

## OECD SCIENCE, TECHNOLOGY AND INDUSTRY WORKING PAPERS

OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the authors.

Working Papers describe preliminary results or research in progress by the author(s) and are published to stimulate discussion on a broad range of issues on which the OECD works. Comments on Working

Papers are welcomed, and may be sent to OECD Directorate for Science, Technology and Innovation, OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France; e-mail: [sti.contact@oecd.org](mailto:sti.contact@oecd.org).

The release of this working paper has been authorised by Andrew Wyckoff, OECD Director for Science, Technology and Innovation.

© OECD/OCDE 2015

Applications for permission to reproduce or translate all or part of this material should be made to: OECD Publications, 2 rue André-Pascal, 75775 Paris, Cedex 16, France; e-mail: [rights@oecd.org](mailto:rights@oecd.org)

## **THE STRUCTURE OF STEEL EXPORTS: CHANGES IN SPECIALISATION AND THE ROLE OF INNOVATION**

Anthony de Carvalho, Naoki Sekiguchi

OECD Paris

### **ABSTRACT**

This paper examines changes in the steel-related export structure of the ten largest steelmaking economies between 2004 and 2014, in terms of the steel products exported and the market destination for those exports. To shed light on how exporters' patterns of specialisation have changed in the period since 2004, indices of "Revealed Comparative Advantage" (RCA) are developed for a number of low, medium and high value-added steel products, indicating that export specialisation patterns may be changing noticeably as some steel producers in emerging economies move up the value chain and begin exporting more sophisticated steel products. The paper also assesses the role of innovation, as measured by patents, in determining the export structure of countries, and finds a positive correlation between innovation activity and export specialisation in higher value-added steel segments.

- Keywords: Steel; Trade; Comparative advantage; Technological advantage; Patents
- JEL Classification: F14; L6; O34

## TABLE OF CONTENTS

ABSTRACT .....	2
TABLE OF CONTENTS .....	3
THE STRUCTURE OF STEEL EXPORTS: CHANGES IN SPECIALISATION AND THE ROLE OF INNOVATION .....	5
Introduction.....	5
Recent world export developments.....	5
Export structures of the ten largest exporters (in order of size).....	6
China: Exporting more alloy flat steel .....	7
Japan: Exporters are increasingly reliant on ASEAN markets.....	9
EU exports to Northern Africa are increasingly important .....	11
Korea: Strong growth in exports particularly to the ASEAN region .....	13
Russia: Exports shift away from Asia .....	15
Ukraine: Exports decline in line with falling production due to the crisis.....	17
Turkey: Exports shifting from regions with less demand to regions that need more steel.....	19
Chinese Taipei: Flat steel exports assume a greater role in exports.....	21
United States: Trade activity with Mexico has increased significantly .....	23
India: Trade balance moves into surplus.....	25
Steel trade and comparative advantage.....	27
Does innovation help explain export specialisation?.....	31
Concluding remarks .....	35
NOTES .....	36
ANNEX: STEEL EXPORTS BY PRODUCT AND MARKET DESTINATION, % SHARES OF TOTAL EXPORTS .....	38

### *Acknowledgements*

The authors are extremely grateful to Filipe Silva and Laurent Moussiégt for invaluable statistical assistance with the construction of indicators of technological advantage. Comments and suggestions on previous versions of this paper by national delegates to the OECD Steel Committee are also greatly appreciated. The authors would also like to thank Nick Johnstone and Dirk Pilat for useful discussions and input, as well as Florence Hourtouat, James Arkininstall and Kate Brooks for editorial support. The authors retain all responsibilities for remaining errors and omissions in this document.

## THE STRUCTURE OF STEEL EXPORTS: CHANGES IN SPECIALISATION AND THE ROLE OF INNOVATION

### Introduction

Global steel trade has undergone significant fluctuation over the past decade. For instance, between 2004 and 2008, the volume of world steel exports increased by almost one-fifth. It then fell by 25% between 2008 and 2009 and has been recovering since then. In 2014, global exports stood at around 442 million metric tonnes (mmt), slightly higher than the pre-crisis level recorded in 2007.

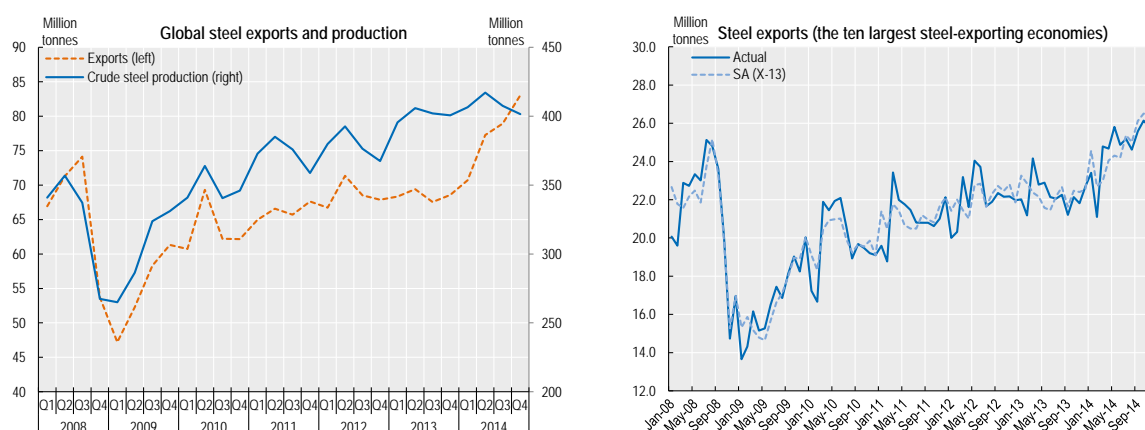
Naturally, the trade performance of individual economies has diverged considerably in the last ten years. Some countries with excess steelmaking capacity have seen relatively faster growth in exports. Regions that have traditionally been large net importers of steel are now investing rapidly in new steelmaking capacity, a trend that is gradually leading to reduced demand for imports. Many changes are also occurring in the types of products being exported; in many emerging economies, steelmakers are moving up the value chain and exporting more sophisticated steel products. Some advanced countries have taken advantage of strong steel demand growth in neighbouring developing economies, and their steel export structure has changed as a result.

This paper examines developments in the export structure of the ten largest steelmaking economies in the world between 2004 and 2014. To the extent possible, linkages are made between the changes in export structures and market factors such as capacity and demand growth. To shed light on how exporters' patterns of specialisation have changed in the period since 2004, indices of "Revealed Comparative Advantage" (RCA) are developed for a number of low, medium and high value-added steel products, and some broad conclusions are drawn about how export specialisation has changed among the major steel-exporting economies. The paper also tries to assess the role of innovation, as measured by patents, in determining the export structure of countries, and finds a positive correlation between innovation activity and export specialisation in higher value-added steel segments.

### Recent world export developments

Steel exports have fluctuated considerably since the global financial and economic crisis (Figure 1). The recovery in global exports from the crisis of 2008-09 began to moderate in 2010, and steel trade growth remained relatively modest until 2013. The most noticeable trend observed recently is the strong export acceleration that began in early 2014 and which continued until the end of the year. In fact, the seasonally-adjusted monthly export levels of the world's ten largest exporters, combined, have reached historically high levels (see the right-hand-side panel of Figure 1).

Table 1 provides trade figures for the world's ten largest steel exporters. Their exports combined expanded by 12% in 2014, led by a 51% increase in Chinese exports. The European Union, India, Korea, Russia, and Chinese Taipei also registered some growth in exports.<sup>1</sup> These export gains more than offset export contractions in Turkey, Ukraine and the U.S. in 2014. Japan's exports in 2014 dipped only slightly from the previous year.

**Figure 1. Global steel exports and production, 2008-2014**


Note: Export data do not include intra-EU trade.

Sources: Iron and Steel Statistics Bureau and the World Steel Association.

**Table 1. The ten largest steel-exporting economies and the change in their exports during 2004-2014**

Yearly levels of exports are in millions of metric tonnes

Position 2014	Position 2013	Economy	2004	2013	2014	%	2014-2015				y-o-y % change				
			(A)	(B)	(B/A)		2014 1H	2014 2H	2015. Jan	2015. Feb	2014 1H	2014 2H	2014	2015. Jan	2015. Feb
1	1	China	19.7	61.1	92.3	369.8	40.3	52.0	10.2	7.7	34.2	67.7	51.2	53.2	61.8
2	2	Japan	34.7	42.4	41.2	18.8	20.4	20.9	3.4	3.2	-6.2	0.9	-2.7	3.6	1.2
3	3	EU-28	32.3	36.1	36.6	13.0	18.1	18.4	na	na	-2.2	4.7	1.2	na	na
4	4	Korea	14.9	28.8	31.8	112.8	15.4	16.4	2.6	2.5	8.0	12.6	10.3	7.1	-0.2
5	6	Russia	30.4	23.6	26.9	-11.5	12.8	14.1	na	na	6.0	22.6	14.1	na	na
6	5	Ukraine	28.2	24.7	21.5	-23.9	12.1	9.3	na	na	-3.6	-22.8	-13.0	na	na
7	7	Turkey	12.2	17.2	16.1	32.4	8.5	7.7	na	na	-9.4	-2.5	-6.2	na	na
8	9	Chinese Taipei	9.4	11.6	12.1	28.2	6.2	5.9	1.0	na	5.0	4.0	4.5	-7.3	na
9	8	United States	7.3	12.2	11.6	58.5	5.8	5.7	0.9	na	-6.2	-3.6	-4.9	-4.1	na
10	10	India	5.2	9.6	9.8	89.6	4.9	5.0	na	na	11.5	-6.0	1.9	na	na
<b>Total</b>			194.4	267.3	300.0	54.3	144.6	155.4	na	na	7.0	17.6	12.2	na	na

Note: Includes all items in Harmonized System Nomenclature from 7206 to 7229 and 7301, 7302, 7304, 7305, 7306 and from 7307.21 to 7307.99. EU data refer to external trade. EU data for 2004 refer to the EU-15.

Source: OECD and Iron and Steel Statistics Bureau (ISSB).

### Export structures of the ten largest exporters (in order of size)

This section provides a cursory glance at how the structure of steel exports has changed in major exporting economies since 2004. Where possible, linkages are drawn between the changes in export structures and market factors such as capacity and demand growth. Such trade comparisons require a large amount of trade data. To keep the exercise manageable, this section examines only the export destinations as well as products shipped abroad in 2004 and 2014, in terms of their relative shares. The data are presented using the same graphs for each of the ten largest steel-exporting economies. Readers should note that the export destinations and products are represented in the graphs in the horizontal order shown in the legends. The data presented in the graphs are also provided in the Annex of the document for ease of reference.

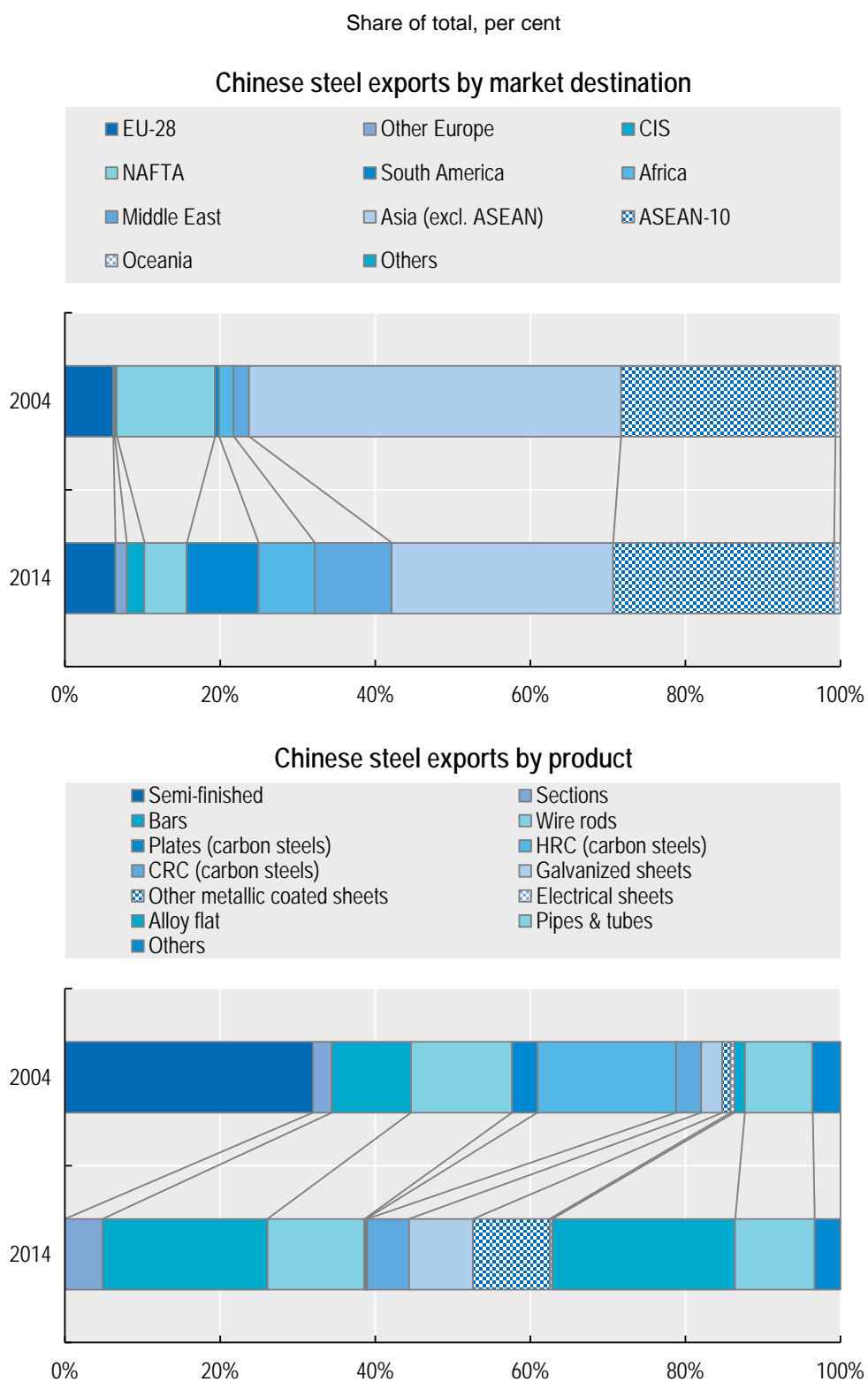
### ***China: Exporting more alloy flat steel***

China exported 19.7 mmt of steel in 2004, but then overtook the EU, Japan, the Russian Federation, and Ukraine to become the world's largest exporter in 2006. Exports then declined sharply during the following two years, reaching 23.7 mmt in 2009. Since then, Chinese exports have been recovering steadily; in 2014, they climbed to a level of 92.3 mmt, an all-time high for China. Today, China accounts for 30.8% of the total exports of the ten largest steel-exporting economies.

Figure 2 shows China's export structure. Competition in East Asia has increased significantly over the past several years. Chinese steel exporters compete intensively with steelmakers based in Japan, Korea and Chinese Taipei for markets located within the Association of Southeast Asian Nations (ASEAN) region. China's export share to ASEAN has gradually increased, with some diversion in China's trade with Korea and Chinese Taipei shifting towards ASEAN. Other notable trends include the considerable rise in Africa, the Middle East and South America as export destinations for Chinese steel products. Each of these regions now import slightly less than a tenth of China's exports. On the other hand, NAFTA now accounts for a lower share of Chinese exports compared to 2004.

Taking a look at changes in the steel products that China exports, the share of exports of relatively low value-added hot-rolled sheets and strips has virtually collapsed, from a share of 17.9% in 2004 to 0.2% in 2014. The share of Chinese exports of carbon steel plates has also declined sharply. Market analysts have pointed out that such developments may have occurred in response to changes in the (differential) VAT rebates that are applied to steel exports, resulting in greater incentives to export, for example, boron-added alloy flat steel products (the share of alloy flat steel exports increased from 1.4% in 2004 to 23.6% in 2014). With respect to plates, Korea has traditionally been a major export market for Chinese plates, and growth in Korean platemaking capacity recently may also explain part of the decline in China's plate exports.

**Figure 2. Chinese steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

Source: Iron and Steel Statistics Bureau (ISSB).



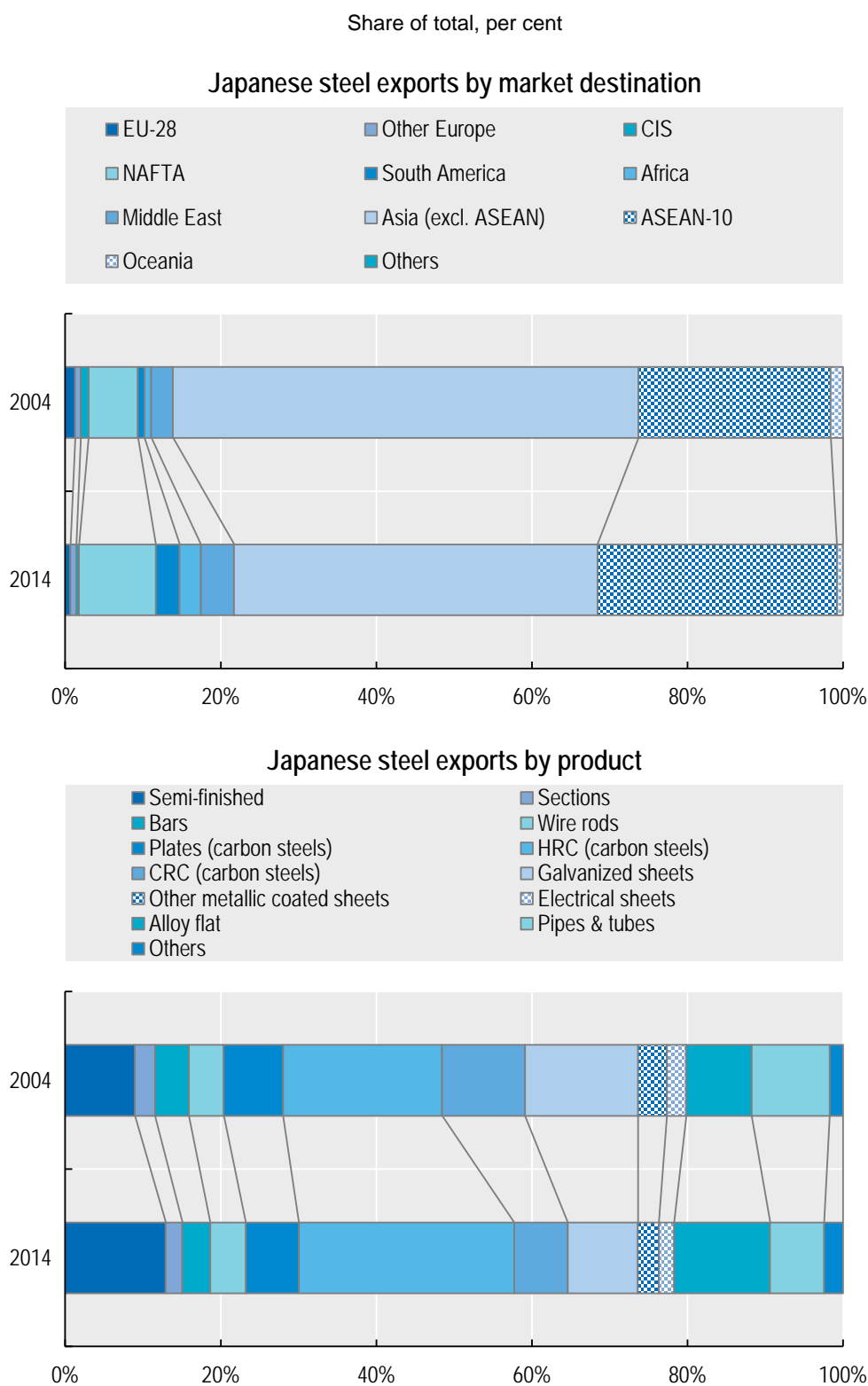
***Japan: Exporters are increasingly reliant on ASEAN markets***

Japanese steel exports tend to be higher value-added, differentiated products, as shown later in this paper. This has meant that Japanese steel producers usually have less need to compete based on price than producers of more commoditised products. Japanese exports have performed relatively well in the last few years. That is, they did not decline as much as those of other regions during the financial crisis, and over the past five years have averaged 41.8 mmt per year, despite a slight dip in 2014. A challenge for Japanese steel producers in the future, however, will be to adjust to greater levels of competition as steel producers in China and other economies in the region move up the value chain.

Total Japanese exports to the ASEAN region have increased sharply, while export volumes sent to China and Korea have declined. Thus, ASEAN's share of Japanese exports has increased from 24.7% in 2004 to 30.8% in 2014, while the rest of Asia's corresponding share has declined from 59.8% to 46.7% (Figure 3). This trend partly reflects the fact that Japanese automobile manufacturers have invested in new plants in the ASEAN region; as Japanese car manufacturers set up ventures abroad, their suppliers tend to follow. In addition, demand for Japanese steel products used in the manufacture of home appliances has also increased in ASEAN.

Examining exports by product, an interesting change has been the increase in the share of semi-finished products as well as alloy flat products, supported by growing demand from ASEAN economies. In addition, there has been a marked increase in exports of hot-rolled sheets and strips, while the share of downstream galvanised sheets has declined. This is because Japanese steel producers are shifting their export behaviour in expanding overseas production and supplying pre-processed original steel materials to local mills invested by the Japanese companies. Japanese exports of hot-rolled coil have grown significantly particularly to Africa, the Middle East, China, Viet Nam, Indonesia and other parts of Asia (India, Pakistan and Bangladesh). Korea has traditionally been Japan's main market for hot-rolled coil exports, but its share of these exports has declined noticeably in recent years. Other product categories have more or less maintained their export volumes during the time period.

**Figure 3. Japanese steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

Source: Iron and Steel Statistics Bureau (ISSB).

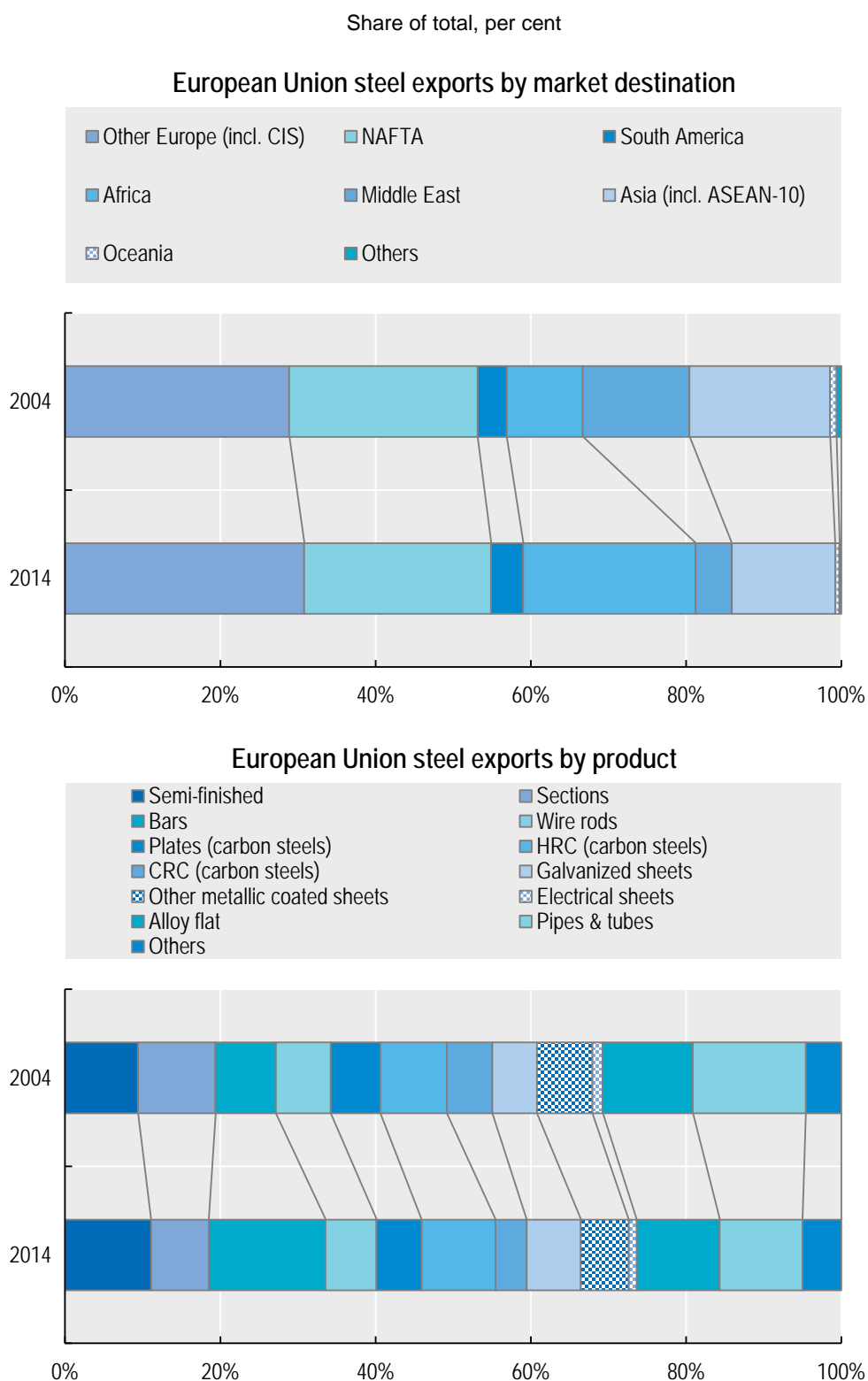
### ***EU exports to Northern Africa are increasingly important<sup>2</sup>***

In the EU, the world's third largest steel exporter after Japan, export developments have been relatively moderate since 2004, with annual levels showing relative stability during the period. In 2014, EU exports stood at 36.6 mmt. Internal trade is much greater than external trade, around 2.8 times greater in 2014, but the gap declined in recent years due to weak demand within the single market.

Significant changes have occurred in the EU's export structure, mainly reflecting demand growth in markets that are located in close proximity to the region. A key development has been the rapid growth of construction activity in northern Africa, which has raised demand for construction steels produced in the EU. As a result, European exports of long products used in construction have increased significantly and Africa has become a very important export market (Africa accounted for 9.8% of EU exports in 2004, but this figure rose to 22.2% in 2014 – see Figure 4). Algeria is a significant importer of reinforcing bar and wire rod from the EU, most of which originates from Italy, Spain and Greece. The market “Other Europe”, a classification that includes Turkey and the Commonwealth of Independent States (CIS) for the statistical purposes of this document, nevertheless remains the main export market for the EU.

The EU's major export product category in 2004 was pipes and tubes followed by alloy flat products. In 2014, the largest export product was steel bars with a share of 15.0% of total exports, a consequence of strong construction activity in northern African markets as noted above. The shares of relatively high value-added pipes and tubes as well as plates have declined only slightly (as have export volumes) during this time period.

**Figure 4. EU-28 steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends. Data for 2004 refer to the EU-25. "Other Europe" includes the CIS in this chart.

Source: Iron and Steel Statistics Bureau (ISSB).

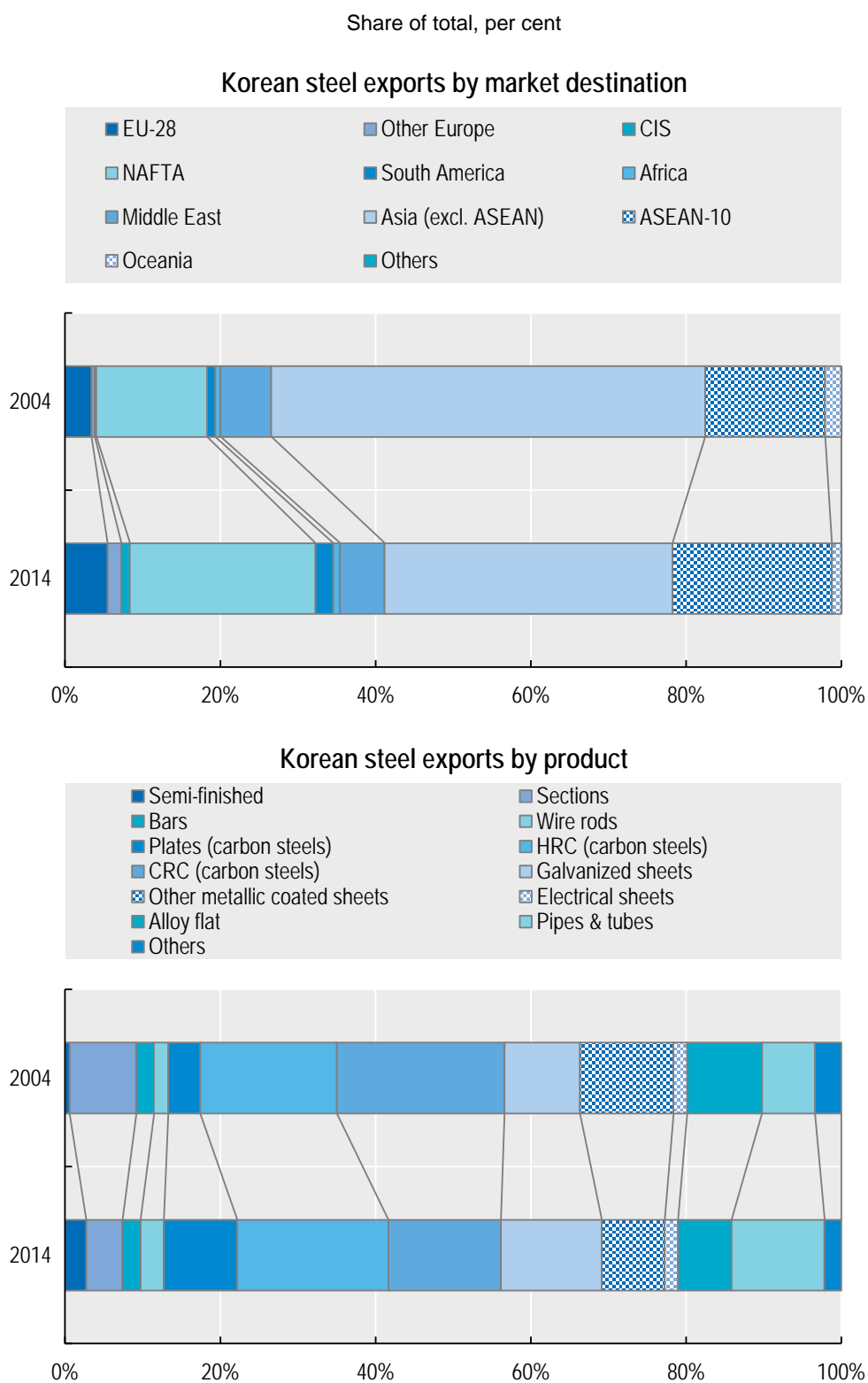
***Korea: Strong growth in exports particularly to the ASEAN region***

Korea is the world's fourth largest steel exporter and has experienced solid growth in exports since 2004. In 2011, the country became a net exporter of steel. Korean exports have increased from 14.9 mmt in 2004 to 31.8 mmt in 2014, *i.e.* by a cumulative 112.8% during the period. Like other East Asian economies, Korea has become increasingly dependent on the ASEAN region for its exports. ASEAN-10 now absorbs around 20% of Korea's exports, up from a share of 15.4% in 2004. This has been supported by investments by some Korean steelmakers in downstream facilities in the ASEAN region.<sup>3</sup>

The rest of Asia's share within Korean exports has gone down, but given the strong growth in total Korean exports, the level of steel shipments to the rest of Asia has increased during the period. Asia excluding ASEAN remains the main export destination for Korea, with a share of 37.1%. North and South America, the other main export markets for Korea, have seen their shares of Korean exports increase. NAFTA's share of Korean exports has increased significantly, owing to growing export volumes of flat products for the automotive industry, particularly in Mexico. Korean exports to NAFTA have also been supported by growing demand for steel used in the U.S. oil and gas sector.

Korea's main export products are hot-rolled sheets and strips, whose share of total exports has increased from 8.6% in 2004 to 19.5% in 2014, partly reflecting capacity developments for hot-rolled sheets (Figure 5). However, an interesting change has been the growing shares of semi-finished steel (reflecting investments by some Korean steelmakers in downstream facilities in Southeast Asia) as well as plates (probably the consequence of expanded capacity for plate). The share of pipes and tubes in Korean exports has increased, and the country has become the largest pipe supplier to the U.S. market.

**Figure 5. Korean steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

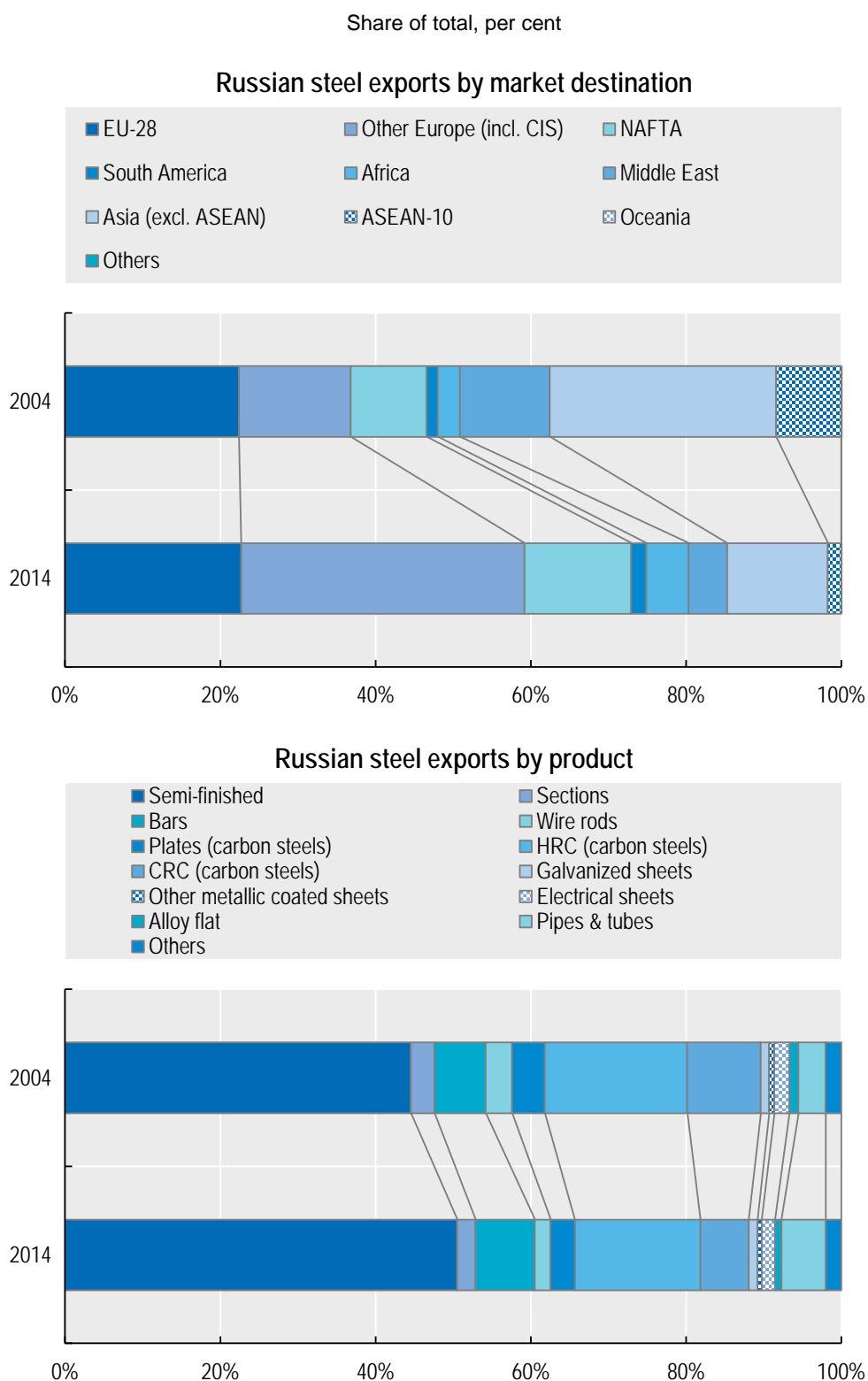
Source: Iron and Steel Statistics Bureau (ISSB).

***Russia: Exports shift away from Asia***

Similar to Ukraine, Russian steel exports have declined over the past few years, from 30.4 mmt in 2004 to 26.9 mmt in 2014. The country is a heavy exporter of semi-finished steel products, which accounted for 50.5% of its outward shipments in 2014. The main export market for Russian steel products is “Other Europe” (including the CIS region), whose share in Russia’s exports has recently increased to 36.5% (Figure 6). Asia’s share of Russian exports has declined significantly.

Regarding exports by product, the main observable trend has been an increase in the share of semi-finished steel in exports, while the shares of some long products such as sections and wire rods have declined. Indeed, the country had been experiencing significant domestic growth in demand for long steel products in response to growing domestic housing and other construction activity, which may have dampened the exports of these products to foreign markets. However, with Russian economic activity and steel consumption expected to contract significantly in 2015, this trend may change.

**Figure 6. Russian steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends. "Other Europe" includes the CIS in this chart.

Sources: Iron and Steel Statistics Bureau (ISSB) and the United Nations Commodity Trade Statistics Database.



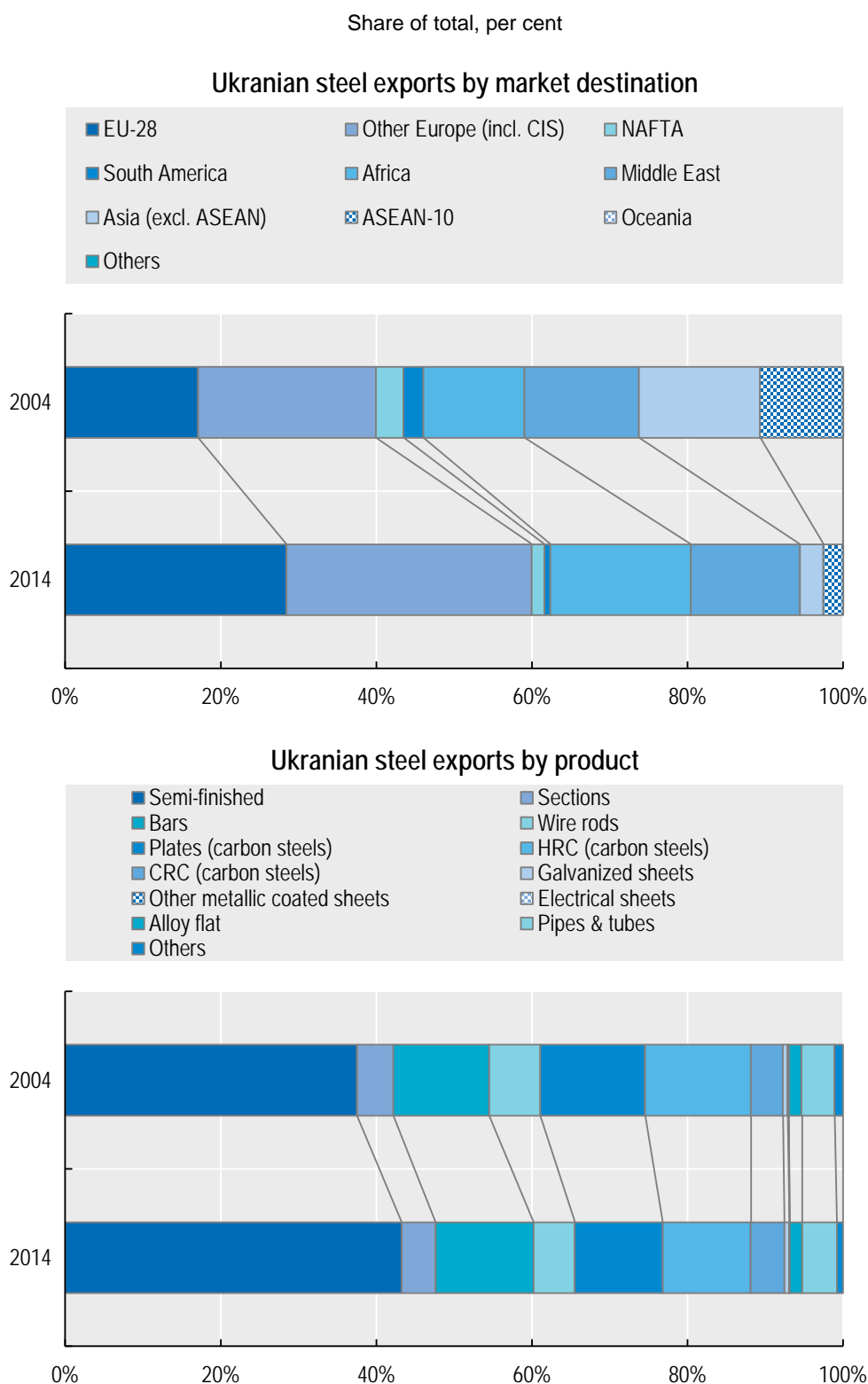
***Ukraine: Exports decline in line with falling production due to the crisis***

Ukraine is the world's sixth largest exporter in volume terms, but is the world's most export-oriented economy in the sense that the vast majority of the country's steel production is exported. Since 2004, the country's steel export volume has declined, from 28.2 mmt to 21.5 mmt in 2014. Recent export declines, however, reflect the significant drop in steel production in 2014 resulting from the crisis. This has also occurred in the wake of declining steelmaking capacity in the country.

Ukrainian exports to most markets have weakened since 2004, with the exception of the EU, a major export market for Ukraine, as well as "Other Europe" and Africa. The EU has imported more steel from Ukraine since 2004, and its share of the country's exports increased from 17.1% to 28.5% between 2004 and 2014 (Figure 7). Ukraine also exports large quantities of steel to Turkey and other economies in the Commonwealth of Independent States (CIS) region. Turkey imported roughly 13% and the Russian Federation 11% of Ukraine's foreign shipments of steel in 2014.

The decline in Ukraine's exports in recent years has affected most product categories, though less with respect to semi-finished steel. Semi-finished steel accounted for 43.3% of the country's total steel exports in 2014, up from 37.5% in 2004. Steel bars are the second most important export product, followed by hot-rolled sheet and strip and plates.

**Figure 7. Ukrainian steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends. "Other Europe" includes the CIS in this chart.

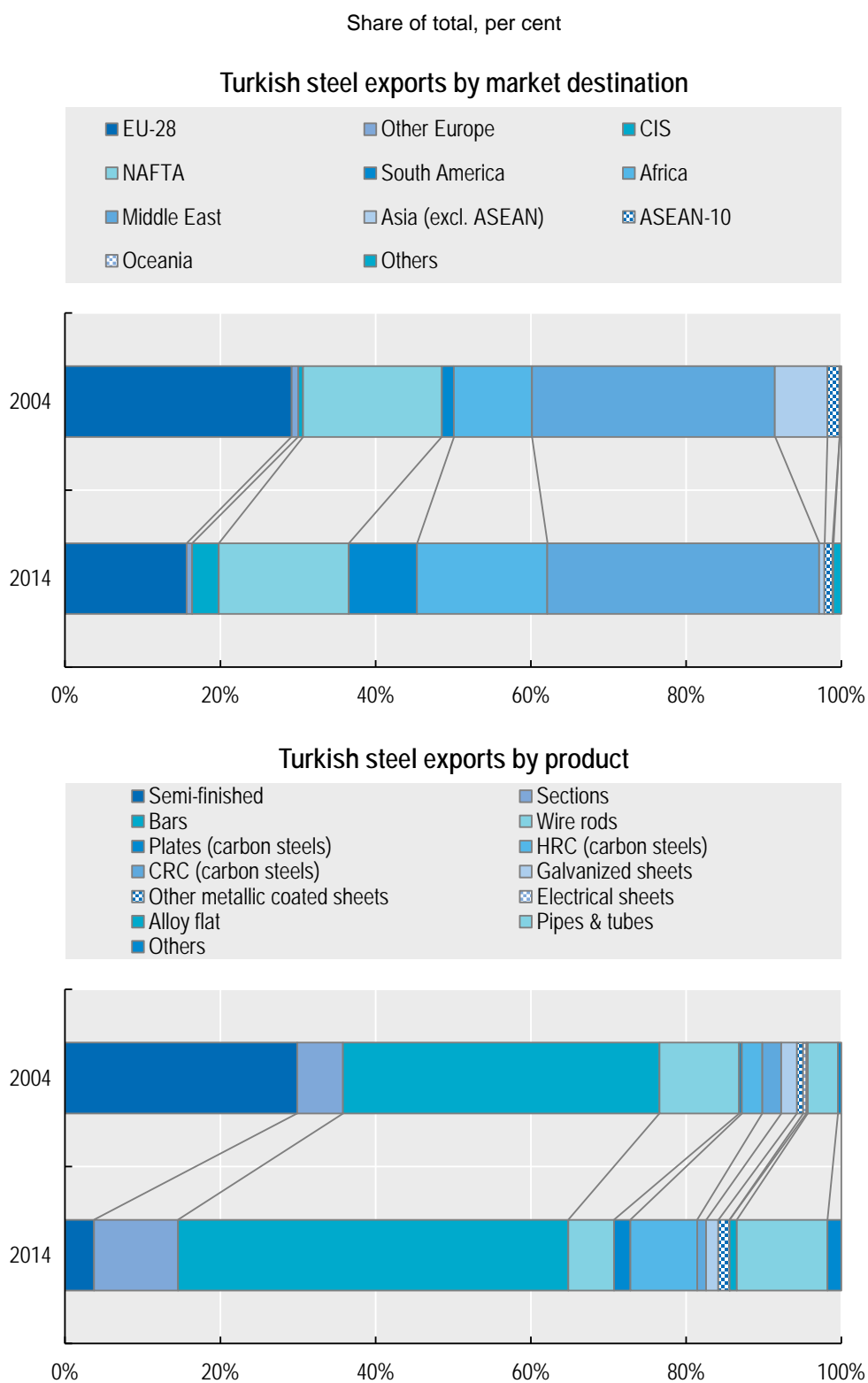
Sources: Iron and Steel Statistics Bureau (ISSB) and the United Nations Commodity Trade Statistics Database.

***Turkey: Exports shifting from regions with less demand to regions that need more steel***

Despite rapid growth in steelmaking capacity and steel production, Turkey's exports of steel have increased moderately between 2004 and 2014, from 12.2 mmt to 16.1 mmt. Nevertheless, Turkey is an important supplier of long steel products for the construction sector, particularly to the Middle East. The EU has traditionally been an important export market for Turkey, but its share of Turkey's exports has declined significantly since 2004, from 29.2% in 2004 to 15.7% in 2014 (Figure 8). Africa has become an increasingly important market for Turkish exports of construction steel, due to growing construction activity particularly in northern Africa. Africa now accounts for almost 17% of Turkish exports. South America has also seen its share of Turkish exports increase since 2004.

On the product side, a notable change has been the rising share of flat products in Turkish exports (mainly hot-rolled steel sheets and strips), supported by the strong capacity expansion to produce flat steel products. Steel bars nevertheless remain the main export item, accounting for around half of the country's exports. There has also been a significant decline in the share of semi-finished products in Turkish exports, possibly due to growing domestic demand for these products.

**Figure 8. Turkish steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

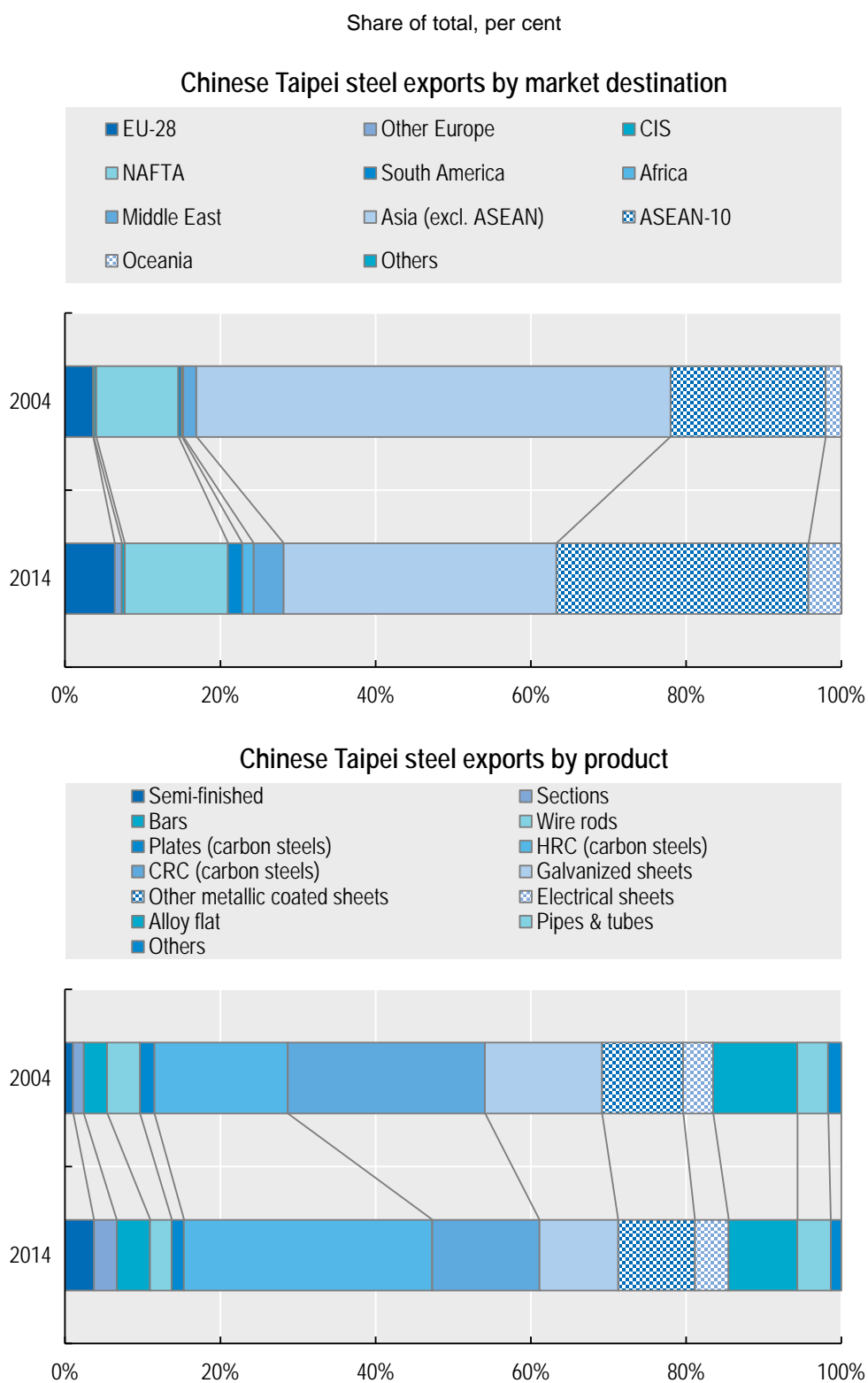
Sources: Iron and Steel Statistics Bureau (ISSB) and the United Nations Commodity Trade Statistics Database.

***Chinese Taipei: Flat steel exports assume a greater role in exports***

Exports from Chinese Taipei have increased only slightly over the past few years, from 9.4 mmt in 2004 to 11.6 mmt in 2014, despite more than six million tonnes of steelmaking capacity additions during the period. The main export markets are found in Asia, which is the destination for 35.2% of Chinese Taipei's exports. Export patterns within Asia, however, have changed considerably, with ASEAN economies importing a significantly larger share of Chinese Taipei's exports and other Asian economies importing less (Figure 9).

Examining the products exported by Chinese Taipei, the main export category is hot-rolled sheets and strips, whose share of exports has increased sharply since 2004. These products now account for almost 32% of the economy's total exports. Alloy flat steels, on the other hand, have become less important in exports.

**Figure 9. Chinese Taipei steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

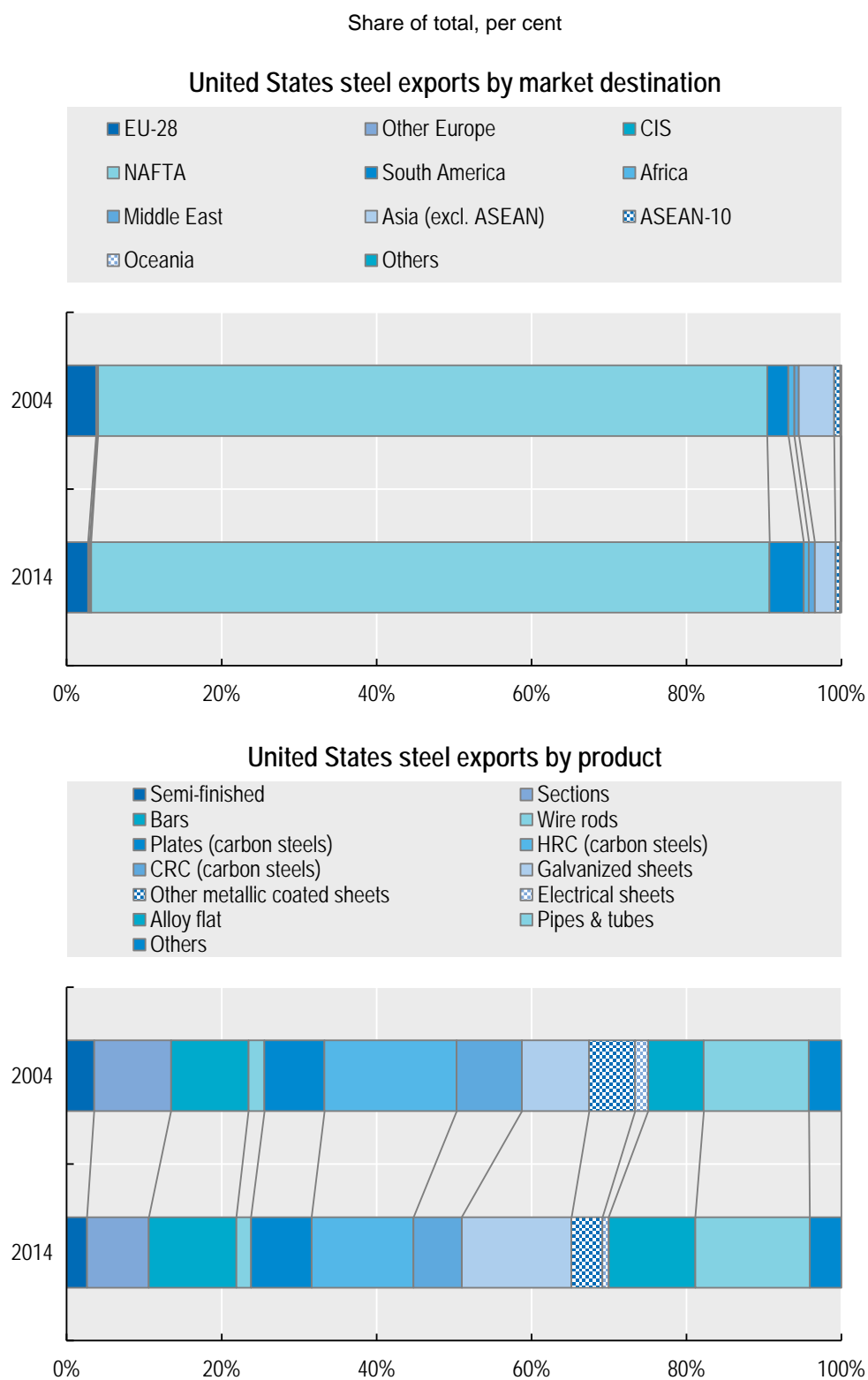
Source: Iron and Steel Statistics Bureau (ISSB).

***United States: Trade activity with Mexico has increased significantly***

Exports from the United States increased from 7.3 mmt in 2004 to 11.6 mmt in 2014, *i.e.* by a total of 58.5% during the period. A major change that has occurred is the significant increase in trade activity with Mexico, whose share of U.S. exports has increased from 21.5% in 2004 to 34.5% in 2014. The U.S. exports large amounts of flat steel to Mexico to meet the demands of a growing automotive industry in that country. At the same time, the EU and Asia have seen their shares of U.S. exports decline during the period (Figure 10).

The composition of products exported by the U.S. has remained relatively stable during the period. Galvanised sheets as well as pipes and tubes are currently playing a somewhat larger role in U.S. exports compared to 2004, while the shares of most other product categories have declined slightly.

**Figure 10. United States steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends.

Source: Iron and Steel Statistics Bureau (ISSB).



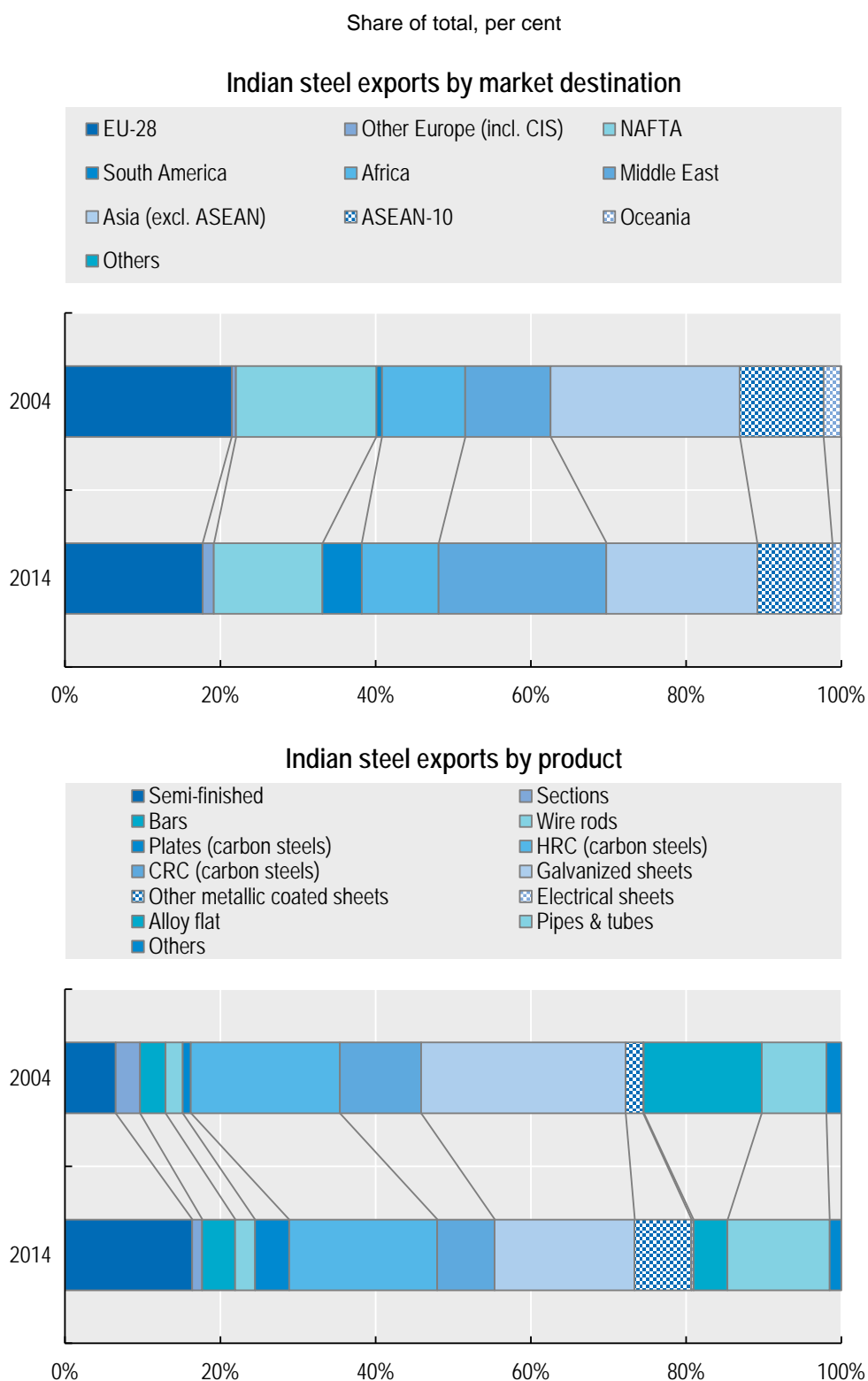
***India: Trade balance moves into surplus***

India has recently surpassed Brazil to become the world's tenth largest exporter of steel. Between 2004 and 2014, Indian exports increased by a total of 89.6%, reaching a level of 9.8 mmt in 2014. The country's steel trade balance (in volume terms) thus moved into surplus for the first time since 2006.

India's main export products are hot-rolled coils and galvanised sheets (Figure 11). Although the export share of the former product group remained steady between 2004 and 2014, in more recent years exports of hot rolled coil have become important for India; India now accounts for approximately 3% of the world's exports of hot-rolled sheets and strips. Semi-finished steel as well as pipes and tubes are the next largest export products supplied by India, though quantities of these exports are still comparatively low in international comparison.

India is relatively diversified with regard to its export markets. Africa, ASEAN, the EU, and the Middle East each account for 10-20% of India's exports. A noticeable development has been the increase of the Middle East as an export destination for Indian steel producers. Indian steelmakers are looking to build steel plants in foreign markets, including the Middle East. Approximately 19% of India's exports are sent to other Asian countries (excluding ASEAN) while 19.0% are destined for the Americas (NAFTA and Latin America).

**Figure 11. Indian steel exports by market destination and product, 2004 and 2014**



Notes: The export destinations and products are represented in the graphs in the horizontal order shown in the legends. "Other Europe" includes the CIS in this chart.

Source: Iron and Steel Statistics Bureau (ISSB).

## Steel trade and comparative advantage

Steel trade is determined to a large extent by the comparative advantage of steel producers. In 1965, Bela Balassa introduced the notion of “Revealed Comparative Advantage” (RCA) as a way to reveal or approximate comparative advantage by examining the relative trade performances of individual countries, particularly with respect to commodities. Barring production or export subsidies, the stronger an economy’s relative trade performance in a given good, the greater the comparative advantage that country has in the good’s production.

Balassa proposed an RCA index which measures an economy’s export share of each commodity compared with the world export shares of that commodity.<sup>4</sup> This measure can be applied to steel by calculating the ratio of the share of a given steel product group in an economy’s total steel exports to the share of that product group in world steel exports. In effect, the steel product-specific RCA measure provides information not only on an economy’s specialisation in a given steel product relative to the rest of the world, but also sheds light on diversification patterns *across* steel products within that economy. If  $x_{k,i}$  is exports of steel product group  $i$  from country  $k$ , then the revealed comparative advantage index is:

$$RCA_{k,i}^* = \frac{x_{k,i} / \sum_i x_{k,i}}{x_{w,i} / \sum_i x_{w,i}}$$

where the subscript  $w$  refers to world exports. RCA index values greater than one for a given product  $i$  indicate that an economy has a revealed comparative advantage in the exports of that product (*i.e.*, the share of that product in the economy’s total exports is higher than the corresponding share at the world level). Values less than one suggest a comparative disadvantage in the export of a given product. In the trade literature, Balassa’s RCA indicator is also often used to empirically identify specialisation patterns.

The steel-specific RCA indices are also useful for identifying diversification across steel products within a given economy. As will be shown below, an example of this can be seen in the comparison of the Russian Federation’s RCA indices with those of the United States. The former has an extremely high RCA index value for semi-finished steel (greater than 4), but relatively low RCA values (below 1) for most other products. The United States, on the other hand, has RCA values near or greater than 1 (but less than 2) for a number of products. This is an indication of greater diversification within the United States relative to the Russian Federation.

An important caveat to bear in mind is that RCA values do not indicate a country’s true comparative advantage when the market is affected by trade distortions. When trade is distorted, then policies and government interventions can lead to an RCA value indicative of comparative advantage, when no such comparative advantage actually exists. Nevertheless, RCA indicators can be a useful starting point when considering the factors that cause observed trade patterns, whether they be true cost advantages or government policies.

Another factor to bear in mind when analysing RCA indices is the role of trade in value added. An OECD publication released in 2013, *Interconnected Economies: Benefiting from Global Value Chains*, shows that revealed comparative advantages measured in value-added terms can differ from those measured in gross terms.<sup>5</sup> This work shows that, in industries that have significant trade in intermediate goods, it is important to identify comparative advantage in terms of value added. This may also be the case, to some extent, in the steel industry, where producers in some economies import raw materials or semi-finished steel and transform these into downstream products in specialised rolling mills. Often, however, steel production is relatively “integrated” with producers involved in most of the production steps.

RCA indices (in gross terms) are calculated for the world's ten largest steel exporters for 12 product groups, namely *i*) semi-finished products, *ii*) sections, *iii*) bars, *iv*) wire rods, *v*) plates (carbon), *vi*) hot-rolled sheets and strips (carbon), *vii*) cold-rolled sheets and strips (carbon), *viii*) galvanised sheets, *ix*) other metallic coated sheets, *x*) electrical sheets, *xi*) alloy flat steels, and *xii*) pipes and tubes. The ordering is, roughly speaking, an indication of the production value chain, from lower to higher value-added steel products. The calculated RCAs for 2014 and 2004 are presented in Figure 12, to provide an indication not only of current specialisation but also how that specialisation has changed over the last decade.

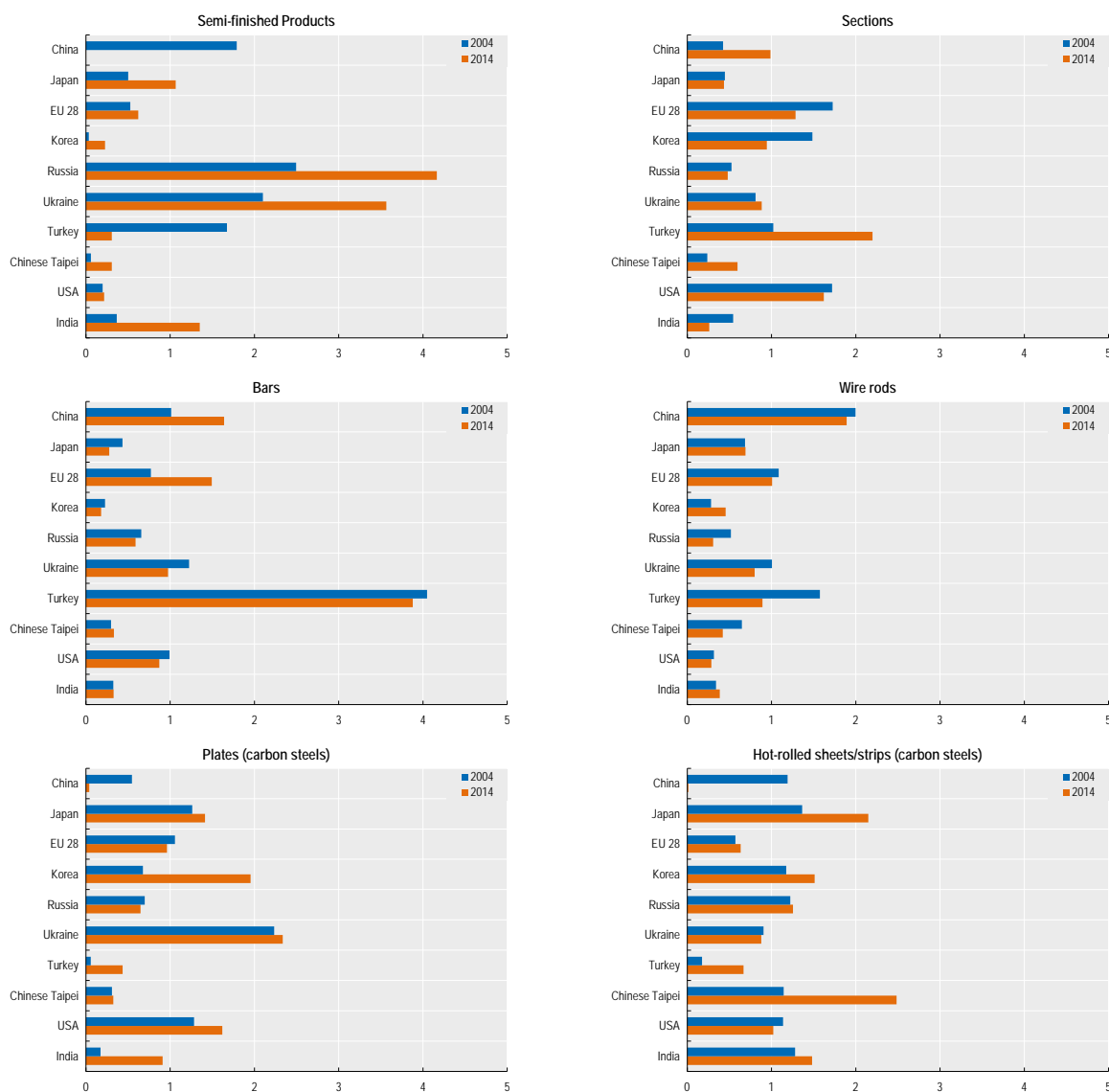
Several broad conclusions can be drawn from the calculated RCA data:

- **Semi-finished steel products:** Ukraine and Russia are, by far, the most specialised in semi-finished steel products, with RCA values greater than three. These products are shipped to downstream facilities that roll the products into final steel products for consuming industries. Russia's and Ukraine's specialisation in these products has increased significantly over the past five years.
- **Sections:** Steel sections are typical long products and are used in a wide range of applications, including architectural and civil engineering uses, as construction materials for housing, high rise buildings and large bridges, as well as in ships and certain industrial machinery applications. Turkey, the United States and the EU are quite focussed on exports of sections, but China and Ukraine have also become increasingly focussed on these exports over the last decade.
- **Steel bars:** Within the long products group, bars are the most exported product. Bars are rod-shaped steel products that are used primarily for concrete reinforcement. Their production usually takes place in electric-arc furnaces. Turkey is by far the most specialised in bars, with an RCA index of approximately four. China's and the EU's RCA indices have also been edging upwards in recent years, and thus bars have become a slightly more important export item for these economies.
- **Wire rods:** Wire rods come in many different varieties and their classification is quite complicated. These products are turned into different kinds of wires and cords and sometimes undergo further processing to manufacture nails, bolts, metal nets and wire ropes. China is the only top-10 steel exporter that has a revealed comparative advantage in the export of wire rods in 2014, though the EU has an RCA close to unity.
- **Plates:** These are relatively high value added and heavy rolled steel products that are used in shipbuilding, but also in some construction and industrial machinery applications. Japan, Korea, Ukraine and the United States have a revealed comparative advantage in plate exports, and their RCA indices have increased over the last ten years. China is an interesting case, as its RCA has plummeted to nearly zero. This has occurred in conjunction with significant RCA increases in higher value-added flat products, such as metallic coated sheets and alloy flat steels.
- **Hot-rolled steel sheets and strips:** Steel sheets and strips are the most commonly used steel products, with global exports of these products amounting to approximately 56 mmt in 2013. Steel sheets are used as inputs in the manufacture of cars, home appliances, and some construction materials. Japan and Chinese Taipei are the most focussed on the export of these products, with RCA values greater than two. These economies have seen their specialisation increase significantly in this product area since 2004.

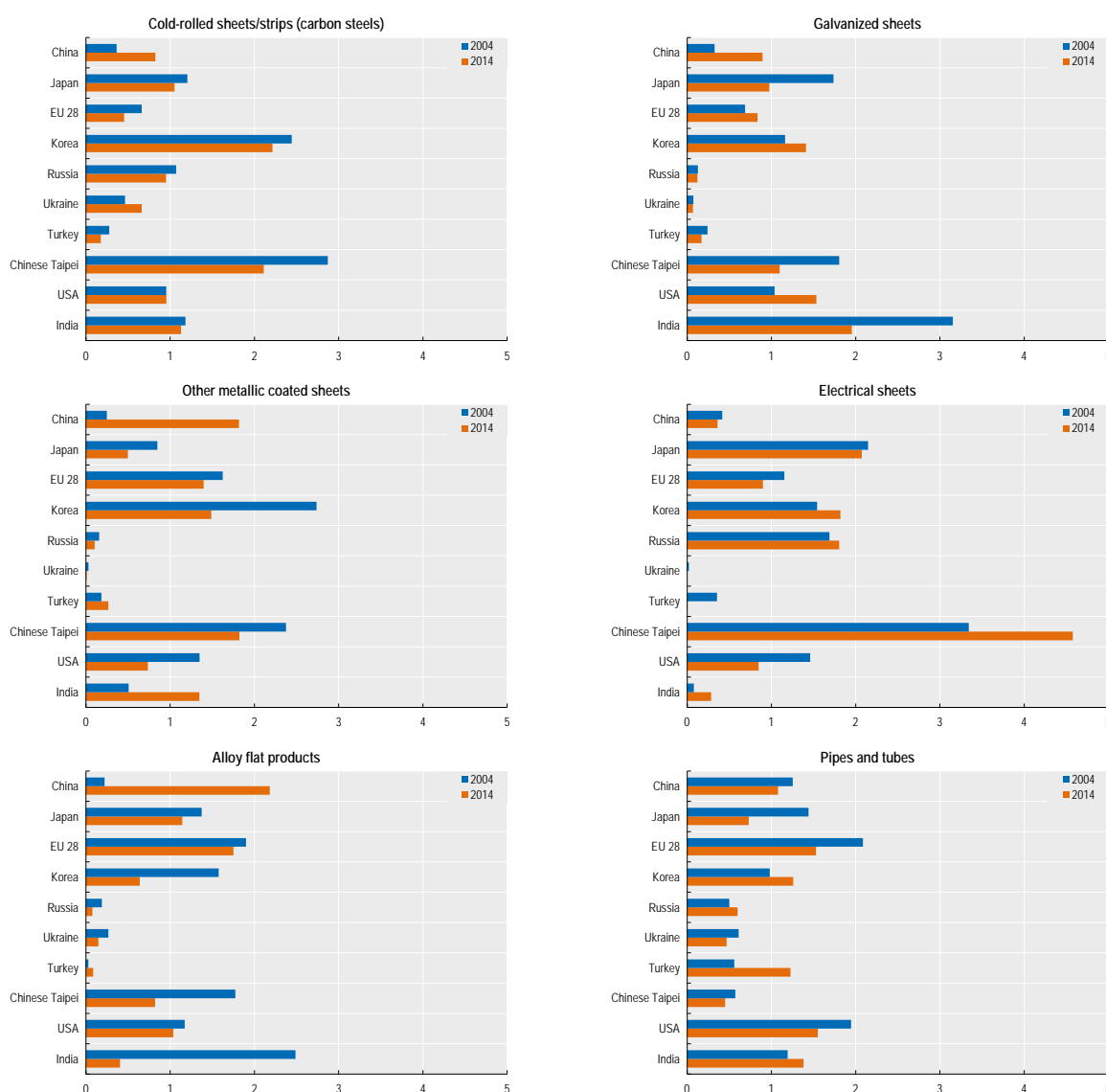
- **Cold-rolled sheets and strips:** Cold-rolled sheets are made from hot-rolled sheets that have been “pickled” (passed through a hydrochloric acid bath to chemically remove scale) and that have been cold rolled and annealed. These are higher valued products because they offer a smoother and cleaner surface than hot-rolled sheets and the steel is more formable. Korea and Chinese Taipei have strong revealed comparative advantages in this product category.
- **Galvanised sheets:** Galvanised sheets are hot- or cold-rolled steel sheets that have been immersed in molten zinc to galvanise them. These sheets are used widely as a basic material for transformation into coated steel sheets and for interiors and exteriors of buildings, cars, and electrical equipment. India, Korea, the United States and Chinese Taipei are relatively specialised in this product. Japan has, however, seen its RCA value decline considerably in the last ten years. China has become more specialised in galvanised sheets, though still does not have a revealed comparative advantage in this segment.
- **Other metallic coated sheets:** These include products such as laminated and pre-painted sheets used in a number of construction applications, some steel furniture and electrical appliances. The world unit value of these products averaged more than USD 1,000 per tonne in 2013 (compared to USD 623 for hot-rolled sheets and strips). China, the EU, India, Korea and Chinese Taipei have comparatively high RCA index values within this product group. China’s and India’s revealed comparative advantage indices have increased significantly since 2004, whereas many other economies have witnessed declining RCA values.
- **Electrical sheets:** Electrical sheets are a variety of cold-rolled sheets that contain silicon and other additives to enhance their magnetic properties. This product can be divided into non-oriented and grain-oriented electrical sheet, according to the product’s magnetic orientation. Non-oriented electrical sheet, whose magnetic properties are uniformly oriented in all directions, is used for the magnetic cores of electrical generators and appliance motors. Grain-oriented electrical sheets exhibit superior magnetic properties along their rolling direction and are used in transformers. Chinese Taipei is extremely specialised in this high value-added product. Japan, Korea, and Russia are less, but still relatively specialised in this product, too. Chinese Taipei’s RCA has increased the most since 2004. The EU and the United States used to be somewhat specialised in this area, but their RCA values have declined since 2004.
- **Alloy flat steels:** These are mainly stainless steel flat products, which, given their corrosion resistance and other favourable properties, are used in many household goods, home appliances, precision devices, construction and civil engineering, car parts and in some chemical plants. These are also high-value products; the world unit export value stood at almost USD 1 500 per tonne in 2013. The EU, Japan and the United States have traditionally been strong in this area, but their RCA values have declined slightly. Since 2004, China’s specialisation has increased very strongly; today, China has the highest revealed comparative advantage in alloy flat steel products (of the top ten steel exporting economies).
- **Pipes and tubes:** The main products in this category are welded and seamless pipes. These products are used for a variety of purposes, including in architectural applications, civil engineering, pipelines, line pipes for oil and gas, and oil drilling. Seamless pipes, in particular, are valued quite highly. Many economies specialise in this segment; China, the EU, Korea, Turkey and the United States are quite specialised in this area, with RCA indices higher than one. Turkey and India have seen their specialisation increase in the past ten years.

**Figure 12. Revealed comparative advantage (RCA) index values by economy and steel product group**

Values greater than 1 suggest comparative advantage while values less than 1 indicate comparative disadvantage



## The structure of steel exports: Changes in specialisation and the role of innovation



Sources: Secretariat calculations based on data from the Iron and Steel Statistics Bureau (ISSB) and the United Nations Commodity Trade Statistics Database.

### Does innovation help explain export specialisation?

In general, steel producers in a given country will specialise in those products in which they have a comparative advantage. Balassa's (1965) measure of revealed comparative advantage shown in the previous section reflects the success of steel-exporting countries relative to the worldwide norm, but should not be interpreted as resulting entirely from true competitive advantage. That is, exports can result from subsidies, tax incentives, exchange rate misalignments, and numerous other policies, which can alter the price competitiveness of the industry and thus determine an economy's revealed comparative advantage in a given product.<sup>6</sup>

One way to move up the value chain in steel production and exports is through innovation, both in terms of the characteristics of the products and in terms of production processes. This is of relevance for trade in steel, because firms that can climb the value chain and move away from producing commoditised

products should not have to compete so much based on price. For example, between 2008 and 2009, when global steel demand contracted sharply, Japan experienced a much smaller percentage drop in steel exports compared to many other exporting economies. It seems likely that Japan was less exposed to demand fluctuations in the rest of the world because it was producing higher value-added goods. In short, innovation should help firms preserve and gain market share.

However, measuring innovation is not a trivial exercise. Because it is a multidimensional concept, there is no single indicator that can capture innovation well. Patents are a key component of firms' knowledge-based assets and are one potential indicator of innovation (OECD, 2013).<sup>7</sup> Moreover, the structure of classifications used in patent data lends itself to the identification of innovation in relatively narrow fields.<sup>8</sup> In addition, patent applications contain rich information on the applicants, the inventors, as well as data which can be used to measure the quality of the inventions (i.e. citation data, office(s) of application, etc.). For example, Squicciarini, Dernis and Criscuolo (2013) provide a detailed discussion about measures of patent quality and explain the debate on the potential links between patents and innovation.<sup>9</sup>

Nonetheless it should be emphasised that patents only capture 'technological' innovation. OECD (2010) provides an overview of alternative indicators of innovation,<sup>10</sup> including investment in all forms of knowledge-based capital, including organisational capital, trademarks, design, etc. The *OECD Innovation Strategy 2015* (OECD 2015) has emphasised the importance of such measures when assessing the relationship between innovation and economic performance. In addition, even within the domain of technological innovation, firms may choose to adopt alternative strategies to capture the rents from innovation, although the metals sector has amongst the highest propensities to patent.<sup>11</sup>

Bearing these qualifications in mind, Figure 13 displays the economies that have patented the most in four process areas, namely, sections, cold-rolled (long and flat steel), galvanised and alloy steel. These four groups are roughly in order of their value added in the production chain. Japan and Germany seem to patent the most in all product groups, but Korea, some European countries, the U.S. and China also patent actively in these processes.<sup>12</sup> Figure 13 also suggests that there is relatively little patenting activity in low value-added steel activity (sections and cold-rolled products) compared to higher value-added activity (galvanised and alloy steel). Because it can be problematic to compare patent levels across technologies, the changes in patents during the 2002 to 2012 period were also calculated; they show that the patent stock for low value-added steels declined for the ten exporting countries while those for higher value-added steels increased significantly. Thus, emerging technologies appear more relevant for galvanised and alloy steel production.<sup>13</sup>

To see whether there is a link between innovation and a country's revealed comparative advantage in steel exports, *revealed technological advantage* (RTA) indices (which are similar in concept to the revealed comparative advantage indices, but applied to patents instead of exports) were calculated and compared to a country's specialisation in steel trade. RTAs for steel are defined as the share of an economy's patents in a particular steelmaking process (e.g., sections or cold-rolled steelmaking) relative to the share of total steel patents in that economy, i.e.:

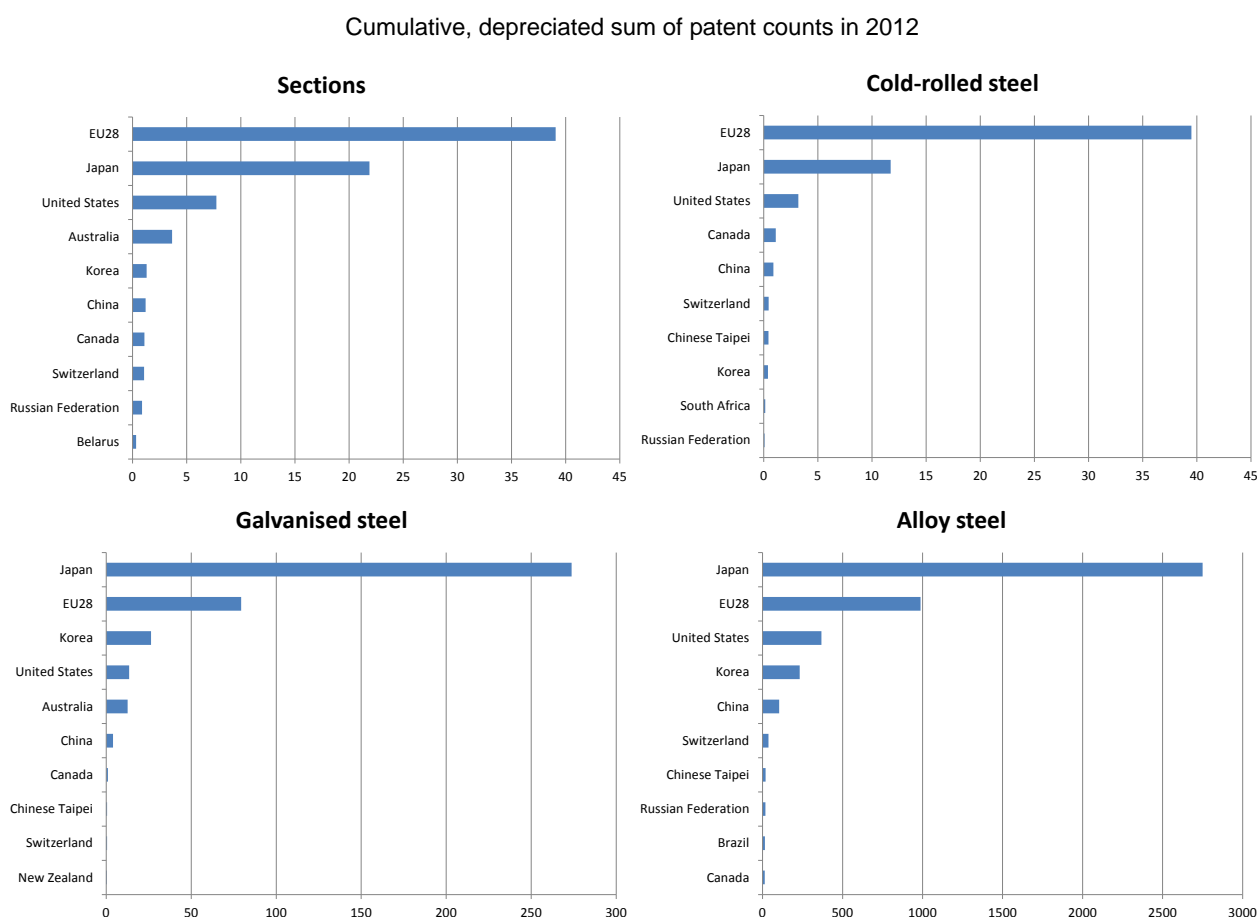
$$RTA_{k,i}^* = \frac{x_{k,i} / \sum_i x_{k,i}}{x_{w,i} / \sum_i x_{w,i}}$$

where  $x_{k,i}$  is the patent stock of steel process  $i$  in country  $k$  and the subscript  $w$  refers to the world. The patent stock is calculated as the cumulative sum of the depreciated yearly patent count, discounted at a 15% rate of depreciation rate per year.<sup>14</sup> The index is equal to zero when the economy has no patents in a given field, is equal to 1 when the economy's patent share for a given process equals the worldwide share, and is



greater than 1 when a country's share of patent activity in a given process is higher than the corresponding world share. The index is calculated using patent applications filed under the Patent Cooperation Treaty (PCT). The patent data are drawn from the OECD Patent Database and the relevant codes for steel products and steelmaking technologies are identified using the stepwise approach described in DSTI/SU/SC(2015)5.

**Figure 13. Economies with the most patents in four steelmaking processes (sections, cold-rolled steel, galvanised steel and alloy steel)**



Source: OECD.

Figure 14 plots the RTA values against the RCA values for the ten largest steel-exporting economies, with respect to the four aforementioned product groups. Interestingly, there is a negative correlation between patent specialisation and trade specialisation in lower value-added activities, but there is a positive correlation for higher value-added steel products. The negative correlation in the low-value added segments indicates that determinants other than knowledge-based assets play an important role in explaining the competitiveness and export shares of firms producing lower value-added steel products, or the opportunity cost of inventing and patenting in these areas might just be too high. Although this may result in lower profit margins in sections and cold-rolled steel compared to those existing in higher value-added steel production, firms that produce lower value-added products can still achieve profits by producing and selling large quantities of output.

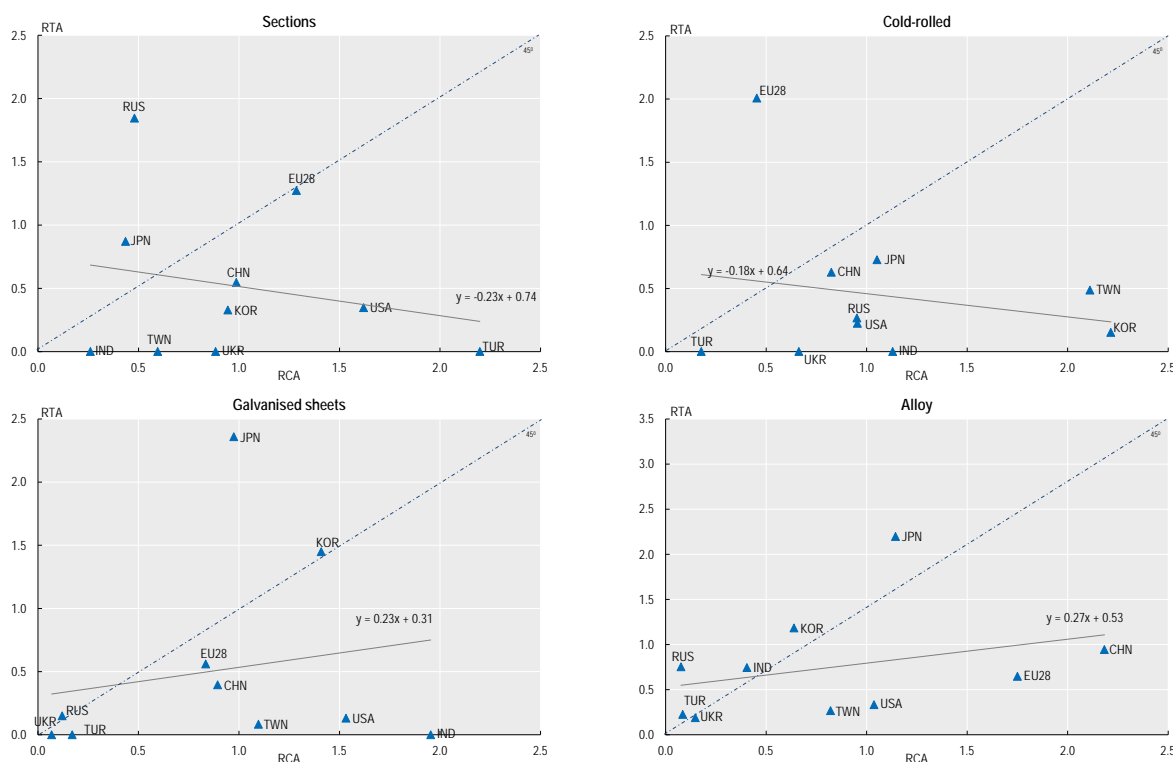
**Table 2. RCAs and RTAs: Correlation coefficients**

	Sections	Cold-rolled	Galvanized sheets	Alloy flat
Correlation coefficient	-0.217	-0.198	0.184	0.313

Source: OECD

On the other hand, patent specialisation in the higher value-added segments of galvanised and alloy steel is positively correlated with export specialisation in those areas (Table 2).<sup>15</sup> Firms that invest in knowledge-based assets in these areas might be doing so in order to differentiate their products and/or raise quality (through process innovations), which in turn helps them achieve higher export market shares as well as profit margins in their production segments. These are also higher-growth segments, with for example world demand for galvanised steel growing considerably faster than corresponding demand for sections and cold-rolled steel over the past decade.<sup>16</sup> Investment in knowledge-based assets, as indicated by patent specialisation, might explain why recent anecdotal evidence suggests that exporters of higher value-added steel products performed better than exporters of commodity steel products during the financial crisis of 2008-2009. An avenue for further research would be to investigate price and income elasticities for steel exporters to determine empirically whether firms that climb the value chain and move away from producing commoditised products are in fact less exposed to demand fluctuations in the rest of the world.

**Figure 14. Revealed technological advantage (RTA) and revealed comparative advantage (RCA) for the 10 largest steel-exporting economies in four segments**



Note: Data on RTAs is calculated using the cumulative, depreciated sum of patent counts in 2012. Data on RCAs refer to 2014.

Source: OECD.

## **Concluding remarks**

Steel exporters have experienced significant change in their export structures over the past few years. Many emerging economies have experienced strong growth in steel demand, which has required large import volumes of steel products to meet infrastructure and industrial development needs. The Middle East, the ASEAN region and Africa, for example, have traditionally been significant net importers of steel. But, domestic and foreign steelmakers are now investing in new production facilities in many of these economies, a trend that is expected to change global trade patterns in the coming years. Steel producers in regions such as South America, which previously was a net exporter of steel, are now facing the challenge of adjusting to lower market shares in their major export markets.

Export specialisation patterns are also changing, as steel producers in some emerging economies move up the value chain and begin exporting more sophisticated steel products. This move should help shield these exporters from swings in demand and prices in the future, as cyclical fluctuations tend to affect commoditised products such as hot-rolled coils more than differentiated products. In some developed economies, export opportunities have been found for products that meet growing demand in neighbouring regions whose economies are developing rapidly, even when such products are lower in value-added.

Looking ahead, one possible area of further study would be to identify the policy and market factors that explain export patterns and revealed comparative advantages across major steel-producing economies. It would also be useful to link export developments and trade specialisation patterns to developments in steelmaking capacity. The policy relevance of this would be in terms of identifying areas where policies are leading to trade distortions and creating export-related adjustment challenges for steelmakers around the world.

## NOTES

- <sup>1</sup> India entered the group of the largest ten steel exporters in 2013, and now exports almost as much as the United States.
- <sup>2</sup> Readers should note that EU data for 2004 as shown in the charts refer to the EU-25. Data for 2014 are EU-28.
- <sup>3</sup> Japanese and Korean companies are investing in facilities in Southeast Asia to supply automotive sheet steel to a growing number of vehicle manufacturers, particularly in Indonesia and Thailand.
- <sup>4</sup> See Balassa, B. (1965), *Trade Liberalization and "Revealed" Comparative Advantage*, The Manchester School of Economic and Social Studies, 33, pp. 99-123.
- <sup>5</sup> See OECD (2013), *Interconnected Economies: Benefiting from Global Value Chains*, OECD Publishing. doi: 10.1787/9789264189560-en.
- <sup>6</sup> Siggell (2007), "International Competitiveness and Comparative Advantage: A Survey and a Proposal for Measurement," Center for Economic Studies and Ifo Institute, available at: [https://www.cesifo-group.de/portal/pls/portal/!PORTAL.wwpob\\_page.show? docname=956160.PDF](https://www.cesifo-group.de/portal/pls/portal/!PORTAL.wwpob_page.show? docname=956160.PDF).
- <sup>7</sup> OECD (2013), *Supporting Investment in Knowledge Capital, Growth and Innovation*, OECD Publishing. <http://dx.doi.org/10.1787/9789264193307-en>.
- <sup>8</sup> Hascic, I, N. Johnstone and J. Silva (2015) "The Use of Patent Statistics for International Comparisons and Analysis of Narrow Technological Fields" STI Working Paper (forthcoming).
- <sup>9</sup> Squicciarini, M., H. Dernis and C. Criscuolo (2013), "Measuring Patent Quality: Indicators of Technological and Economic Value", OECD Science, Technology and Industry Working Papers, No. 2013/03, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5k4522wkw1r8-en>.
- <sup>10</sup> OECD (2010), *Measuring Innovation: A New Perspective*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264059474-en>.
- <sup>11</sup> See, for example, <http://pascal.iseg.utl.pt/~depeco/wp/wp092013.pdf>.
- <sup>12</sup> However, these figures do not show the relative patent specialisation of a country; Japan patents a lot in the area of sections compared to other countries, but it patents relatively little in sections compared to what it patents in processes for higher value-added galvanised and alloy steel.
- <sup>13</sup> For the ten major steel exporting economies studied in this paper, the patent stock for sections declined by 10% during 2002-2012 and by 30% for cold-rolled steel. In contrast, the patent stock increased by 410% for galvanised steel and by 121% for alloy steel during the same time period.
- <sup>14</sup> This is the standard depreciation rate used in patent studies. For more details, see Hall et al. (2005), "Market Value and Patent Citations", *Rand Journal of Economics*, Vol. 36, No. 1.
- <sup>15</sup> This is not to say that there is causality. It is likely that there is two-way causality in the relationship, with innovation explaining trade specialisation and vice versa.

- <sup>16</sup> The compound annual demand growth rate between 2000 and 2012 for galvanized steel amounted to 4.1%, compared to 3.2% demand growth for sections and 2.8% in the cold-rolled segment according to World Steel Dynamics (2014), Global Steel Mill Product Matrix, Core Report X, Englewood Cliffs, New Jersey.

## ANNEX: STEEL EXPORTS BY PRODUCT AND MARKET DESTINATION, % SHARES OF TOTAL EXPORTS

### China

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	6.2	0.2	0.3	12.7	0.5	1.9	2.0	48.0	27.6	0.6	0.0	100.0		
2014	6.5	1.5	2.3	5.5	9.2	7.3	9.9	28.6	28.5	0.8	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	32.0	2.5	10.2	13.0	3.3	17.9	3.2	2.7	1.1	0.5	1.4	8.7	3.6	100.0
2014	0.0	4.9	21.3	12.5	0.2	0.2	5.4	8.3	9.9	0.3	23.6	10.3	3.3	100.0

### Japan

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	1.3	0.7	1.0	6.3	0.8	0.9	2.8	59.8	24.7	1.6	0.0	100.0		
2014	0.7	0.7	0.4	9.9	3.0	2.7	4.3	46.7	30.8	0.8	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	9.0	2.6	4.4	4.5	7.6	20.5	10.6	14.5	3.7	2.5	8.4	10.0	1.7	100.0
2014	12.9	2.1	3.6	4.6	6.8	27.7	6.9	9.0	2.7	2.0	12.3	6.9	2.4	100.0

### European Union

	EU-28	Other Europe (incl. CIS)	CIS	NAFTA	South America	Africa	Middle East	Asia (incl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	-	28.9	-	24.3	3.7	9.8	13.8	18.1	-	0.8	0.6	100.0		
2014	-	30.8	-	24.1	4.1	22.2	4.7	13.3	-	0.6	0.2	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	9.4	10.0	7.8	7.1	6.4	8.6	5.9	5.8	7.1	1.3	11.6	14.5	4.6	100.0
2014	11.1	7.4	15.0	6.6	5.8	9.5	4.0	7.0	6.1	1.0	10.7	10.7	5.0	100.0

### Korea

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	3.4	0.4	0.2	14.3	1.0	0.7	6.5	55.9	15.4	2.1	0.0	100.0		
2014	5.5	1.8	1.1	23.9	2.3	0.9	5.7	37.1	20.5	1.2	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	0.6	8.6	2.3	1.8	4.1	17.6	21.6	9.7	12.0	1.8	9.6	6.8	3.4	100.0
2014	2.7	4.7	2.3	3.0	9.4	19.5	14.5	13.0	8.1	1.7	6.9	12.0	2.2	100.0

### Russia

	EU-28	Other Europe (incl. CIS)	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	22.4	14.4	-	9.8	1.4	2.8	11.6	29.1	8.4	0.0	0.0	100.0		
2014	22.7	36.5	-	13.8	1.9	5.5	4.9	13.0	1.7	0.0	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	44.6	3.0	6.6	3.4	4.2	18.4	9.5	1.1	0.7	1.9	1.2	3.5	2.0	100.0
2014	50.5	2.4	7.6	2.0	3.1	16.2	6.2	1.1	0.6	1.7	0.8	5.7	2.0	100.0

The structure of steel exports: Changes in specialisation and the role of innovation

Ukraine

	EU-28	Other Europe (incl. CIS)	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	17.1	22.8	-	3.6	2.6	13.0	14.7	15.6	10.7	0.0	0.0	100.0		
2014	28.5	31.5	-	1.6	0.8	18.0	14.0	3.0	2.5	0.0	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	37.5	4.7	12.3	6.6	13.5	13.6	4.1	0.6	0.1	0.0	1.6	4.3	1.1	100.0
2014	43.3	4.4	12.6	5.3	11.3	11.3	4.3	0.6	0.1	0.0	1.6	4.5	0.8	100.0

Turkey

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	29.2	0.9	0.6	17.9	1.5	10.0	31.3	6.8	1.6	0.0	0.2	100.0		
2014	15.7	0.7	3.4	16.7	8.8	16.8	35.0	0.7	1.0	0.1	1.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	29.9	5.9	40.8	10.3	0.3	2.6	2.4	2.0	0.8	0.4	0.2	3.9	0.4	100.0
2014	3.7	10.8	50.3	5.9	2.1	8.6	1.2	1.6	1.4	0.0	0.9	11.7	1.8	100.0

Chinese Taipei

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	3.6	0.1	0.3	10.6	0.4	0.2	1.7	61.1	20.0	2.0	0.0	100.0		
2014	6.4	0.9	0.4	13.3	1.8	1.5	3.9	35.2	32.5	4.2	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	1.1	1.4	3.0	4.2	1.9	17.2	25.4	15.1	10.4	3.8	10.8	4.0	1.7	100.0
2014	3.7	2.9	4.3	2.8	1.6	32.0	13.8	10.1	9.9	4.3	8.9	4.3	1.4	100.0

United States

	EU-28	Other Europe	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	3.8	0.1	0.1	86.4	2.7	0.8	0.6	4.6	0.8	0.1	0.0	100.0		
2014	2.8	0.2	0.2	87.6	4.4	0.7	0.8	2.7	0.6	0.2	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	3.6	9.9	10.0	2.1	7.8	17.1	8.4	8.7	5.9	1.7	7.2	13.6	4.2	100.0
2014	2.6	8.0	11.3	1.9	7.8	13.2	6.2	14.1	4.0	0.8	11.2	14.8	4.1	100.0

India

	EU-28	Other Europe (incl. CIS)	CIS	NAFTA	South America	Africa	Middle East	Asia (excl. ASEAN)	ASEAN 10	Oceania	Others	Total		
2004	21.5	0.6	0.0	18.1	0.7	10.7	11.0	24.4	10.8	2.2	0.1	100.0		
2014	17.7	1.4	0.0	14.0	5.1	9.9	21.6	19.4	9.7	1.1	0.0	100.0		
	Semi-finished	Sections	Bars	Wire rods	Plates (carbon steels)	HRC (carbon steels)	CRC (carbon steels)	Galvanized sheets	Other metallic coated sheets	Electrical sheets	Alloy flat	Pipes & tubes	Others	Total
2004	6.5	3.1	3.3	2.2	1.0	19.2	10.5	26.4	2.2	0.1	15.2	8.3	1.9	100.0
2014	16.4	1.3	4.3	2.5	4.4	19.1	7.4	18.0	7.3	0.3	4.4	13.2	1.5	100.0