The Effect of Product Classifications on the Formulation of Export Unit Value Indices: A Comparison of Export Unit Value Indices based on SITC and HS

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A Comparison of Export Unit Value Indices based on SITC and HS

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Abstract

With the globalization of economic activity, the relative weight of foreign trade in national economic activities has increased, and the question of how to measure trends in the value and quantity of international trade has become an important issue for policy-makers and economists. This paper compares the chain-linked indices formulated by Masato Kuroko, based on HS this fiscal year for individual industry categories and countries with chain-linked indices based on SITC-R1 codes, in order to study how changes in the quality composition of the same products, which cannot be considered using unit value indices based on SITC-R1 codes, can be considered using unit value indices based on the more detailed HS product classifications.

JEL classification: C43, F15

Keywords: Export value indices, Export unit value indices, SITC Code, HS Code, Quality change adjustment

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Introduction

With the globalization of economic activity, the relative weight of foreign trade in national economic activities has increased, and the question of how to measure trends in the value and quantity of international trade has become an important issue for policy-makers and economists. In relation to this issue, the United Nations Statistics Division has formulated manuals which provide standards for measurement, and has also published a number of surveys and research reports.(Note 1)

Using international trade statistics formulated by the UN, the trade index project of the Institute of Developing Economies organizes trade flows by individual product classifications and products in addition to total value, and formulates indices for price and quantity by product classification and product. In this type of procedure, it is necessary at the initial stage to achieve consistency between the country codes and product codes used in the trade statistics of different countries, in order to enable comparison of trade data (value and quantity) over a time series. Next, unit value indices and quantity indices are formulated by product classification and product using the values and quantities for the individual product codes which have been rendered consistent.

The characteristics and problems of the trade price indices formulated by the IDE's trade index project have already been studied.(Note 2) This paper will compare unit price indices formulated using different product classification levels, and will consider problems related to product homogeneity and the treatment of changes in quality.

1. Unit Price Indices and Price Indices as Trade Price Indices

The price data employed in the formulation of trade price indices can be divided into unit values and survey prices. According to UN surveys, with the exception of a small number of countries, trade price indices are formulated using unit values as trade prices. The main countries which use survey prices rather than unit values are Australia, Singapore, Germany, Sweden, the UK (for industrial products), and the US.(Note 3)

In Japan, the Ministry of Finance formulates trade price indices using unit values, and the Bank of Japan publishes import and export price indices based on survey prices. Because the methods of surveying prices and of calculating the indices differ, trends in both totals and individual classifications do not necessarily match in these two sets of trade price indices.

When trade price indices are formulated based on survey prices, representative products are specified and a price survey is conducted, with quality held constant and only changes in prices being focused on. By contrast, the average price for each product (value÷quantity) in customs statistics is used in the formulation of trade price indices based on unit values, and changes in price and changes in quality are therefore both reflected in the price indices. Because of this, if there is a simultaneous increase in prices and a change or increase in quality, price indices based on unit values will overestimate the price increase by the amount of the increase in quality.

Clearly, to formulate price indices which reflect the true trends of trade prices, it would be most desirable to calculate the indices on the basis of survey prices, for which homogeneous quality has been maintained. However, the majority of countries actually formulate indices based on unit values. The main reason for this is the fact that it is difficult to conduct price surveys for a large number of products. Considering Japanese indices for base year 2000, we find that the unit values of approximately 2,100 products were focused on to formulate export price indices based on customs statistics, but only approximately 200 products were surveyed in the formulation of export price indices by the Bank of Japan.(Note 4)

There is therefore a limit to the usefulness of trade indices based on survey prices as tools for understanding trends in import and export prices at detailed classification levels, making it necessary to formulate indices based on customs unit values.

2. Problems of Unit Value Indices and Approaches to Their Resolution

When employing customs trade statistics, if there are no gaps in the statistics, quantity data can be used together with value data for each classified product. With respect to value, Japanese statistics are denominated in yen, while UN trade statistics are all expressed in US dollars, making international comparison possible. The units of quantity employed are either kilograms or number; the same units are employed for specific products by the vast majority of reporting countries. In some cases, countries have employed kilograms up to a specific point in time, and have then made the transition to number. In some cases also, quantity data is lacking for some countries.

Unit value indices for a classification j are calculated as follows when value (Vit) and quantity (qit) are available for each product (i) classified in classification j:

$$UVIj=\Sigma wji*(pit/pi0)$$

Here, UVIj is the unit value index for classification j, wji is the weighting of product i, pit is the value of product i for year t, and pi0 is the value of product i for base year 0.

The problematic issue in the formulation of unit value indices is whether quality is homogeneous for product i. When product i is a product group for which quality differs in detailed classifications, changes in the unit values of product i reflect, in addition to changes in the unit values of detailed classifications of the products, changes in the composition of the products within detailed classifications encompassed by product i, i.e. changes in quality. This issue can be discussed as follows, using an example drawn from a UN report (Table 1). Here, q is quantity, p is unit value, and V is value.

Table 1 Hypothetical example: Value and quantity by size of refrigerators

	Small			Medium			Large			Total		
	q	p	V	q	p	V	q	p	V	q	p	V
Base year (0)	5	1	5	3	2	6	2	3	6	10	1.7	17
Comparison year (t)	2	2	4	3	4	12	5	6	30	10	4.6	46

Source: United Nations (1981), p.15

In terms of changes in unit value by refrigerator, what this shows is that for all sizes p(t)/p(0)=2 and there is a 100% increase, but the unit value as totaled from the separate sizes is 4.6/2.71, or a 171% increase. The unit value calculated for the total is 36% higher than the original unit value. This is because the relative weight of high-cost products in the total export value of refrigerators has increased.

One method of preventing this overestimation or underestimation of unit value indices is to employ the most detailed possible trade product classifications. Considered in terms of the example above, this would involve breaking the classification of refrigerators down into more detailed classifications by size.

3. Characteristics of the IDE UN COMTRADE-based Indices

The IDE's trade index project uses trade statistics based on SITC and HS drawn from the UN COMTRADE database as basic data for the formulation of trade price indices. However, as Table 3 shows, the SITC has been revised three times since 1960, and the edition in use therefore differs depending on the period under consideration. The HS has also been revised twice since 1988.

When using trade data organized by product as long-term time series data, it is therefore necessary to achieve consistency between the different classification systems for the same products. In the UN COMTRADE data, the product classifications for different revisions have been standardized by conversion, making it possible to use continuous time series data from 1960 onwards irrespective of whether Rev. 1, 2 or 3 is employed.

In the following discussion, IDE export unit value indices are SITC-R1 indices for all periods and indices linking different classification standards from SITC-R2 to HS-2002, as formulated by Masato Kuroko using COMTRADE data. These unit value indices cover 21 industry categories.(Note 5)

As for the product numbers for each classification standard, the approximately 1,300 products for SITC-R1 increases to approximately 1,800 for R2 and approximately 3,000 for R3, and the greater detail of classifications sees the number increase to approximately 5,000 for HS. Because of this, comparison of series based on SITC-R1 and series based on HS can be considered to enable clarification of the effect of changes in the composition of detailed level products which make up the same category of products on changes in unit values. To take an example of one same category of products, it is possible to analyze the effect of changes in the composition of passenger vehicle classified by displacement on changes in the average unit values of passenger vehicles.

The indices formulated by Masato Kuroko for use in comparisons are therefore chain-linked indices which are able to reflect time series changes in trade structure. The merit of chain-linked indices is that the weighting is not fixed in the base year or the comparison year, enabling changes in the export structure from the base year onwards to be reflected.

When chain-linked indices are formulated, weighted average indices are not calculated for the base year. Instead, aggregate average indices are calculated for each year (with the base year as 100) by 1) computing annual changes in the unit value for each item with the previous year as 100, 2) aggregating them using the weights of previous year , and 3) multiplying these year-to-year change indices to compute the time series of aggregate unite indices with base year as 100.

4. Formulation of Export Unit Value Indices by HS Classification

This section will discuss changes in classification standards, products numbers, and coverage in the formulation of indices for unit value indices based on SITC and HS formulated for the US, Europe, and major Asia-Pacific countries including Japan.

4.1 Changes in Classification Standards in International Trade Statistics used in the Formulation of Indices

The SITC, a classification system developed by the UN in 1950 for use in the formulation of trade statistics, has undergone four revisions since its original publication, with Rev. 1 in 1962 and Rev. 4 in 2007. The HS, originally developed by the Customs Cooperation Council (now the World Customs Organization) in 1988, has undergone two revisions, in 1996 and 2002. The IDE uses the SITC revisions for periods in which the HS cannot be used, and uses HS series in place of the SITC for periods for which it can be used. In this way, by using the most detailed classification standard possible for product classifications, we are able to adjust the overestimation or underestimation of export unit value indices when comparing them with export price indices.

Looking at the Table 4 on comparison of the classification standard by country, we find that HS can be used from 2000 onwards for all 26 countries for which indices are formulated, but from 1990, this figure is for only 13 countries, including Japan and Germany, countries which record high export values. However, SITC-R3 series can be employed for some 3,000 products for the US and nine European countries. From 1980-1989, SITC-R2 series are used for 22 countries.

It may therefore be considered most appropriate when comparing SITC-R1 and HS series to limit the period for comparison to the period from 1995 onwards. This point should be borne in mind in the following discussion, in which the period from 1980 onwards is divided into the 1980s and the period following the 1980s.

Table 2　Availability of SITC and HS by country

Area	Country	SITC			HS			Export values (year 2000, million of US dollar)
		Rev.1	Rev.2	Rev.3	1988	1996	2002	
1	JPN	62～76	77～88		89～96	97～02	03～05	479,249
2	USA	62～78	89～89	90～91	92～96	97～02	03～06	782,000
2	CAN	62～78	79～88	89	90～96	97～02	03～05	276,635
3	AUT	62～78	79～88	89～94	95～96	97～02	03～06	64,155
3	BEL	62～78	79～88	89～95	96	97～02	03～06	187,838
3	DEU	62～78	79～88		89～96	97～02	03～05	550,120
3	DNK	62～76	77～88	89	90～98	97～02	03～06	50,380
3	ESP	62～78	79～88	89	90～96	97～02	03～05	113,325
3	FIN	62～76	77～88		89～96	97～02	03～06	45,473
3	FRA	62～78	79～88	89～94	95～96	97～02	03～05	300,024
3	IRL	62～76	77～88	89～92	93～96	97～02	03～06	77,081
3	ITA	62～77	79～88	89～94	95～96	97～02	03～05	239,886
3	NLD	62～78	79～88	89～92	93～96	97～02	03～05	213,382
3	NOR	62～76	77～88	89～93	94～96	97～02	03～06	60,058
3	PRT	62～79	80～88		89～96	97～02	03～05	23,234
3	SWE	62～76	79～88	89～92	93～96	97～02	03～05	87,724
3	GBR	62～78	79～88	89～93	94～96	97～02	03～05	281,564
5	CHN		84～92		93～96	97～02	03～05	249,203
5	HKG	62～78	79～92	93	94～96	97～02	03～05	201,860
5	IDN	62～79	80～89		90～96	97～05		65,604
5	KOR	62～76	79～88		89～96	97～02	03～06	172,268
5	MYS	62～78	79～88	89	90～97	98～02	03～05	98,229
5	PHL	62～77	78～91	92～96	97～00	01～05	03～05	39,783
5	SGP	62～79	80～89		90～97	98～02	03～05	137,804
5	THA	62～76	77～89		90～99	00～02	03～05	68,962
4	AUS	62～79	79～88		89～96	97～02	03～05	63,870

Note: Area 1=Japan, 2=north America, 3=Europe,　4=Australia, 5=east Asia
"Country" indicates ISO 3digit alphabetical country code. (Note 6)

4.2 Comparison of Export Product Organized by Category: Japan and the US

The product numbers in separate categories used in the formulation of Kuroko's indices for the US and Japan were organized for separate product classification standards. As a result, when product numbers are compared for SITC and HS in **Table 3**, the HS-2002/SITC-Rev.1 ratios are 4.6 for Japan and 6.0 for the US in all categories. For Japan, the multiplication factor of the product numbers was higher than the average value in six categories: Textiles (TX), apparel (AP), rubber and

Table 3　Product numbers in separate categories : Japan vs US

a. Japan's exports

Product categories	Product numbers					Ratio
	SITC		HS			HS2002/
	R1	R2	1988	1996	2002	SITC-R1
Agricultural products	46	54	133	113	119	2.6
Mine products	24	34	70	69	70	2.9
Foodstaffs	81	110	235	290	299	3.7
Textiles	90	128	500	518	532	5.9
Apparel	24	69	221	212	216	9.0
Leather products	21	21	74	76	85	4.0
Lumber and wood products	21	25	71	75	86	4.1
Paper and pulp	39	48	139	135	139	3.6
Rubber and plastics	13	18	65	69	85	6.5
Chemical products	189	253	811	840	849	4.5
Petrochemical products	15	18	26	30	23	1.5
Ceramics	51	53	137	137	133	2.6
Iron and steel	56	65	187	164	205	3.7
Non-ferrous products	41	47	118	125	147	3.6
Metal Products	61	64	250	262	220	3.6
Machinery	63	150	492	489	505	8.0
Electrical equipment and machinery	25	63	258	296	281	11.2
Transport equipment	27	34	109	116	112	4.1
Precision instruments	29	28	144	149	154	5.3
Miscellaneous manufactured products	45	47	166	134	131	2.9
Total	961	1329	4206	4299	4391	4.6

b. US exports

Product categories	product numbers						Ratio
	SITC			HS			HS2002/
	R1	R2	R3	1988	1996	2002	SITC-R1
Agricultural products	73	76	148	298	261	266	3.6
Mine products	35	34	46	110	112	110	3.1
Foodstaffs	103	101	247	403	448	453	4.4
Textiles	65	60	187	523	541	564	8.7
Apparel	17	56	67	244	244	245	14.4
Leather products	14	16	23	60	77	90	6.4
Lumber and wood products	11	4	29	62	69	73	6.6
Paper and pulp	26	49	77	138	147	149	5.7
Rubber and plastics	10	9	27	53	60	74	7.4
Chemical products	142	185	362	757	837	851	6.0
Petrochemical products	14	18	25	39	39	34	2.4
Ceramics	30	24	90	89	103	99	3.3
Iron and steel	41	31	153	193	171	211	5.1
Non-ferrous products	46	44	68	127	127	148	3.2
Metal Products	24	25	46	166	203	158	6.6
Machinery	27	73	260	388	403	416	15.4
Electrical equipment and machinery	13	29	100	172	238	219	16.8
Transport equipment	19	28	46	72	101	102	5.4
Precision instruments	12	27	36	69	73	72	6.0
Miscellaneous manufactured products	15	35	14	69	60	56	3.7
Total	737	924	2051	4032	4314	4390	6.0

plastics (RB), and the three machinery-related categories machinery (MC), electrical equipment and machinery (EM) and precision instruments (PI). The total was eight for the US, adding leather products (LT) and lumber and wood products (WD) in addition to the three categories already listed for Japan in the light industry category, and substituting metal products (MT) for the PI listed for Japan in the heavy industry category.

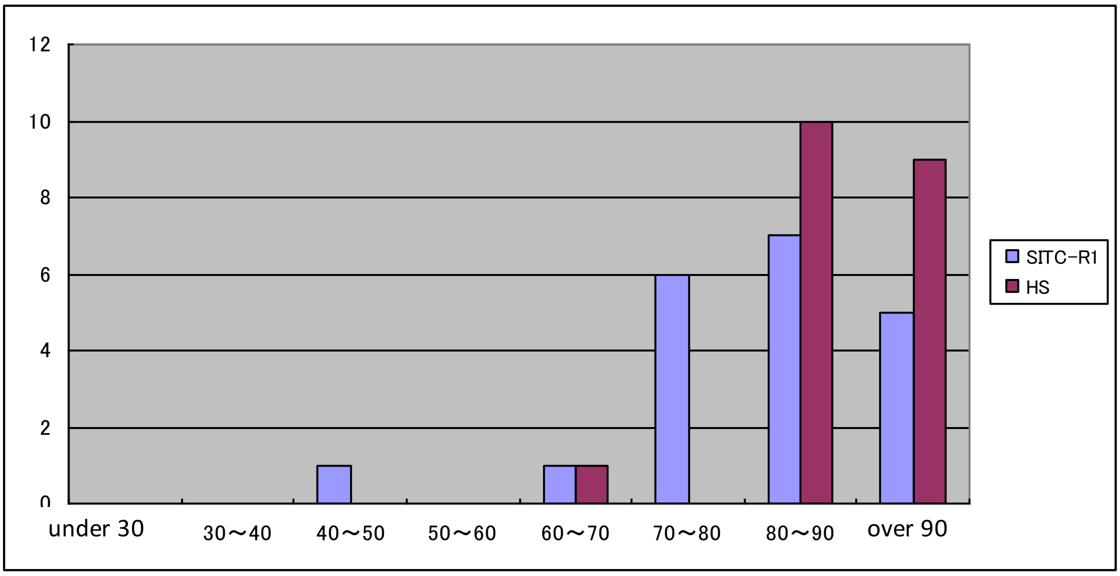
4.3 Coverage of Products by Category (Export Value-based): Japan and The US

As indicated above, the formulation of indices by category based on the HS offers the advantage of significantly increasing the number of products employed. At the same time, it is also important that the coverage rate for the numbers and values of the increased number of products is high for all categories. Here, it is necessary to determine the coverage of both SITC-R1 and HS for the US and Japan.

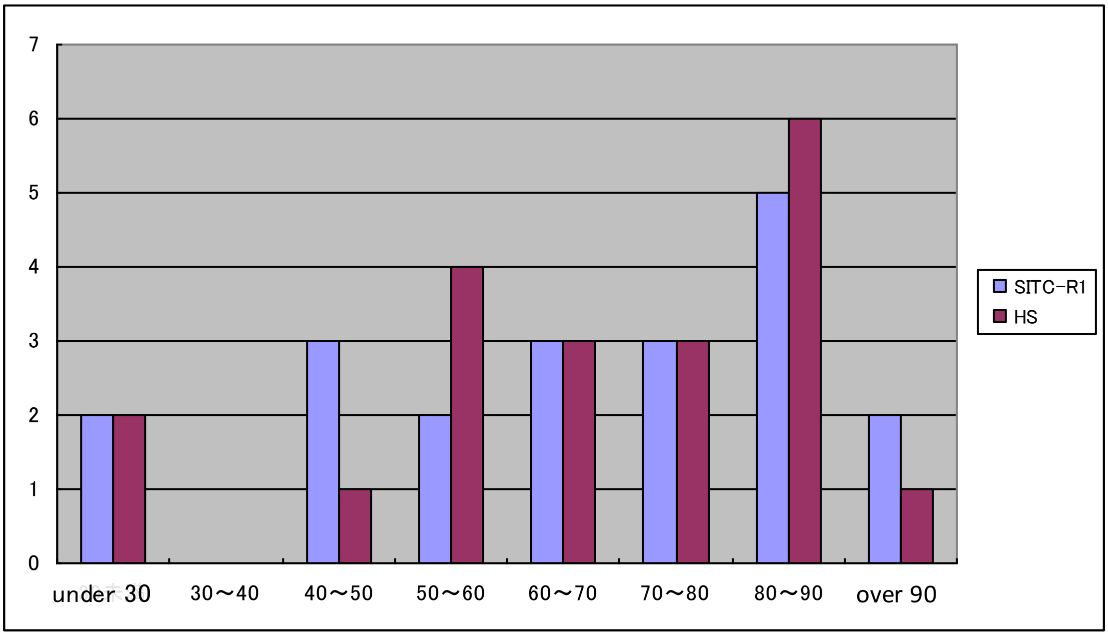
A comparison of the distribution of average values by coverage class for Japan and the US for the period 1980-2005(6) is shown in figures 1. For Japan, except for a coverage of 60% for one category, the coverage for the HS series for the remaining 19 categories is 80% or higher. These figures are considerably higher than the figures for SITC-R1. In the case of the US, by contrast, for SITC there are seven categories for which the coverage is 80% or more, but for HS, there are only eight. For both HS and SITC-R1, there are seven categories for which coverage is less than 60%. While the US has two less categories for which coverage is between 40-50% and two more categories for which coverage is between 50-60%, it is clear that the coverage for the US is low in comparison to Japan.

Figure 1 Distribution of sectoral average coverage of export values

(1) Japan



(2) USA



5. Comparison of SITC-R1 Indices and HS Indices

The Kuroko indices have been formulated for 1962 to 2005(6); however, the comparison in this paper is limited to 1980 onwards. One reason for this is that SITC-R1 is the classification from 1962 to 1977-1978, and this makes it impossible to measure the effect of increasing the detail of classifications. Another reason is the fact that in the long-term time series from 1962 onwards, indices for some countries are discontinuous, making comparison difficult. From the 1980s, chain-linked indices for 20 industry categories can be used for almost all countries, making it possible to conduct comparisons.

However, indices based on HS can only be formulated for early-adopting countries from 1989, and for all remaining countries from 1995 onwards, and HS indices from 1980 onwards therefore contain series based on SITC-R2 and SITC-R3. Because of this, comparisons between countries have been divided into three time periods – 1980-1990, 1990-2000, and 2000-2005(6) – in order to study the effect of increasing the detail of product classifications.

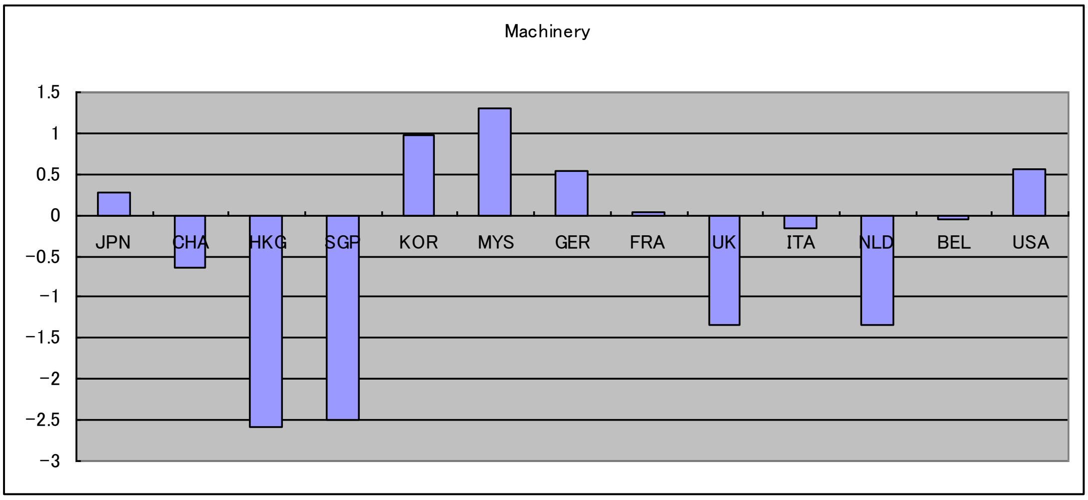
In comparing two indices, the quality index has been defined using the following formula, and the annual average rate of change of this index has been employed.

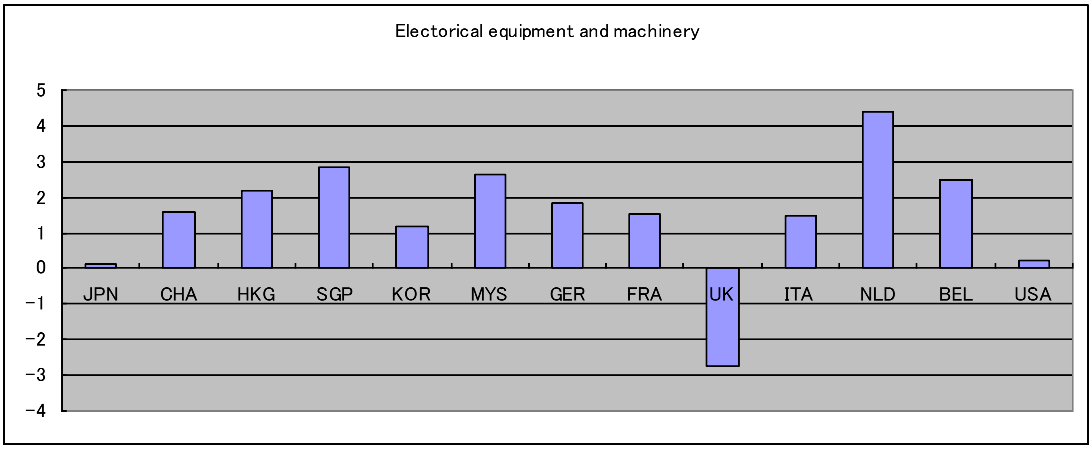
Quality index = SITC-R1 indices / HS indices

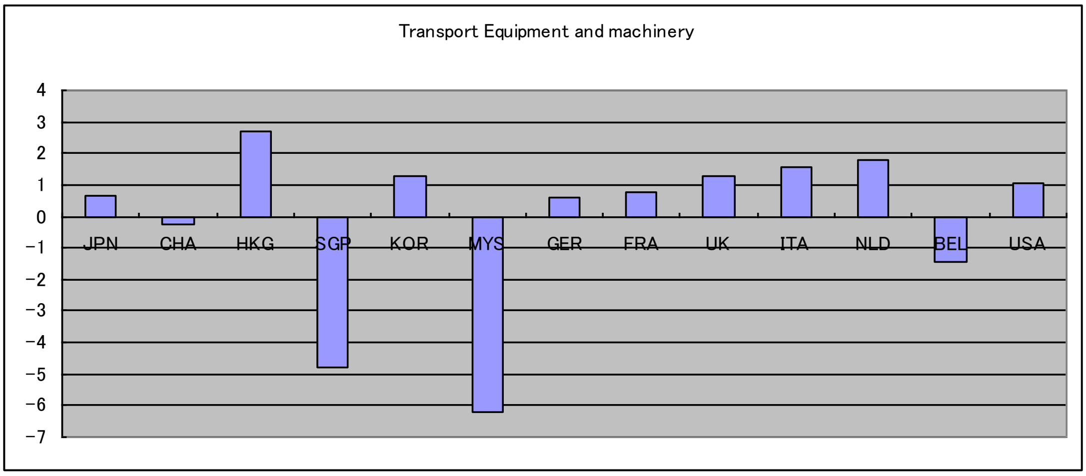
5.1 Comparison by Industrial Category and Country: 1990 Onwards

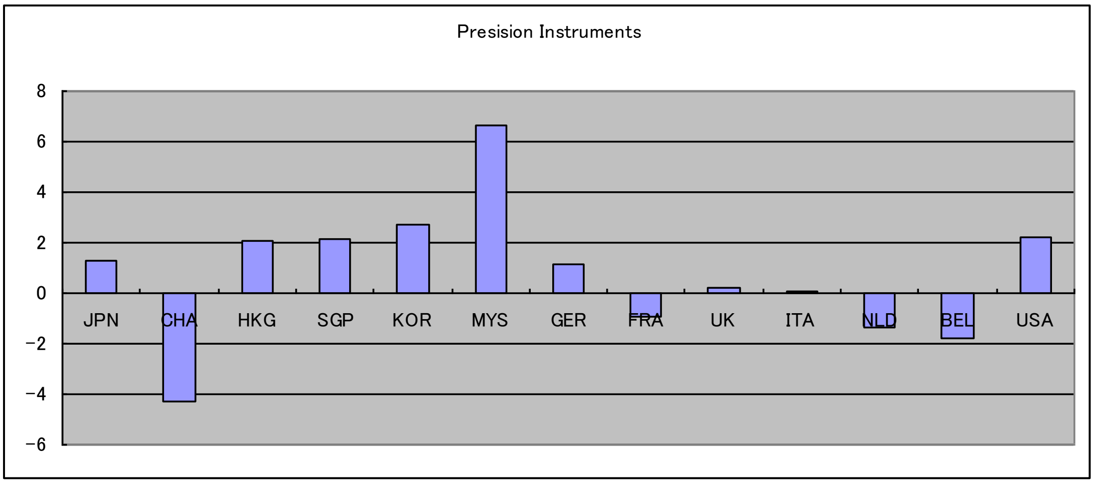
Here, the rate of change of quality indices based on SITC-R1 will be compared by industry category from 1990 onwards, a period in which the number of products by industry category increased 3-5-fold. 13 countries are compared, representing six Asian countries, the US, and six European countries. First, the four machinery-related categories will be compared, as shown in **Figure** 2.

Figure 2 Quality changes of machinery-related sectors 1990-2005(2006)









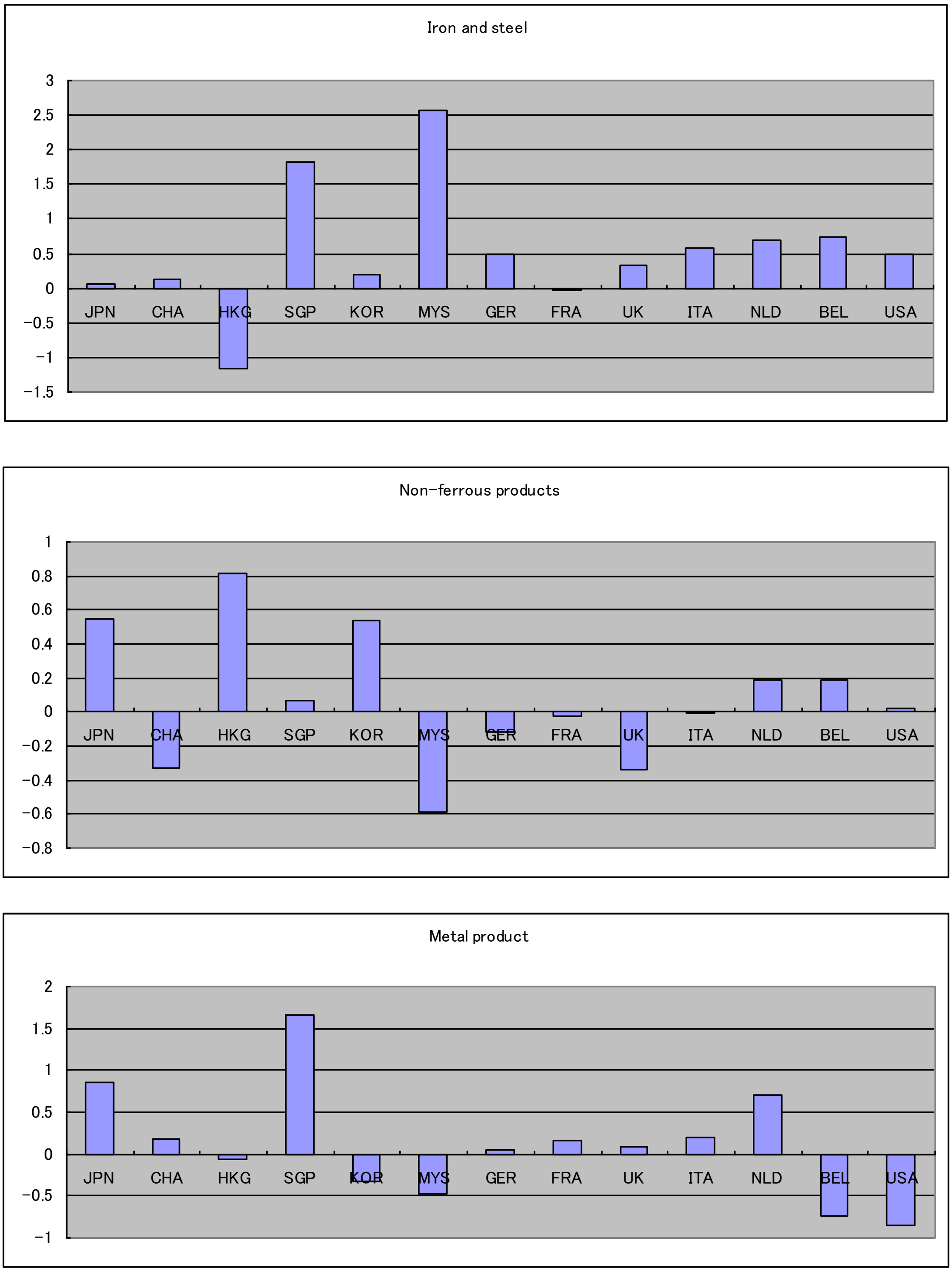
There were two countries for which 1% or more positive change occurred in the machinery category, 10 in the electrical equipment and machinery category, six in the transport equipment category, and seven in the precision instruments category. Negative change of 1% or more was measured for four countries in the machinery category, one country in the electrical equipment and machinery category, three countries in the transport equipment category, and four countries in the precision instruments category. In the machinery category, the increase in value due to the increase in quality in the electrical equipment and machinery category was greatest.

Comparing the metal-related categories next, we find in **Figure 3** two countries with positive quality changes of 1% or more in the iron and steel category, no countries in the non-ferrous metals category, and one country in the metal products category. One country recorded negative change of 1% or more in the iron and steel category, and no countries recorded negative change of 1% or more in the non-ferrous metals or metal products categories. The change in quality in this these categories was extremely low in comparison to the machinery categories.

The results of remaining categories were summarized as follows:

Agricultural, forestry and fisheries products: 10 countries were measured as displaying positive change, but change was of 1% or higher in only two of these. Two countries were measured as

Figure 3 Quality changes of metal-related sectors: 1990-2005(2006)



displaying negative change of 1% or higher.

Mining: 10 countries were measured as displaying positive change of 1% or higher, of which six countries displayed positive change of 2% or higher.

Foodstuffs: 8 countries displayed positive change, but only 1 displayed change of 1% or more. Four countries displayed negative change, of which 2 displayed change of 1% or higher.

Textiles: Seven countries displayed positive quality change, of which two displayed change exceeding 1%.

Apparel: Four countries displayed positive change, of which one country displayed change of 1% or higher.

Leather products: Eight countries displayed positive change, of which four displayed change of 1% or higher.

Lumber and wood products: 11 countries displayed positive quality change, of which four displayed change of 1% or higher.

Paper and pulp: 10 countries displayed positive quality changes; three Asian countries displayed positive quality changes of 1% or higher.

Rubber and plastics: Eight countries displayed positive quality changes, with three countries displaying quality changes of 1% or higher.

Chemical products: Five countries displayed positive quality changes, and eight countries displayed negative quality changes. Two countries displayed a rate of change of 0.5% or higher including positive and negative change.

Petroleum and coal products: Three countries displayed positive quality change, with one country displaying positive change of 1% or higher. Of 10 countries displaying negative quality change, seven displayed change of 1% or higher.

Ceramics: Nine countries displayed positive quality change, of which five displayed positive change of 1% or higher. Negative quality change was 1% or less.

5.2 Comparison by Country and Industry Category (1): Japan and the US

This section will discuss the quality changes for Japan and the US when quality changes are measured for separate periods for whole world and for important regions.

First, we will discuss the results of Japanese exports to the whole world.

As shown in **Table 4**, eight categories of a total of 19 displayed positive quality change for the 1980s; from 1990 onwards, this figure increased to 17. In addition, if the period from 1990 onwards is divided into the 1990s and the 2000s, 13 categories display positive quality change for each period. Of these, four categories, mining, foodstuffs, leather products, and metal products, display a quality increase of 1% or higher for the 1990s, while eight categories, agricultural, forestry and fisheries products, mining, apparel, leather products, paper and pulp, ceramics, transport equipment, and precision instruments, display a quality increase of 1% or higher for the 2000s.

Table 4 Japan's quality changes in exports by sector; Exports to the world

Product categories	T(80-90)	T(90-00)	T(00-05)	T(90-05)
Agricultural products	-0.31	-0.28	3.62	1.00
Mine products	-2.01	1.96	7.47	3.77
Foodstaffs	-0.36	1.69	-1.79	0.52
Textiles	0.37	0.74	0.74	0.74
Apparel	-0.27	-0.79	3.15	0.51
Leather products	1.00	6.96	3.07	5.65
Lumber and wood products	-0.86	0.32	-0.25	0.13
Paper and pulp	2.05	-0.65	2.92	0.52
Rubber and plastics	-0.61	0.75	-0.99	0.17
Chemical products	0.36	-0.60	0.51	-0.23
Petrochemical products	1.40	0.19	-4.20	-1.29
Ceramics	0.18	0.86	2.22	1.31
Iron and steel	-0.44	-0.05	0.27	0.05
Non-ferrous products	-0.17	0.76	0.14	0.55
Metal Products	-0.16	1.46	-0.35	0.85
Machinery	-1.04	0.14	0.56	0.28
Electrical equipment and machinery	1.24	0.52	-0.61	0.14
Transport equipment	0.70	0.44	1.11	0.66
Precision instruments	-3.50	0.55	2.87	1.32
Number of positive sector	8	13	13	17
Max	2.05	6.96	7.47	5.65
Min	-3.50	-0.79	-4.20	-1.29

Table 5 shows quality changes measured by the unit value of exports to the entire world for the four machinery-related categories divided by export market (North America, the EU, and Asia).

Table 5 Rate of Quality Change for Japan by Export Market: 4 Machinery Categories

Product categories	1990-2000				2000-2005			
	North America	EU	East Asia	World	North America	EU	East Asia	World
Machinery	0.72	-0.01	0.33	0.14	1.55	0.59	1.25	0.56
Electrical equipment and machinery	0.42	1.26	0.79	0.52	-2.67	1.71	-0.63	-0.61
Transport equipment	1.63	-0.03	-3.66	0.44	1.18	2.28	0.89	1.11
Precision instruments	0.79	1.88	-1.93	0.55	5.01	1.25	4.86	2.87

Source: Calculated from indices formulated by Kuroko.

Looking at the 1990s, the greatest rate of increase in quality in the machinery category occurred in the North America, in the electrical equipment and machinery category in the EU, in the transport equipment category for North America, and in the precision instruments category in the EU. For the 2000s, the greatest rate of quality increase occurred in the machinery and the precision instruments categories for North America, and in the electrical machinery and transport machinery categories for the EU. Asia recorded the second highest rate of increase in quality after North America in the machinery and precision instruments categories. Looking at the whole world, excepting electrical equipment and machinery, the rate of quality increase was higher for the 2000s than for the 1990s.

We will now look at **Table 6** showing the detailed results for North American exports to the whole world.

For the 1980s, 10 industry categories out of 19 recorded positive quality changes for exports; this figure increased to 14 from 1990 onwards. From 1990 onwards five industry categories recorded positive quality increases of 1% or higher, as follows: mining, leather products, petroleum and coal products, transport equipment, and precision instruments. If the period from 1990 onwards is divided into the 1990s and the 2000s, 10 categories and 8 categories record positive change, respectively.

Table 6 US quality changes in exports by sector; Exports to the world

Product categories	T(80-90)	T(90-00)	T(00-06)	T(90-06)
Agricultural products	0.47	0.63	-0.13	0.35
Mine products	0.13	-1.00	10.13	3.04
Foodstaffs	0.08	-0.09	-0.69	-0.31
Textiles	0.36	-0.30	-0.27	-0.29
Apparel	-0.49	0.57	-4.97	-1.54
Leather products	1.39	-3.17	10.43	1.72
Lumber and wood products	-0.08	-1.23	2.86	0.28
Paper and pulp	0.09	0.19	0.46	0.29
Rubber and plastics	6.69	1.68	-0.49	0.86
Chemical products	-0.77	0.45	-0.43	0.12
Petrochemical products	-1.23	3.51	0.94	2.54
Ceramics	-0.34	-1.17	-0.05	-0.75
Iron and steel	-2.84	0.99	-0.30	0.50
Non-ferrous products	-0.12	0.01	0.05	0.02
Metal Products	2.24	-0.32	-1.74	-0.85
Machinery	1.67	0.93	-0.02	0.57
Electrical equipment and machinery	-0.24	-2.55	5.03	0.23
Transport equipment	-1.68	1.93	-0.34	1.07
Precision instruments	5.39	-1.13	11.11	2.22
numbers of positive sector	10	10	8	14
Max	6.69	3.51	11.11	3.04
Min	-2.84	-3.17	-4.97	-1.54

For the 1990s, three industry categories, rubber and plastics, petroleum and coal products, and transport equipment were measured as displaying a quality increase of 1% or higher; for the 2000s, 5 categories, mining, leather products, paper and pulp, electrical equipment and machinery, and precision instruments, displayed an increase of 1% or higher.

For North America in the 1990s, for the machinery-related categories, when changes in quality are compared by export market, the greatest rate of change of quality is recorded for Canada in the machinery category, for Asia in the electrical equipment and machinery category, for the EU in the transport equipment category, and for Japan in the precision instruments category. For the 2000s, the rate of increase is highest for machinery category in the EU and for transport equipment and precision instruments in Asia. There were negative quality changes in four industry categories for

Japan as export market. (See **Table 7**).

Table 7 Rate of Quality Change for North America by Export Market: 4 Machinery Categories

Product categories	1990-2000				2000-2006			
	Japan	EU	Asia	North America	Japan	EU	Asia	North America
Machinery	0.17	-0.30	0.63	1.65	-6.11	2.01	0.87	0.44
Electrical equipment and machinery	-1.25	-1.86	4.70	-2.72	-1.62	-0.07	-0.89	-0.90
Transport equipment	-2.85	1.50	0.70	0.01	-3.86	-0.18	6.22	0.46
Precision instruments	2.10	0.75	-4.08	0.91	-11.34	-15.51	3.21	-21.10

Note: Calculated from indices formulated by Kuroko.

5.3 Comparison by Country and Industry Category (2): Asian Region

Quality indices were calculated for 8 countries in the Asian region (excluding Japan) for 19 industry categories.

Looking first at quality changes for the 1990s and the 2000s when the period from 1990 onwards is divided into two. As shown in **Table 8**, for the 1990s five countries including Singapore recorded positive changes in 10-14 industry categories, and for these (excluding South Korea), six-eight categories displayed an annual rate of change of 1% or higher.

Table 8 Export quality changes of 19 sectors

Country	1990〜2000		2000〜2005	
	number of positive sector	(more than 1%)	number of positive sector	(more than 1%)
CHN	8	3	10	3
HKG	9	5	16	13
SGP	13	7	11	10
KOR	12	3	11	6
MYS	14	8	8	7
THA	12	8	11	6
PHL	10	6	6	3
IDN	5	3	11	7

For the 2000s, six countries and areas including Hong Kong record positive change in 10-16 categories, with change greater than 1% in 13 categories and 10 categories for Hong Kong and Singapore respectively.

Next, we will examine the characteristics of these quality changes for each important category..

Looking at results for the four machinery-related categories in **Table 9**, we find that for machinery, for the 1990s, South Korea and four ASEAN nations displayed positive change, with the highest rate of increase recorded by Malaysia at 9.5%. For the 2000s, positive change was displayed only by China and Hong Kong, with the figure highest for Hong Kong at 2.2%.

Table 9 Quality changes of machinery-related sectors

(% per year)

Country	Machinery		Electrical machinery		Transport equipment		Precision instruments	
	90～00	00～05	90～00	00～05	90～00	00～05	90～00	00～05
CHN	-1.16	0.18	1.26	2.07	-0.46	0.15	-2.62	-6.88
HKG	-5.36	2.21	0.63	4.80	1.25	5.08	-0.33	6.18
SGP	-1.54	-4.38	1.21	6.11	-7.92	1.74	4.98	3.34
KOR	1.62	-0.12	0.20	2.78	0.64	2.35	-0.99	9.30
MYS	9.50	-13.30	1.16	5.60	-6.06	-6.49	8.69	2.58
THA	1.65	-5.06	4.29	14.63	-3.44	2.53	-5.75	2.73
PHL	2.58	-3.07	-1.16	7.97	-0.89	6.18	-6.13	-16.25
IDN	5.65	-2.93	-0.93	0.79	0.24	-1.02	-1.13	10.39
max	9.50	2.21	4.29	14.63	1.25	6.18	8.69	10.39
min	-5.36	-13.30	-1.16	0.79	-7.92	-6.49	-6.13	-16.25

Excluding the Philippines, for electrical equipment and machinery all countries displayed positive change from 1990 onwards. However, the rate of increase was higher for all countries in the 2000s than in the 1990s. The rate of increase in quality was particularly marked in the case of Thailand.

For transport equipment, Hong Kong displayed the highest rate of increase in the 1990s, at 1.25%. Other countries all displayed positive or negative change of 1% or below. In the 2000s, by contrast, seven countries displayed positive change, of which five displayed positive change of 1% or higher.

Only Malaysia and Indonesia displayed negative change.

For precision instruments, Singapore and Malaysia displayed positive change of 2% or higher for both periods. Of the other countries, China, the Philippines, and Indonesia displayed negative change for both periods.

For the three machinery-related categories excluding machinery, the increase in quality was greater for the 2000s.

Looking at results for other categories shown in **Table 10**, we find that positive change was displayed by China, Hong Kong, and Indonesia in the agricultural, forestry and fisheries for both periods. The greatest rate of increase in quality was displayed by Malaysia in the former period and by Indonesia in the latter period. In the lumber and wood products category, China, Hong Kong, and Singapore displayed positive change for both periods, with the highest rate for China and Hong Kong at approximately 2.6% for the former period, and the highest rate for Singapore at 4.56% for the latter period. Finally, for the ceramics category, both Singapore and Thailand displayed positive change for both periods, with Singapore displaying the greatest increase for both periods. For the latter period, Hong Kong, Singapore, Thailand, and Indonesia displayed quality increase rates of 2% or higher.

Table 10 Quality changes of agriculture and others

(% per year)

Country	Agriculture		Wood and its product		Non-metallic minerals	
	90～00	00～05	90～00	00～05	90～00	00～05
CHN	0.80	0.55	2.61	1.63	-0.86	-0.18
HKG	0.82	2.82	2.59	1.18	-0.53	2.73
SGP	-3.09	3.25	0.88	4.56	5.02	3.72
KOR	-3.34	-1.61	0.64	-0.56	-0.66	2.27
MYS	2.05	-1.28	-1.34	-4.99	2.82	-0.21
THA	-1.88	1.25	-0.38	-1.86	0.84	2.84
PHL	1.14	-1.02	0.91	-2.49	-5.98	-0.99
IDN	0.66	4.37	-0.05	-0.34	-0.31	3.43
max	2.05	4.37	2.61	4.56	5.02	3.72
min	-3.34	-1.61	-1.34	-4.99	-5.98	-0.99

5.4 Comparison by Country and Industry Category (3): The European Region

First, we will consider the distribution of positive quality changes by industry category for the 1990s and the 2000s for 13 countries including Germany. **Table 11** shows the summary results.

For the 1990s, 11 countries, excluding the UK and Denmark, displayed positive change in 10 industry categories or more. By contrast, only four countries – Germany, France, Italy, and Spain – displayed positive change in 10 industry categories or more for the 2000s. For the 1990s, Germany, Belgium, and Norway displayed an increase in quality of 1% or higher in either 0 or 1 industry category, while the figure was 7-8 categories for Holland and Spain. For the 2000s, Denmark, Norway, and Finland recorded quality increases of 1% or higher in three industry categories or less, while the remaining countries recorded increases of 1% or higher in 4-6 categories.

Table 11 Quality changes of 19 sectors

	number of positive sector	(more than 1%)	number of positive sector	(more than 1%)
DEU	11	0	11	4
FRA	14	4	10	5
GBR	8	4	8	6
ITA	14	4	14	5
NLD	15	8	9	4
BEL	14	1	4	4
ESP	13	7	11	5
POL	10	4	9	2
DNK	6	2	8	4
SWE	11	4	9	4
NOR	10	1	9	3
FIN	10	2	5	2
AUT	11	5	9	5

Next, we will compare the change in quality indices for the four machinery-related categories, as in the case of Asia.

As shown in **Table 12,** only three countries, Belgium, Sweden, and Finland, recorded positive change for machinery for the 1990s, and the change was 1% or less in each case. In the 2000s, the number of countries recording positive change increased to seven, with the highest rate recorded by the UK at 3.09%.

Table 12 Quality changes of machinery-related sectors

Country	Machinery		Electrical machinery		Transport equipment		Precision instrument	
	90～00	00～05	90～00	00～05	90～00	00～05	90～00	00～05
DEU	-0.46	2.53	0.71	4.06	0.61	0.54	0.30	2.81
FRA	-0.16	0.44	2.06	0.41	0.62	1.00	-1.99	1.12
GBR	-3.50	3.09	-4.83	1.65	2.29	-0.68	-0.87	2.50
ITA	-0.25	0.04	1.12	2.27	0.82	3.14	-0.43	1.16
NLD	-0.53	-2.93	3.51	6.19	3.02	-0.62	1.42	-6.74
BEL	0.56	-1.07	0.35	6.09	-0.19	-3.49	-1.57	-2.07
ESP	-0.92	1.17	0.07	-0.78	0.87	1.62	-0.69	1.37
POL	-0.22	0.74	1.24	1.44	4.52	3.43	3.37	-8.14
DNK	-0.81	-1.39	0.49	-1.39	-0.35	0.41	-1.49	10.29
SWE	0.04	-0.66	5.66	-3.19	0.12	-0.48	0.10	5.00
NOR	-3.83	0.17	-0.56	-2.43	0.84	-0.74	0.05	0.31
FIN	0.64	-5.72	2.26	-5.89	1.52	-2.36	-0.86	-0.94
AUT	-0.30	-4.66	1.27	-3.28	-0.51	1.88	-1.12	-5.21
max	0.64	3.09	5.66	6.19	4.52	3.43	3.37	10.29
min	-3.83	-5.72	-4.83	-5.89	-0.51	-3.49	-1.99	-8.14

For electrical equipment and machinery, 11 countries, excluding the UK and Norway, all recorded positive change in quality, with Sweden recording the highest increase at 5.66%. For the 2000s, the number of countries recording positive change declines to seven, with Germany, Holland, and Belgium recording increases of 4% to more than 6%. Of the five countries which recorded positive change for both periods, the rate of increase of quality indices increased in the 2000s for Germany, Italy, Holland, and Belgium, but not for France.

For transport equipment, the number of countries recording positive change declines from 10 for the 1990s to seven for the 2000s. For the 1990s, four countries, the UK, Holland, Portugal, and Finland, recorded positive change of 1% or more. Four countries again recorded positive change of 1% or more in the 2000s, this time Italy, Spain, Portugal, and Austria. Portugal is conspicuous here, recording the highest rate of increase for both periods, at levels from 3 to more than 4%.

For precision instruments, five countries, Germany, Holland, Portugal, Sweden, and Norway, display positive change for the 1990s; of these, Holland and Portugal display change of 1% or higher. The number of countries displaying positive change increases to eight for the 2000s, with seven countries recording positive change of 1% or higher, including Denmark at 10.29%.

Considering the machinery-related categories as a whole, the increase in quality was greater for the 2000s than for the 1990s.

Looking next at the three metal-related categories, changes in quality by country from 1990 onwards were shown in **Table 13**.

Table 13　Quality changes of metal-related sectors

Country	Iron-steel		Nonferrous metal		Metal products	
	90～00	00～05	90～00	00～05	90～00	00～05
DEU	0.45	0.54	-0.12	-0.10	0.06	0.03
FRA	-1.21	2.36	0.06	-0.16	0.11	0.27
GBR	0.65	-0.30	-0.20	-0.61	0.87	-1.44
ITA	0.51	0.73	-0.32	0.61	0.16	0.26
NLD	0.67	0.76	0.40	-0.22	0.89	0.33
BEL	0.08	1.85	0.38	-0.11	-1.10	-0.11
ESP	0.43	0.70	1.66	5.78	-0.24	-0.49
POL	-0.09	-0.74	-0.36	-0.52	-0.75	0.72
DNK	0.02	-1.90	-1.25	-0.16	-0.84	0.70
SWE	-0.40	-1.05	-1.09	0.64	0.99	0.49
NOR	0.44	1.07	-1.51	-0.32	0.03	0.03
FIN	-0.71	-0.61	0.53	0.11	0.07	2.44
AUT	0.84	-0.20	0.10	0.01	0.49	0.59
max	0.84	2.36	1.66	5.78	0.99	2.44
min	-1.21	-1.90	-1.51	-0.61	-1.10	-1.44

For the iron and steel category, France, Belgium, and Norway recorded positive change of 1% or higher for the 2000s. All other countries recorded either negative or positive change of 1% or less for both the 1900s and the 2000s. For non-ferrous metals, excepting Spain, five-six countries recorded positive change for both periods, at a level of 0.5% or less. Spain stands out by recording an increase in quality of 1.66% for the 1990s and 5.78% for the 2000s. For metal products, the only countries which recorded a change in quality of 1% or more were Sweden for the 1990s and Finland for the 2000s. Overall, the measured quality changes in the metal-related categories can be judged as being low.

Last, we will examine the characteristics of quality changes in light-industry categories, namely textiles, apparels and leather products by country. The result is shown in **Table 14**.

For textiles, the countries with positive quality change from 1990 onward are Netherlands and Spain for the 1990s and Italy and Spain for the 2000s. The 2000s saw nine countries with negative changes, four of which record more than 3%.

For apparel, only two countries, UK and Belgium recorded positive changes of more than 1% in the 1990s. For the 2000s, Belgium showed positive change of 10%, while negative changes of more than 3% were recorded in five countries, Germany, UK, Spain, Finland and Austria.

For leather products, in the 1990s, countries with quality changes of more than 1% are Netherlands, Spain and Sweden. Remaining countries recorded positive change of less than 1% or negative change. For 2000s, significant positive changes were recorded for France (3.2%) and Austria (5.2%). Remaining countries showed characteristics similar to the case of textiles.

Table 14 Quality changes in exports of light industry sectors

	Textile		Apparel		Leather product	
	90～00	00～05	90～00	00～05	90～00	00～05
DEU	0.88	-1.53	-0.53	-13.07	0.08	-2.21
FRA	-0.09	-0.39	1.19	-1.64	-0.52	3.20
GBR	-1.23	-0.99	-2.90	-7.16	-1.85	0.84
ITA	0.36	1.31	-0.53	0.16	-0.19	-0.98
NLD	1.42	1.57	1.23	-0.42	1.76	-0.23
BEL	-1.18	-3.36	0.36	10.61	0.50	-1.77
ESP	1.89	-3.04	0.95	-3.22	2.00	-1.49
POL	0.05	0.01	0.59	0.52	-1.35	-6.33
DNK	-0.27	-7.24	-3.19	-2.40	-2.32	-0.99
SWE	-0.43	0.35	-0.49	1.29	1.73	0.10
NOR	0.38	-1.04	-0.06	-0.85	-0.90	-1.61
FIN	0.23	-1.77	-1.35	-11.28	-0.22	-3.94
AUT	0.16	-4.98	-0.28	-5.76	-1.69	5.17
max	1.89	1.57	1.23	10.61	2.00	5.17
min	-1.23	-7.24	-3.19	-13.07	-2.32	-6.33

6. Conclusion

In the preceding discussion, we have compared unit value indices formulated based on SITC-R1 and the ones based on HS for the period from 1980 onwards by industry category and country, in order to study the effect of differences in the digit level of product classifications on export unit value indices. Comparison of unit value indices based on SITC-R1 which incorporate the effect of increases in quality (more advanced functions, increased size, etc.) for the same products with indices based on HS, which are able to adjust the effect, has shown that the former indices tend to be overestimated for certain industry categories and certain countries.

Of course, the HS indices used here have been based on the UN 6-digit standard; if indices based on the 9-digit codes used by reporting countries were used, it would have been possible to formulate indices closer to genuine price indices.

In relation to the interpretation of the results of this study, it will be necessary to engage in further study as to whether the cases in which negative change occurs in quality indices can be regarded simply as declines in the quality of the products.

Footnote

1 See United Nations (1981), (1991), (2003).

2 Kinoshita (2003) compared for Japan, the US, South Korea and Taiwan the fixed-weighted export unit value indices compiled by IDE with export price indices of those four countries and region. Next, Kinoshita (2005) compared fixed weighted unit value indices with chain-weighted ones sector by sector for Japan, the US and four East Asian countries and region, and concludes superiority of chain-weighted indices over fixed weighted indices. Further, Kinoshita (2008) computed SITC five digit unit value indices and HS nine digit indices(nine digit) for Japan’s automobile exports, and measured the factor of quality change in unit value indices.

3 United Nations (2003) made a survey on compilation of external trade index to member countries and summarized the reports from 77 countries in the following items; namely index number series produces, source of information, index calculation methods, release dates, revision policy, dissemination and compiling agency.

4 Trade price indices by Ministry of Finance cover the commodities with the share of more than 1/100,000 of total exports or imports of base year and the transaction of 32months over 36 months during the three year centering the base year. Base year changes every five year from 1985 and Fisher formula index. On the other hand, Bank of Japan index covers the commodities with the share of 5/10,000, and Laspeyres formula is used changing the base year every five year.

5 Kuroko (2009) reports the results of HS unit value indices of export and imports by sector for the period from 1962 to 2005(2006). Areas covered are 25 countries and region including nine East Asia, North America and Europe.

6 JPN=Japan, USA=United States, CAN=Canada, AUT=Austria, BEL=Belgium-Luxembourg (1962-1998) and Belgium (1999-), DEU=Former Federal Republic of Germany (1962-1990) and Germany (1991-), DNK=Denmark, ESP=Spain, FIN=Finland, FRA=France, IRL=Ireland, ITA=Italy, NLD=Netherlands, NOR=Norway, PRT=Portugal, SWE=Sweden, GBR=United Kingdom, CHN=China, HKG=Hong Kong, IDN=Indonesia, KOR=Korea, MYS=Malaysia, PHL=The Philippines, SGP=Singapore, THA=Thailand, AUS=Australia

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