value:** Due to the nature of welding industry, it is difficult to identify the boundary of welding industry. In addition, monetary impact of welding industry was not revealed in practical manner. In this paper, we categorize the welding industry into two sub-industries and analyze the statistical data with our framework to reveal monetary impact of welding industry. With our results, it is possible to estimate the economical effects of welding industry in South Korea.

**Keywords:** Statistical analysis; Welding industry; HSK classification; Industrial classification

#### Reference to this paper should be given in the following way:

C. Kim, M. Kang, S. Bae, Statistical analysis of welding industry of South Korea, Journal of Achievements in Materials and Manufacturing Engineering 36/2 (2009) 207-211.

## 1. Introduction

The manufacturing industry, as of 2007, is one of Korea's major industries, accounting for 27.9% of the Gross Domestic Product and 37.9% of employment [1]. The production infrastructure industry, in particular, underpins the manufacturing sector as a core infrastructure industry, as it is in this industry where materials are processed into components, which are then assembled into products. Included in this industry are welding, casting, die and mould, coating, forming, and heat treatment sub-industries.

It is true that the Korean production infrastructure industry has relatively weak competitiveness compared to the country's world-class competitiveness in the automobile, shipbuilding, and electronics industries, which are major export industries of Korea. Moreover, it is difficult to perform a systematic analysis of the scope of the production infrastructure industry and its effect on employment on a national level.

This difficulty is attributable to the very nature of the production infrastructure industry. To elaborate, while it is easy to examine industry trends and supply-and-demand trends in the casting and die and mould industries as they produce products on their own, all other sub-industries in the production infrastructure industry fall under intermediate processing and assembly processes, making it difficult to estimate the status of the relevant industries.

In this manner, it is difficult to identify the welding industry's trends, as the industry is part of the intermediate processing and assembly process involved in making final products; this is especially so when only the trends of the final product-centric industries and supply and demand trends are investigated.

In other words, the welding industry consists of the sub-industry that produces welding equipment and materials and the welding engineering sub-industry where parts and products are designed and manufactured using welding. While it is easy to analyze industrial trends of the welding equipment and material sub-industry given that it produces final products, it is not easy in the case of the welding engineering sub-industry to define the portion taken up by welding in the production process of final products.

To address this challenge, the present study is based on another study published by the American Welding Society (AWS) and Edison Welding Institute (EWI) in 2002, which offer an examination of the status of the welding industry based on the sales and other relevant costs in each field of American industries where welding is used as a core technology [2]. Also, the study uses data on each domestic industry compiled by the National Statistics Office (NSO) and Korea International Trade Association (KITA) to draw statistics on the production amount, export and import status, number of companies and employees by company size, and regional distribution. Based on these items, the status of the domestic welding industry was analyzed.

This analysis is expected to help identify how much the welding industry accounts for in monetary terms in the manufacturing industry of Korea as well as determine the possibility of expansion of the welding industry in the future.

## 2. Literature review

The AWS defines welding as "a kind of a joining process that produces coalescence of materials by heating them to the welding temperature, with or without the application of pressure or by the application of filler." Other definitions distinguish welding from joining. In this study, joining through brazing and soldering was included in welding for the statistical analysis in accordance with the AWS definition.

As mentioned above, the welding industry consists of the sub-industry that produces welding equipment and materials and the welding engineering sub-industry that employs welding as an engineering technique. For statistical analysis of the welding equipment and materials sub-industry, the entire welding industry's status was analyzed by using industrial statistics classification codes, whereas the statistical figures were multiplied by the portion the welding industry occupies to perform the analysis.

In Korea, because the portion the welding industry takes up in the engineering industry has not been studied, the portion suggested in the Welding-Related Expenditures, Investments, and Productivity Measurement in U.S. Manufacturing, Construction, and Mining Industries, a report published by AWS in 2002, was used instead.

This report designated manufacturing, construction, and mining industries as those utilizing welding as its core technology. Table 1 shows the ratio of the welding-related expenditure against the entire expenditure, broken down by sub-category.

Table 1.  
Welding-Related Expenditure by Industry (cited from AWS)

Industry	Proportion (%)
Heavy Industrial Manufacturing	5.19%
Construction	3.09%
Light Industrial Manufacturing	2.36%
Automotive	0.72%
Capitalized Repair & Maintenance	0.34%
Electronics / Medical	0.34%
Aerospace	0.21%
Average for all industry	0.72%

The export and import amounts cited in this study were based on data published by KITA in 2008, while the production amount and the numbers of companies and employees were based on statistical research outcomes for the mining and manufacturing industries conducted by NSO in 2006 [3, 4].

NSO classifies the manufacturing business with D codes, while KITA classifies the industries with HSK codes. The industries considered for this analysis are shown in Tables 2 and 3. The industries were divided into three groups with  $\angle$  representing the equipment and materials sub-industry, and  $\nabla$  and  $\circledast$  representing the manufacturing industries falling under major infrastructure industries and the manufacturing industries not falling under major infrastructure industries, respectively.

Table 2. Industrial Classification of NSO data

Item	Code	Industry
∠	D29291	Welding equipment manufacturing business
	D32	Electric components, video, audio and telecom equipment manufacturing business
▽	D34	Automobile and trailer manufacturing business
	D351	Ship- and boat-building business
⊗	D30	Computer and office equipment manufacturing business
	D31	Other electronic machinery and electronic conversion device manufacturing business
	D33	Medical, precision, optical instruments, and timepiece manufacturing business
	D352	Railway equipment manufacturing business
	D353	Aircraft, spacecraft and components manufacturing business

Table 3. HSK classification used in Export/Import statistics

Classification	HSK Code	Items
∠	HSK 3810	Pickling preparations for metal surfaces, fluxes for soldering, brazing
	HSK 8311	Wire, rods, tubes, plates, electrodes, similar products, of base metal or of metal carbides, wire, ribs, of agglomerated base metal powder, used for metal spraying
	HSK 8515	Electric (electrically heated gas), laser, other light, photon beam, ultrasonic, electron beam, magnetic pulse, plasma arc soldering, brazing, welding machines and apparatus, irrespective of cutting capability, electric machines and apparatus for hot spraying of metals, cermets
▽	HSK 85	Electro-mechanical apparatus and components thereof
	HSK 87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof.
	HSK 89	Ships and floating structures
⊗	HSK 86	Railway or tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings
	HSK 88	Aircraft, spacecraft, and parts thereof
	HSK 90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus;

According to the NSO data, the welding materials industry of the welding equipment and materials industry was excluded from the statistical analysis as it belongs to D28999 (other assembled metal products manufacturing business) and D24399 (All other unclassified chemical products manufacturing business), but includes a large number of other industries.

### 3. Results and statistical analysis

#### 3.1. Total production amount

In 2006, the Korean welding industry's total product amount stood at USD 2.77 billion and the trends for the past three years are shown in Fig. 1. The annual average for the past five years of the total production amount of the welding industry was about 12.7%, which represents sharp growth, attributable to the boom in the engineering industry during the 2002-2006 periods.

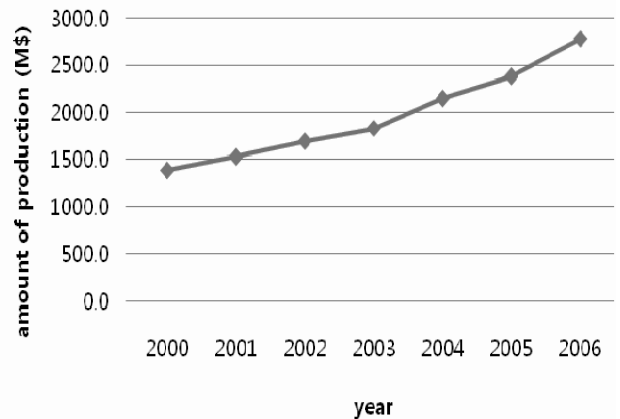


Fig. 1. Total production amount of the welding industry

Fig. 2 shows the total amount divided into the welding equipment and materials sub-industry and the welding engineering sub-industry. The former classified electric components, video, audio, and telecom equipment, automobile and trailer manufacturing business, and ship- and boat-building business, which are D32, D34, and D351, respectively, as major industries, presenting the electronics, automobile, and shipbuilding industries and other manufacturing industries. The welding equipment and materials industry accounts for 11% of the entire size of the welding industry, which combines the major industries and other manufacturing industries, and has an average growth ratio of 15.3%, representing a sharper rise than the welding engineering sub-industry whose average growth rate stood at 12.5%.

Fig. 3 presents a comparison of the production amounts of the three industries classified as major industries. The welding production amount in the shipbuilding industry accounts for 57% of that in the overall major industries. This is because Korea's shipbuilding industry is the world's largest, the production amount itself being quite large, and also because welding occupies a high portion of the shipbuilding industry.

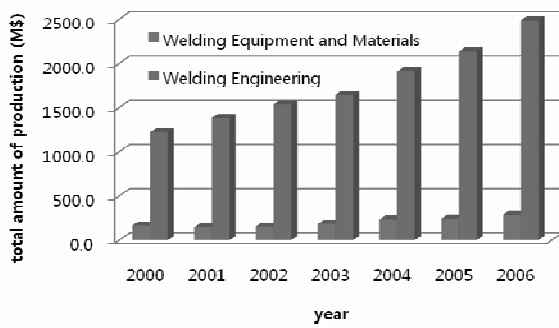


Fig. 2. Production amount by industrial classification

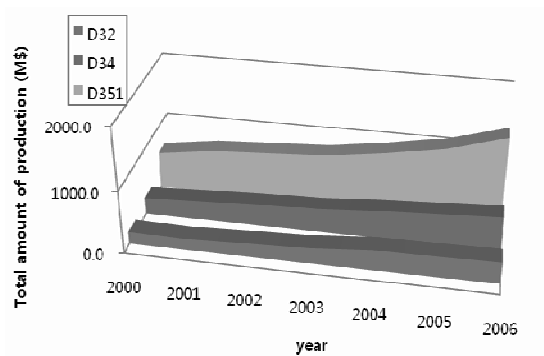


Fig. 3. Welding production amount amongst major industries

### 3.2. Export/Import amount

The export/import amount in the periods within 2004-2008 is as shown in Fig. 4. While the export amount was double the import amount in 2004, the export amount was confirmed to be 3.5 times the import amount in 2008. The export amount of the welding industries grew dramatically at an annual average of 21% during those five years.

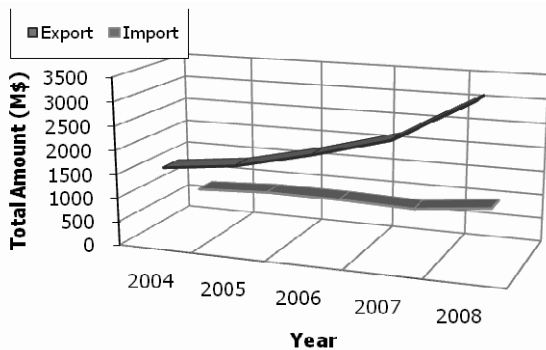


Fig. 4. Export/import amount of the welding industry

As shown in Fig. 5, in 2008, export amount is six times larger than import in the welding engineering industry and its portion is on the rise as well.

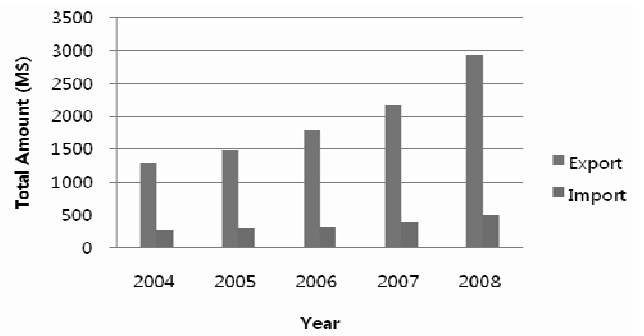


Fig. 5. Export/import amount of the welding engineering industry

Fig. 6 represents the export/import status of the welding equipment and materials industry. As shown in this figure, exports have been on a steady rise in recent years in the welding equipment and materials industry, whereas imports have been on the decline, representing an ease in the imbalance in trade accounts.

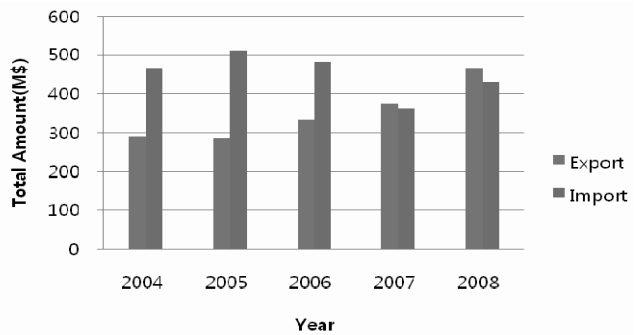


Fig. 6. Export/import amount of the welding equipment and material industry

Fig. 7 and Fig. 8 show the status of export and import of welding materials and equipment. The deficit in the trade balance in the welding materials industry had been steadily shifting toward a surplus, and the welding equipment industry in particular saw its imports reach the highest level in 2005. Imports fell gradually thereafter, striking a balance in trade accounts of the welding equipment and materials industry in 2008. This is believed to be attributable to vigorous export activities in the relevant business sectors despite the costly segment in the domestic equipment and materials market, formed by high-end welding equipment imported from advanced countries.

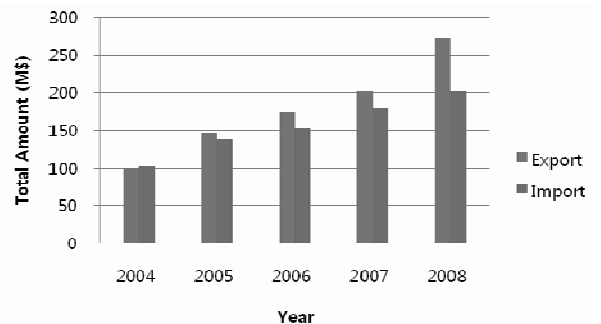


Fig. 7. Export/import amounts of the welding materials industry

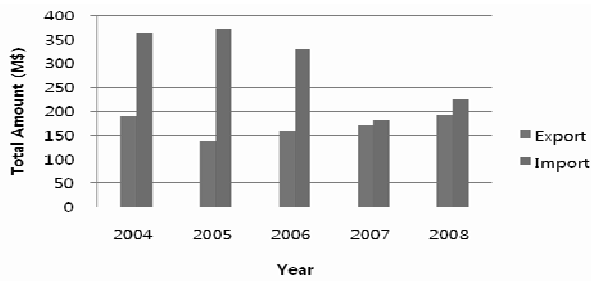


Fig. 8. Export/import amounts of the welding equipment industry

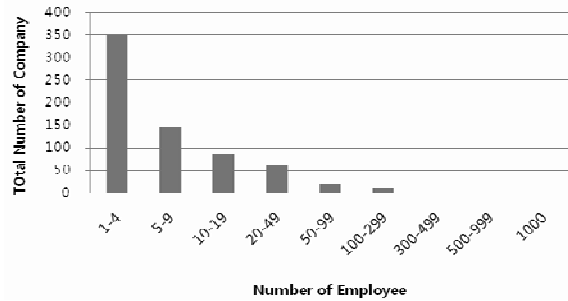


Fig. 9. Number of businesses by size

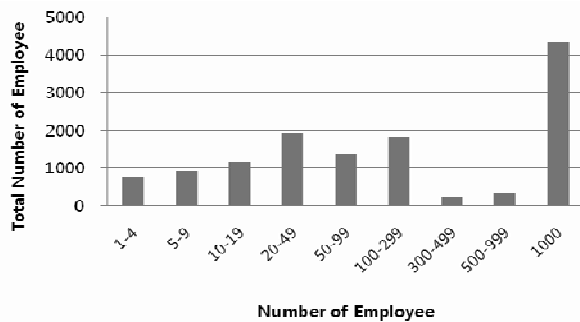


Fig. 10. Number of employees by business size

### 3.3. Numbers of business and employees

As of 2006, the numbers of welding-related companies and employees stood at 679 and 12,890, respectively. Fig. 9 and Fig. 10 represent the number of businesses and their employees based on the company size determined by the number of employees. 85.6% of the businesses are small-sized, with less than 20 employees. Meanwhile, 33.5% of the employees are hired by large businesses (with over 1,000 employees), indicating that large businesses play a major role in creating jobs in the welding-related industries.

## 4. Conclusions

The study investigated the status of the domestic welding industry by using the portion of the welding-related expenditure in the demand industries investigated by the American Welding

Society based on statistical study results of the mining and manufacturing industries in 2006 and export and import data of 2007.

Due to the nature of the welding industry, the welding-related portion in the engineering industry showed much higher figures - about 9 times higher in production amount and over 5 times in export amount - than the welding equipment and materials industry. In addition, the total production of the welding industry, determined through such a method, amounted to 3.9 trillion won, indicating that the welding industry holds a very important place in the entire domestic industries.

Also can be drawn from this study is that the sales and trade surplus of the welding industry is on a sharp annual rise. The welding equipment and materials industry underpins the welding engineering industry, which has shown an upward trend in exports of late, but still pales beside the engineering industry in terms of its scale.

As for demand and supply of human resources, large businesses employing more than 1,000 people, which take up 0.11% of the entire number of welding-related businesses, are found to employ 33.5% of the entire number of people engaged in the welding-related industries, indicating that the industry is highly dependent on large businesses in terms of production. However, small companies employing less than 10 people take up 76% of the number of welding-related businesses in Korea, suggesting that they have great importance in the welding sector as well.

According to the derived statistical data, welding-related production amount and export/import amounts were much higher in the major industries such as shipbuilding, automobile, and electronic device industries. This suggests that the production and export amounts of the domestic major industries take up higher portions than other industries, and that welding accounts for a considerable part in major infrastructure industries.

The following recommendations can be made based on this statistical analysis:

- Balanced development of the welding equipment and materials industry, which is smaller in scale than the engineering industry but, nevertheless, underpins the latter
- Continued growth of major infrastructure industries
- Policy-driven support system extended to small- and mid-sized businesses, which take up most of the welding industry
- Focused support provided to areas with high concentration of welding-related businesses.

## References

- [1] <http://web.istans.or.kr> (in Korean).
- [2] American Welding Society, Welding-Related Expenditures, Investments, and Productivity Measurement in U.S. Manufacturing, Construction, and Mining Industries, AWS, 2002.
- [3] <http://www.nso.go.kr> (in Korean).
- [4] <http://stat.kita.net> (in Korean).