OECD publishing

MEASURING DISTORTIONS IN INTERNATIONAL MARKETS

THE ROLLING-STOCK VALUE CHAIN

OECD TRADE
POLICY PAPER
February 2023 **n°267**

OECD
BETTER POLICIES FOR BETTER LIVES

Measuring Distortions in International Markets: The Rolling-Stock Value Chain

Government support to producers of rolling stock is raising concerns about possible market distortions and unfair competition. This report aims to quantify both the scale of government support and to identify the various ways in which governments have been supporting local rolling-stock producers at the expense of foreign competitors. Over the period 2016-20, governments provided about USD 5 billion to the sector, much of it in the form of government grants and income-tax concessions. While not quantified, discriminatory practices in government procurement and competition enforcement, forced technology transfers, as well as non-market export credits may have also distorted global competition in the rail-supply industry. Similar to earlier OECD studies of government support in the aluminium and semiconductor value chains, this report helps shed light on the magnitude and ways in which governments subsidise the producers of materials and equipment they view as strategic, with a view to informing efforts to revisit global trade rules.

Key words: Rail; signalling; subsidies; procurement; competition; trade

JEL codes: F13, F23, H25, H81, L52, L62, O25

Acknowledgements

The present report was written by Ida Vangsgaard Christensen, Yuki Matsumoto, Chloé Papazian, and Jehan Sauvage, working under the supervision of David Drysdale. Christian Steidl contributed additional research. The report also benefitted from the helpful comments and suggestions of (OECD unless specified otherwise) Gianpiero Mattera, Julia Nielson, and Silvia Sorescu.

The authors would like to thank Jacqueline Maher for formatting this document and preparing it for publication. The OECD is also grateful for the helpful comments and feedback that delegations and government officials provided throughout the preparation of this report.

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Abbreviations

AVE	Alta Velocidad Española
BEMU	Battery electric multiple units
BRI	Belt and Road Initiative
CDB	China Development Bank
CIRR	Commercial Interest Reference Rates
CRRC	China Railway Rolling Stock Corporation
CRSC	China Railway Signal & Communication Corporation
EMU	Electric multiple units
GPA	Government Procurement Agreement
HS	High speed
HVAC	Heating, ventilation, and air conditioning
ITF	International Transport Forum
LCR	Local-content requirement
MENA	Middle East and North Africa
PTA	Preferential trade agreement
SASAC	State-owned Assets Supervision and Administration Commission
SEC	US Securities and Exchange Commission
SOE	State-owned enterprise
SNCF	Société nationale des chemins de fer français
TGV	Train à grande vitesse
UNIFE	Union des Industries Ferroviaires Européennes
VHS	Very high speed

Executive Summary

While recent OECD work has greatly helped improve understanding of the scope and scale of government support in industrial sectors, knowledge gaps remain. The present report aims to fill some of these gaps by looking at government support in the rolling-stock value chain. The report documents not only traditional forms of support (i.e. grants, tax concessions, below-market borrowings, and government equity infusions) but also other policies potentially distorting the level playing field in the rolling-stock industry.

International trade and investment form important channels in the rolling-stock value chain through which companies compete for the provision of rolling stock, as well as related parts and equipment. While several OECD countries are both top exporters and importers of rolling stock and signalling equipment, other economies do not appear to import large amounts of said products. Besides purely economic factors affecting imports, notably the scale of domestic demand and production, countries may also have policies in place that hamper market access. Market-access restrictions on foreign competition can be a potent driver of support for local rolling-stock manufacturers.

Applied tariffs on rolling stock and signalling equipment are generally low and hence do not seem to constitute a major trade barrier in the rolling-stock industry. By contrast, other explicit (e.g. mandatory joint-venture requirements, non-transparent prior licensing requirements, or local-content requirements) and implicit policies, including standardisation, can have the effect of giving preference to domestic firms or incumbents in government procurement contracts and thus represent important barriers to market access.

In the past few years, the rolling-stock industry has witnessed significant consolidation through mergers and acquisitions, instances of bid rigging, as well as low-pricing strategies by bidders that might have been underpinned by government support. Rolling-stock manufacturers have also at times been required to transfer their technology to local, often state-owned, partners to access a foreign market. Competition and regulatory authorities have, in this regard, a key role to play in ensuring that effective competition in the market is not significantly impeded.

Relying on a sample of 22 firms, whose combined revenue represented more than 70% of the global rolling-stock market in 2020, the OECD has found these companies to have received about USD 5 billion over the period 2016-20 in government grants (34%), tax concessions (54%), and below-market borrowings (12%). The People's Republic of China's (hereafter "China") state-owned rolling stock manufacturer, CRRC, alone obtained almost 60% of all the below-market borrowings that this study has identified and quantified. Below-market funding for rolling stock customers in the form of export credits at non-market rates has also raised concerns as it may represent another important other channel of support for the industry, although information remains scarce about individual transactions.

In sum, the range of tools employed to support domestic rolling-stock manufacturers is broad but does not always lend itself to quantification and economic analysis. The findings in this report should, nevertheless, help governments identify the main areas of concern, with a view to reforming trade rules and better disciplining distortive practices.

Recent work by the OECD has greatly helped improve understanding of the scope and scale of government support in industrial sectors but knowledge gaps remain. Although we now know considerably more about complex forms of support such as below-market finance (OECD, 2021[1]), a comprehensive picture of all support in industrial sectors has yet to emerge. The present report contributes to that goal by further expanding knowledge of government support in the rolling-stock value chain. This follows earlier sector studies that looked in detail at the value chains for aluminium (OECD, 2019[2]) and semiconductors (OECD, 2019[3]). As in the case of previous such studies, while sectoral in focus, the present report also provides broader insights about the nature of government support in industrial sectors more generally.

1. The scope of the rolling-stock industry

Rolling stock refers to the entire set of vehicles used for the transportation of people and goods by rail, whether such vehicles are self-propelled (e.g. locomotives) or not (e.g. coaches and freight cars). Rolling stock serves many different markets that can differ in their tonnage, the speed at which trains travel, and the distance over which they operate. High-speed (HS) and very-high-speed (VHS) trains[1] are perhaps the most prominent as they evoke pictures of Japan's *Shinkansen* and France's *Trains à Grande Vitesse* (TGV). Yet passenger transport includes many more market segments, spanning multiple units (regional and intercity trains), coaches, light rail vehicles (e.g. trams), metro vehicles, and automated systems (e.g. monorails). In addition to passenger transport, locomotives and freight cars are important market segments of the rolling-stock industry.

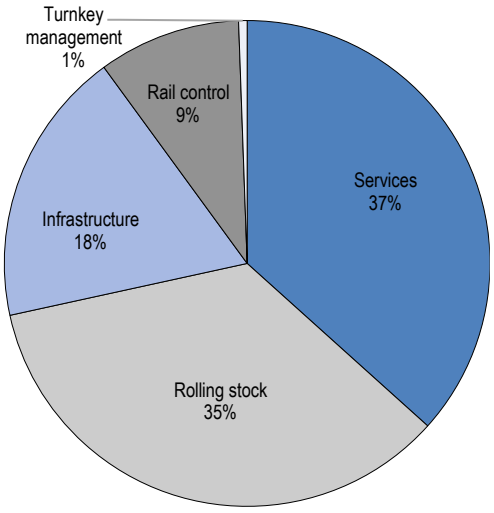
Rolling stock is only one part of the wider rail supply industry, which also comprises the provision of infrastructure (e.g. tracks and electrification), dedicated services (e.g. repair and maintenance of rolling stock), and rail control and signalling. The European Rail Industry association (UNIFE) estimated the global rail-supply market at about EUR 177 billion (USD 200 billion) annually over the period 2017-19 (UNIFE and Roland Berger GmbH, 2020[4]). Of this amount, rolling stock accounted for 35% and services another 37%, leaving infrastructure and rail control at 18% and 9%, respectively (Figure 1). A smaller segment of the market concerns the management of turnkey offers by integrator companies that oversee the development of rail projects and outsource work to contractors (or conduct specific tasks internally in the case of large rail-supply groups). Turnkey projects therefore combine the purchase of new equipment such as rolling stock and signalling hardware and the optional supply of dedicated services and maintenance.

It is in practice difficult to separate neatly the different segments of the rail-supply market, as the same companies are often involved at different stages of a rail project or provide bundled offers of equipment and services. As an example, Construcciones y Auxiliar de Ferrocarriles (CAF), a large Spanish producer of rolling stock, noted in its 2020 annual report that the supply of trains represented 44% of its total sales, while services (e.g. leasing and maintenance) represented 19% and civil construction, signalling, and engineering contract revenue constituted another 11%. Likewise, France's Alstom reported that rolling stock made up 52% of its total revenue in FY 2020, followed by services (20%), signalling (18%), and systems (i.e. turnkey offers, 10%). Accordingly, although the focus of this study is on the manufacture of rolling-stock, it will also cover to a lesser extent the supply of signalling and other products.

[1] Trains operating at 300 km/h or above are normally considered very-high-speed. The threshold for high-speed trains is 220 km/h.

Figure 1. Rolling stock accounted for 35% of the global rail-supply market in 2017-19

Global rail-supply market by segment, 2017-19



Note: Turnkey only includes here the management component but not the purchase of new equipment (e.g. rolling stock), which is counted under its dedicated segment.
Source: UNIFE and Roland Berger GmbH (2020[4]).

2. The industry landscape[2]

Beginning with the opening of the first steam-powered railway between Liverpool and Manchester in 1830, rail transport has been an important driver of industrialisation, growth, and economic integration. By enabling the faster transport of people and goods – initially coal and cotton for the most part – over greater tracts of land, railways lowered trade costs and fostered specialisation and economies of scale. The growth of rail was partly eclipsed in the 20th century with the advent of automobiles, lorries, and aeroplanes, but railways have remained an essential component of countries' transport systems (Wolmar, 2010[5]), either for passengers (e.g. in Europe) or freight (e.g. in the United States). Continued urbanisation, the rapid economic growth of emerging economies (especially of China), and a growing appetite for lower-carbon modes of transport is providing renewed impetus to the sector (Figure 2).[3]

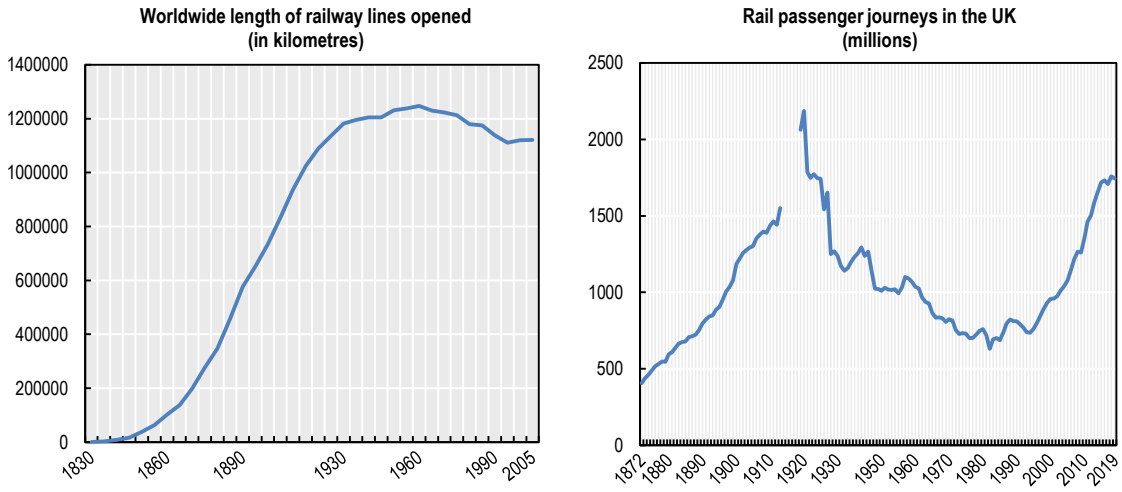
Rail transport hinges on heavy investments in long-lived infrastructure and equipment that make its deployment slow and complex. Siting decisions can arouse controversy with landowners and local residents, while laying the tracks generally involves heavy construction work to overcome natural obstacles (e.g. using tunnels and bridges). The decision by railway companies to purchase rolling stock also represents a significant commitment, as equipment is costly and can last more than 30 years. France's SNCF, the state-owned railway company, noted in its annual report for 2020 that its rolling stock operates for about 40 years, during which time it undergoes significant repair and maintenance. Importantly, the

[2] Given that the main concern of this report is government support benefitting producers of rolling stock, the following section only provides a brief overview of industry trends and characteristics. A more in-depth discussion of industry trends and market drivers can be found in (UNIFE and Roland Berger GmbH, 2020[4]) and (UIC, 2021[6]) among others.

[3] According to the IPCC's fifth assessment report, rail transport, waterborne transport, and buses emit the least amount of CO_2 per passenger-kilometre and per tonne-kilometre for freight (Sims et al., 2014[24]). A recent study of rail transport by the IEA confirms these findings, noting that "[t]he much lower carbon intensity of rail (per passenger- or tonne-kilometre) compared with most other modes of transport, means the rail sector already plays a key role in containing global GHG emissions" (IEA, 2019[8]). See also Lin et al. (2021[29]) in the case of China.

long life of rail equipment locks in technical specifications and standards for elements such as track gauge (i.e. the spacing between the two rails), signalling technologies, and electrification and safety systems. This in turn imposes constraints on future purchases of equipment that need to be compatible with older, pre-existing infrastructure.

Figure 2. Rail was partly eclipsed in the 20th century but is seeing renewed impetus



Source: left: Harvard Business School, *Railroad Length Density* (on the basis of international historical statistics from B.R. Mitchell; www.hbs.edu/businesshistory/courses/resources/historical-data-visualization/Pages/details.aspx?data_id=23, accessed on 8 December 2021); right: UK National Infrastructure Commission and UK Department for Transport (data are missing for the World War 1 period).

The global installed base of train tracks and rolling stock is largely concentrated in the Asia-Pacific[4], North America, and Western Europe. Of the 1.7 million km of train tracks that are currently installed worldwide, 72% are found in those three regions, with the Asia-Pacific alone accounting for 470 000 km (28% of the total) and North America 450 000 km (26%) (UNIFE and Roland Berger GmbH, 2020[4]). Less than half of those tracks are electrified and a significant share is devoted to freight transport. In HS and VHS rail specifically, China accounts for as much as 68% of the global 56 130 km of high-speed networks in commercial operation as of 2020 (UIC, 2021[6]), with much of it having been installed in recent years in the context of massive infrastructure investments by central and local authorities.[5]

The absolute length of tracks does not tell the whole story, however, given that countries vary in size and geography. Looking again at the specific example of HS and VHS networks, expressing the length of countries' high-speed networks relative to their land size shows that Korea, Japan, and Spain had the densest high-speed networks globally in 2020 (UIC, 2021[6]). China was in eighth position in the ranking after other European countries, namely Belgium, France, Germany, and Switzerland. Other than size, geographical features also play an important role in determining which countries are best positioned to develop extensive rail networks. Mountain ranges and large water bodies can pose major obstacles to railway development, forcing the construction of expensive infrastructure or diverting tracks to less direct routes. This has historically slowed railway expansion in certain parts of the world but not stopped it altogether, as evidenced by the perilous construction in the 19th century of mountain railways in places such as the Alps, India's Western Ghats, the American Sierra Nevada, and the Peruvian Andes (Wolmar, 2010[5]).

[4] This broad regional grouping includes India and other South Asian countries.

[5] The length of China's high-speed network was still only about 5 000 km in 2010 but had already grown to more than 20 000 km by 2015. These large investments were underpinned by a series of ambitious government plans, starting with the *Medium- and Long-Term Railway Plan* of 2004 and successive *Five-Year Railway Development Plans* (Lawrence, Bullock and Liu, 2019[25]).

2.1. The global installed base of rolling stock[6]

The global installed base of rolling stock logically follows the patterns observed for train tracks, although there are marked differences at the level of individual market segments. The Asia-Pacific and Europe largely dominate, for example, the HS and VHS segments, as North America has few such trains. The opening of high-speed lines in Morocco and Saudi Arabia effectively means that the MENA region had, as of 2020, a larger installed base of HS and VHS rolling stock than North America (UNIFE and Roland Berger GmbH, 2020[4]). Leading countries in Asia and Europe include China, France, Japan, and Korea. The segments of multiple units (regional and intercity trains) and coaches offer a similar picture, with the Asia-Pacific and Europe leading again in terms of the number of installed units of rolling stock. France, Germany, Italy, and the United Kingdom together account for about two-thirds of all multiple units in Western Europe (Ibid).

Unlike for passenger transport, North America, Eastern Europe, and Central Asia are the main users worldwide of rolling stock for freight transport. The Asia-Pacific is also again a significant actor in freight (Figure 3). Far from being a small segment, freight cars account for as much as 87% of the global installed base of all rolling stock (Ibid). Freight was originally the impetus for the invention of steam railways and it retains an essential role today. This is especially true for the mining industry in Australia, Brazil, Canada, the Russian Federation (hereafter "Russia"), and the United States, where trains enable the transport over large distances of iron ore, bauxite, coal, fertilisers, chemicals, and even crude oil in specialised tank cars (where pipelines are lacking). Besides mining, large shipments of grain also help explain why these countries dominate the freight segment. Research has found, for example, that more than 80% of the difference between Europe and the United States in the share of freight carried by railways could be ascribed to "natural or inherent differences, principally geography, shipment distance, and commodity mix" (Vassallo and Fagan, 2007[7]). This leaves less than 20% of the difference explained by policy factors and regulatory hurdles such as lack of cross-border interoperability across parts of Europe and the priority given to passenger service. The IEA (2019[8]) similarly notes that "[h]igh freight rail transport activity is normally related to the existence of large landlocked resources that can be effectively exploited if traded widely and often over long distances."

Countries' position in the freight market segment affects where they stand in the segments of locomotives and shunters.[7] Accordingly, the Asia-Pacific, North America, Russia, and Central Asia have the largest installed base of locomotives worldwide (UNIFE and Roland Berger GmbH, 2020[4]). This also explains why the majority of locomotives in operation still use diesel fuel rather than electricity, as train tracks connecting faraway mines to ports do not tend to be electrified.

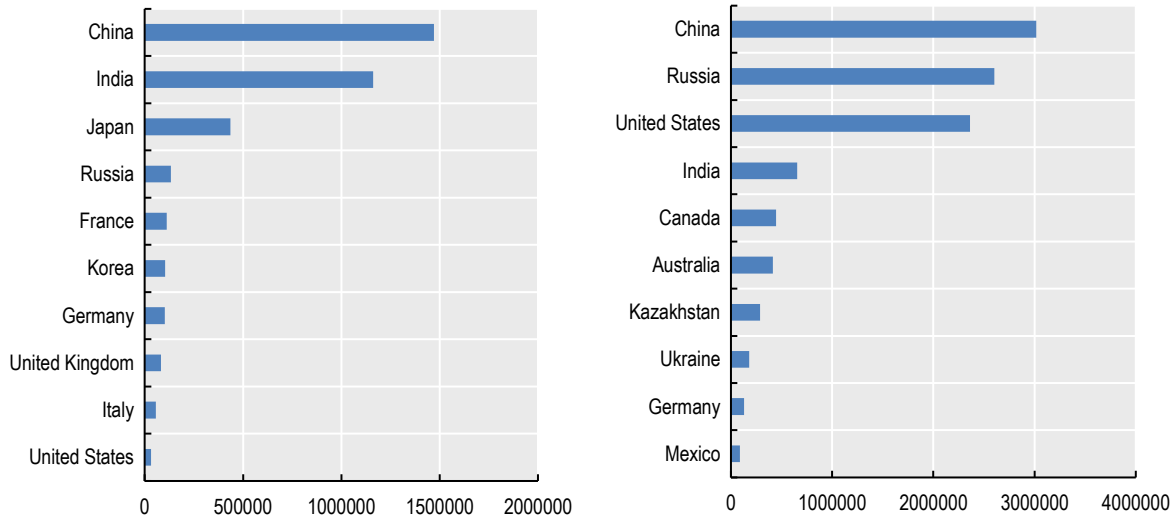
Another notable segment in the rolling-stock market is that of urban transit, which includes metros, light rail, and automated systems (e.g. monorails). Here again the Asia-Pacific and Europe top the rankings, with the former – especially China – possessing the largest installed base of metro vehicles, while Europe leads for light rail systems such as tramways (Ibid).

[6] This sub-section draws heavily on data obtained from UNIFE's 2020 *World Rail Market Study* (2020[4]). To the authors' knowledge, there are no other publicly available data sources covering the global rolling-stock market in its entirety.

[7] Shunters are self-propelled rail vehicles that are used for manoeuvring rolling stock in train yards, industrial sites, port facilities, and workshops.

Figure 3. Leading countries in the transportation by rail of passengers (left) and freight (right)

Left: Millions of passenger-kilometres, 2019
Right: Millions of tonnes-kilometres, 2019



Note: Data for Australia and India are for 2016 and 2017 respectively.
Source: International Transport Forum, OECD.

2.2. The demand for rolling stock and its drivers

The global rolling-stock market in 2020 is estimated at about USD 70-75 billion, dominated largely by the Asia-Pacific, Europe, and North America (Figure 4) (UNIFE and Roland Berger GmbH, 2020[4]). Demand from particular countries or railway companies evolves in fits and starts due to the discrete and infrequent nature of rolling-stock purchases. The long life of rail equipment implies that customers will not repeat orders every year, requiring rolling-stock manufacturers to spread their offer over a large customer base. This makes the rolling-stock market eminently international, as companies compete globally to win large contracts. Market access is therefore crucial, as will be discussed later in this report.

Like maritime vessels or commercial aircraft, the demand for rolling stock essentially derives from downstream demand for rail transport. Just as orders for shipyards evolve with expected future demand for sea transport, orders for trains follow expected demand for rail transport. The latter in turn depends on a complex set of interrelated factors, including intermodal competition in the broader transport market. Competition from other transport modes is a major factor affecting demand for rail transport (and thus rolling stock), although there are practical limits to intermodal substitutability. As noted by the OECD's International Transport Forum (ITF), "[m]ode shift is difficult to achieve at scale because rail services can only replace air travel on high-demand routes and over a limited distance" (ITF, 2021[9]). Similarly, in the freight market segment, "[a] significant share of road freight trips simply cannot shift to rail, not to mention intercontinental trade, which relies on sea transport and to a lesser degree on airfreight" (Ibid).

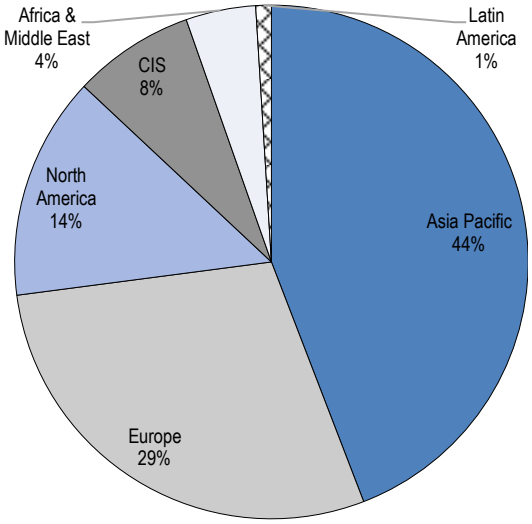
Other important drivers of demand for rolling stock include urbanisation, sustainability considerations (e.g. local air pollution and climate change), and, more directly, public and private investment in transport infrastructure. With several railway companies remaining in government hands, much of the market for passenger rolling stock involves bidding for public contracts issued by state enterprises.[8] Customers can be national in scope (e.g. Deutsche Bahn, SNCF, and Trenitalia), but also regional and even municipal in the case of urban-transit solutions. Japanese rolling-stock manufacturer Nippon Sharyo, for example, counts as customers its private parent, the Central Japan Railway Company (JR Central), but also the

[8] This report uses the phrase 'state enterprise' to refer to companies that are state-owned, -invested, or otherwise influenced by the state.

East Japan Railway Company (JR East), the West Japan Railway Company (JR West),[9] state-owned Tokyo Metro (the company operating Tokyo's metro network), and Nagoya Railroad, a private and local railway. In certain cases, state-owned railway companies have a near domestic monopsony such that they account for almost all purchases of rolling stock in the country. This is, for instance, the case of China Railway, which accounts for virtually all purchases of passenger rolling stock in mainland China, save for urban transit.[10]

Figure 4. The global demand for rolling stock is driven largely by the Asia-Pacific, Europe, and North America

Global rolling-stock market by region, 2017-19



Source: UNIFE and Roland Berger GmbH (2020[4]).

While the COVID-19 pandemic has disproportionately affected rail passenger transport (ITF, 2021[9]), many of the stimulus packages adopted by countries to support the recovery contain some amount of funding for the rail sector. As part of the American Rescue Plan Act of 2021, the US Federal Government has made "more than [USD] 1.69 billion available to the National Railroad Passenger Corporation (Amtrak) to provide relief from the impacts of COVID-19 […]."[11] Funding of USD 66 billion for passenger and freight rail is also available under the Infrastructure Investment and Jobs Act that was signed into law in November 2021.[12] Meanwhile, the European Commission approved in the summer of 2021, EUR 550 million in state aid to compensate Deutsche Bahn's subsidiary DB Fernverkehr AG for the revenue decline wrought by the pandemic.[13] It is also expected that the national plans put forth by Member States under the EU's Recovery and Resilience Facility will include some support for the rail sector.

[9] JR Central, JR East, and JR West form part of the Japan Railways Group (JR Group) of companies that was formed following the privatisation and breakup of the Japanese state-owned railways. All three companies are private and listed on Tokyo's stock exchange. They operate several sections of the *Shinkansen*, among other lines.

[10] A 2019 reform aims to end China Railway's monopoly on intercity rail, with new competitors that are for now owned by local governments. See www.straitstimes.com/asia/local-governments-on-track-to-smash-rail-monopoly (accessed on 8 September 2022).

[11] See www.transportation.gov/briefing-room/us-transportation-secretary-pete-buttigieg-announces-169-billion-amtrak-response (accessed on 8 September 2022).

[12] See https://transportation.house.gov/committee-activity/issue/infrastructure-investment-and-jobs-act (accessed on 8 September 2022).

[13] See https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4161 (accessed on 8 September 2022).

Freight offers a different picture, with the segment having, on the whole, withstood the pandemic better due to higher demand for goods and key commodities. This reflects the fact that demand for freight rail evolves generally in line with commodity cycles. In the United States – a key market for freight rail (Figure 3) – there has nevertheless been a decline in the number of rail freight carloads since 2007, a trend which is partly due to the decline of coal in US power generation and its replacement by natural gas.

While the discussion above has largely concerned the demand side of the rolling-stock market, the report will, in what follows, focus more on the supply side and the policies that affect it.

3. Key players in the rolling-stock value chain

The rolling-stock value chain is both short and complex. It is short, in the sense that there are fewer production stages involved in the manufacturing and delivery of rolling stock than there are in aircraft, cars, or semiconductors. Yet it is complex, in terms of the large number of suppliers that take part in the production of specific parts, components, and materials. Corporate structures vary greatly too, with companies differing in their degree of vertical or horizontal integration. Central to the value chain are the rolling-stock manufacturers themselves, which are the primary focus of this study.

3.1. Rolling-stock manufacturers

Looking at a global selection of key companies manufacturing rolling stock (Table 1) shows, unsurprisingly, that they tend to come from regions of the world that possess a relatively large installed base of train tracks and rolling stock. Spain, which has the densest HS network in Europe, counts, for example, two notable rolling-stock producers, namely CAF and Talgo. Both companies are largely focused on passenger transport, including in the HS segment known locally as *Alta Velocidad Española* (AVE). Likewise, several manufacturers are based in Japan (e.g. Hitachi and Nippon Sharyo), home to the world's first HS line,[14] while others operate from France, Germany, and Korea. Russian (e.g. Transmashholding) and US firms (e.g. Greenbrier and Trinity) have, meanwhile, a strong presence in the freight segment of rolling-stock manufacturing, which reflects these countries' stronger specialisation in fossil fuels and other commodities. Last but not least, China has both the largest installed base of rolling stock and is the largest manufacturer by a considerable margin. With nearly 25% of the global market, the China Railway Rolling Stock Corporation (CRRC), a central state enterprise under direct supervision of China's State-owned Assets Supervision and Administration Commission (SASAC), has a large presence in every segment, reflecting China's large and protected domestic market (see the next section). It is also the only large rolling-stock manufacturer to be state-owned and -controlled.

While rolling-stock manufacturers tend to be based in jurisdictions with a large home market, most companies are global in scope and usually bid for contracts worldwide. Their manufacturing operations are often globalised too, with a view to serving distant markets from closer locations. Policies certainly play a role in steering location decisions (see the discussion in the next two sections), but transport costs are also an important factor, given the difficulty and complexities of shipping rolling stock by sea.[15] US manufacturer Greenbrier operates, for example, freightcar-production facilities in Mexico, Poland, Romania, Türkiye, and the United States.

[14] The world's first HS line opened in 1964 between Tokyo and Osaka for the Tokyo Olympics that were held in October that year. The Tokaido Shinkansen benefitted from World Bank funding at the time.

[15] See, for instance, https://news.europawire.eu/dhl-facilitates-the-transport-of-the-largest-order-of-rolling-stock-in-the-history-of-hungary/eu-press-release/2021/03/01/12/19/03/86354/ (accessed on 4 February 2022).

Table 1. An overview of key players in rolling-stock manufacturing

	Consolidated revenue in FY2020 (USDmn)	Home jurisdiction	Government ownership	% of rail activities in consolidated revenue	Estimated global market share in rail supply	Estimated global market share in rolling stock	Business segments
CRRC	36 425	CHN	>50%	70%	12.7%	24.3%(2)	Rolling stock; services; signalling & control; turnkey
Wabtec	7 556	USA	No	99%	3.7%	8.2%	Rolling stock; services; signalling & control; turnkey
Alstom	9 870	FRA	No	100%	4.9%	6.8%	Rolling stock; services; signalling & control; turnkey
Siemens	64 201	DEU	No	16%	5.1%	6.8%(2)	Rolling stock; services; signalling & control; turnkey
Bombardier(1)	14 331	CAN	No	55%	3.9%	6.4%	Rolling stock; services; signalling & control; turnkey
Hitachi	76 004	JPN	No	7%	2.6%	5.1%(2)	Rolling stock; services; signalling & control; turnkey
Transmashholding	3 970	RUS	No	100%	2.0%	4.2%(2)	Rolling stock; services; signalling & control
Stadler	3 363	CHE	No	100%	1.7%	4.0%	Rolling stock; signalling & control; services
Greenbrier	2 792	USA	No	100%	1.4%	3.1%	Rolling stock; services
CAF	3 104	ESP	No	74%	1.1%	1.8%	Rolling stock; services; signalling & control
Hyundai Rotem	2 312	KOR	No	52%	0.6%	1.6%(2)	Rolling stock; services; signalling & control; turnkey
Trinity	1 999	USA	No	100%	1.0%	1.6%	Rolling stock; services
Kawasaki HI	12 950	JPN	No	9%	0.6%	1.5%(2)	Rolling stock; services; turnkey
Nippon Sharyo	865	JPN	No	78%	0.3%	0.9%	Rolling stock; services
Talgo	547	ESP	No	100%	0.3%	0.6%	Rolling stock; services
Tatravagonka	464	SVK	No	100%	0.2%	0.6%	Rolling stock; services
NEWAG	331	POL	No	91%	0.2%	0.4%	Rolling stock; services
Titagarh Wagons	198	IND	No	99%	0.1%	0.3%	Rolling stock; services
PT INKA	162	IDN	100%	100%	0.1%	0.2%	Rolling stock; services
TOTAL					**42.6%**	**78.5%**	

Note: This table does not list all players in the rolling-stock market but rather a selection of the most important ones for which sufficient information could be obtained.
(1) Bombardier finalised the sale of its rail activities (Bombardier Transportation) to Alstom in January 2021.
(2) The exact share of rolling-stock manufacturing in the total rail-supply revenue of these companies is unclear and market shares are therefore imprecise.
Source: OECD research.

Similar to many industrial sectors, rolling-stock manufacturing appears to be concentrated, with 20 companies accounting for nearly 80% of global annual sales and half of the broader rail-supply market. Producers display, however, considerable heterogeneity in both their size and their degree of vertical and horizontal integration. Some are large industrial conglomerates for which rolling stock is one business sub-segment (e.g. Hitachi and Siemens). Some are large rail-supply companies covering the whole spectrum of signalling and rail control, rolling-stock manufacturing, services, and turnkey management (e.g. Alstom and CRRC). Others are relatively small companies with less than USD 500 million in annual revenue, which specialise in the production of specific types of rolling stock and parts and components. The smallest company in Table 1, PT INKA, is an Indonesian state enterprise that specialises in locomotives, coaches, and multiple units, sometimes in partnership with larger producers. By contrast, the only other state enterprise in the list is China's CRRC, the largest rolling-stock manufacturer globally, with a market share three times that of the next largest company.

Besides rolling-stock manufacturers, there are other major rail-supply companies that specialise in the provision of signalling and train control. The two largest are China Railway Signal & Communication Co., Ltd. (CRSC), a central state enterprise, and France's aerospace and defence conglomerate Thales, which is 26% owned by Bpifrance (France's public investment bank) and generates 10% of its revenue from rail-related activities. Given that they compete directly with several of the leading companies listed in Table 1, they can also be considered key players in the industry.[16] Other key market participants in rail control include large telecommunication network groups, such as Nokia and Huawei.

Recent years have witnessed considerable consolidation and reorganisation through mergers and acquisitions in the rolling-stock industry. Examples abound and help explain why certain large groups that have long been involved in rolling-stock manufacturing no longer feature in Table 1. Most recent is the acquisition of Bombardier Transportation – the rail activities of Canadian group Bombardier – by France's Alstom in January 2021. This follows the unsuccessful attempt to merge Alstom and Siemens Mobility, which the European Commission blocked in 2019 on the grounds that it would have "harmed competition in markets for railway signalling systems and very high-speed trains."[17] Of significance also are the sale by General Electric (GE) of its locomotive business to Wabtec in 2019 and its signalling activities to Alstom earlier in 2015.[18] Hitachi, for its part, acquired in 2015 two Italian companies, namely AnsaldoBreda, a rolling-stock manufacturer, and Ansaldo STS, a signalling company. That same year, Indian producer Titagarh Wagons also acquired Italian company Firema.

The merger in 2015 of China's two state-owned rolling-stock manufacturers CNR and CSR to form state giant CRRC was undoubtedly the largest consolidation to have occurred in the rolling-stock industry in the recent past. As mentioned earlier, CRRC had consolidated revenue of USD 36 billion in 2020, making it the largest rolling-stock manufacturer by far. It is also present in all segments of the industry: multiple units, urban transit, light rail, HS and VHS, coaches, freight, locomotives, shunters, signalling and control, services, turnkey management, and infrastructure. This reflects a broader trend in China that has seen the state consolidating key actors in manufacturing into large state-owned champions.[19] It is in this context that the 2015 merger between CNR and CSR needs to be understood. CRRC itself has since engaged in further acquisitions, including German company Vossloh's diesel-locomotive business in 2020, leaving that firm to focus its remaining activities on the provision of rail infrastructure and signalling.

The universe of rolling-stock manufacturers is evidently broader than just the companies listed in Table 1, but it was not possible to obtain sufficient information about other firms. While it is a historical actor in European rolling stock, Czech company Škoda Transportation does not publish detailed annual reports or

[16] Thales noted in its annual report for FY2020 that it is "a pure rail control player [which] sets itself apart from its main competitors, who offer product ranges dominated by rolling stock." Note that Thales was, at the time of writing, in the process of selling its rail activities to Hitachi Rail.

[17] See https://ec.europa.eu/commission/presscorner/detail/en/IP_19_881 (accessed on 4 February 2022).

[18] This coincided with the acquisition by GE of Alstom's energy business and the latter's restructuring into a rail-only company.

[19] See the discussion in a forthcoming Trade Policy Paper (including Annex A of that document) and in the next section of this report.

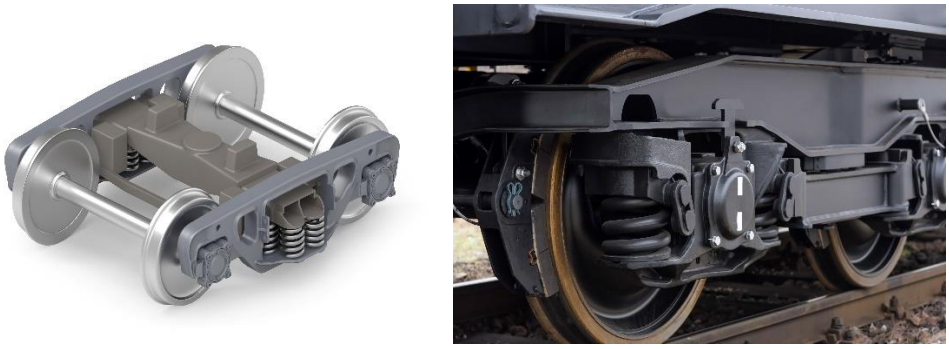
financial statements that would enable the OECD to gather sufficient data.[20] India has a number of rolling-stock factories[21] that operate under direct supervision of state-owned Indian Railways, and which describe themselves as production units under the Ministry of Railways. While some of these factories publish annual reports online, their format does not follow international accounting standards and they contain little information that could be used in a trade and financial context. Information could also not be located for other companies with smaller market shares, including: National Steel Car (Canada); CZ Loko (Czech Republic); Altaivagon (Russia); Sinara Holdings (Russia); and KVSZ (Ukraine). There are also manufacturers for which information could be located but which were not included in this report due to their relatively small size: Kinki Sharyo (Japan) and the United Wagon Company (Russia).

3.2. The manufacturing process and upstream participants in the rolling-stock value chain

The manufacturing process for rolling stock generally takes three to four years from the signing of the contract to delivery of the product. To this should be added the time spent during the procurement phase, which can take an entire year prior to signing. It is during that phase that work will already begin on the initial product designs that will be submitted when bidding for a contract.[22] Design is thus the first step in the manufacturing process. It involves engineers using computer-aided design software (e.g. Dassault Systèmes's CATIA™ or Siemens's Solid Edge™) to build a virtual product in modular form and determine the parts and components that will be necessary for assembly. Orders for raw materials and components are generally placed around that time. Although rolling-stock manufacturers often do their own design in-house, some rely on external companies such as Italian design firm Pininfarina.

Parts and components for the assembly of rolling stock can either be manufactured in-house or purchased externally. The 'make-or-buy' decision is eventually a matter of corporate strategy that varies according to the company and each individual piece. Whatever the decision, work proceeds on the main locomotive or car body at the same time as parts' production takes place. At the risk of oversimplifying, preparation of the car body involves placing a vehicle's frame onto a large jig that will keep it steady while welding metal panels to form the outer body. Car interiors then undergo fitting to install wiring, electronics, plumbing, insulation, etc. Bogies are later installed, which are an essential component of rolling stock (Figure 5) in that they bring together wheels, axles, brake discs, motors, and suspensions, where applicable. Once assembled and finalised, rolling stock then goes through a long process of testing and certification, which can take up to a year or more.

Figure 5. The bogies are an essential component of rolling stock



Source: Shutterstock (stock footage).

[20] The company belongs to the PPF Group, which is a Prague-based investment firm. Škoda Transportation is possibly similar in size to Slovak company Tatravagónka, with annual revenue exceeding USD 450 million in 2020 according to the financial statements of the PPF Group.

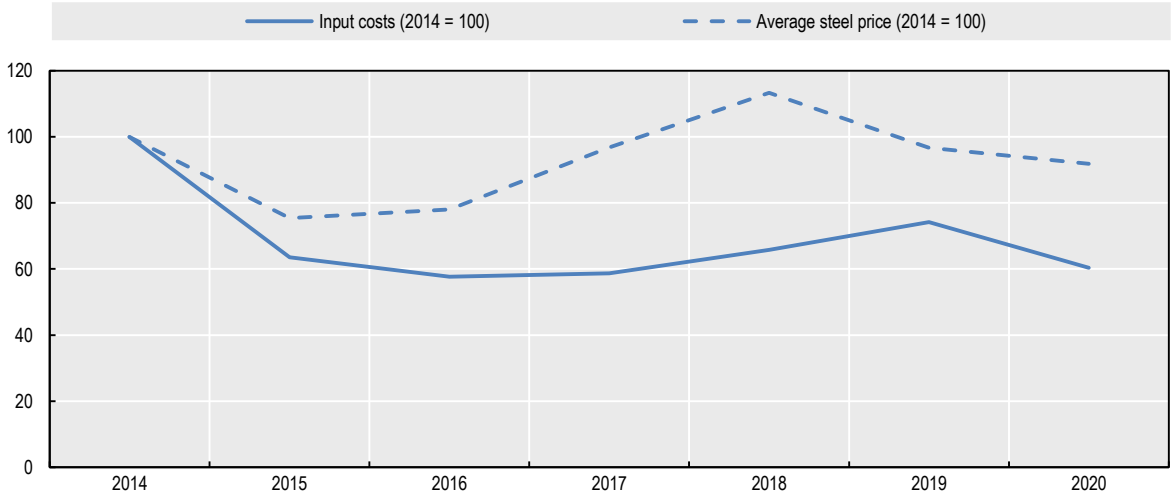
[21] These include Rail Coach Factory, Integral Coach Factory, Modern Coach Factory, Banaras Locomotive Works, and Chittaranjan Locomotive Works.

[22] Rolling-stock designs are to a varying extent customised to suit customers' technical requirements. This makes rolling stock a project-based industry rather than a product-based one.

The various materials, parts, and components used in the production of rolling stock can number in the thousands, but some stand out for their importance, size, or cost. First is steel,[23] which is the raw material behind the frame, the structure, and many essential parts (including the bogies). This has led some manufacturers to establish close partnerships with large steelmakers, which in turn advertise their contribution to the rail industry.[24] A new framework agreement for strategic co-operation between CRRC and Chinese state enterprise Baowu Steel was, for example, signed in 2020.[25] Taiyuan Iron and Steel Company, a provincial state enterprise in Shanxi province, is manufacturing wheels and axles for China's high-speed trains.[26] Much steel casting is also done in-house by rolling-stock manufacturers. US company Greenbrier – which has a 42% interest in Axis, a manufacturer of axles – noted in its annual report for 2020 that: "[t]he cost of steel and all other materials used in the production of our railcars represents more than half of our direct manufacturing costs per railcar" (Figure 6). US company Trinity even noted that: "[c]ertain contracts for the sales of railcars include price adjustments based on steel-price indices."

Figure 6. Steel accounts for a significant part of the costs of manufacturing rolling stock

Average input costs of rolling-stock manufacturers and steel prices



Note: Input costs are estimated by subtracting labour costs, depreciation, and amortisation from companies' cost of sales or total expenses.
Source: OECD research and Wood Mackenzie for steel prices.

Besides bogies, wheelsets, and the car body itself, notable parts and components that enter the rolling-stock manufacturing process include braking systems, doors, HVAC systems, and traction equipment. Braking systems generally rely on compressed air circulating throughout the train in dedicated pipes or hoses, with conductors using a valve in their cabin to change air pressure in the system and activate the brakes by applying pads on the discs. These so-called 'air brakes' are either manufactured by specialised suppliers or produced in-house by rolling-stock companies.[27] Notable suppliers include US group Wabtec

[23] Aluminium is also used widely in rolling-stock manufacturing. Suppliers include France's Constellium, Norsk Hydro's subsidiary Sapa, and Chinese state enterprise Chalco, among many others.

[24] Rail tracks are a larger source of demand for steel, but this does not make steel less important for rolling-stock manufacturers.

[25] See www.seetao.com/details/53016.html (accessed on 7 February 2022).

[26] See http://english.cctv.com/2017/03/24/VIDEWkDh388Rp9h8XCpJ1fNl170324.shtml (accessed 7 February 2022): "Chinese manufacturers have developed domestic versions of high-speed train wheels and axles. This means the country no longer needs to import these vital components."

[27] French group Alstom acquired, for example, small brake-disc manufacturer Ibre in 2020.

(which stands for Westinghouse Air Brake Technologies), Akebono Brake Industry (Japan), Amsted Rail (United States), DAKO-CZ (Czech Republic), Hanning & Kahl (Germany), Knorr-Bremse (Germany), Nabtesco (Japan), Rane (India), and Yujin Machinery (Korea).

Several of these suppliers do not limit themselves to manufacturing braking systems for trains but offer a wider range of parts and components used in the production of rolling stock. Some also serve other industries like carmakers and aircraft manufacturers (e.g. Akebono, Nabtesco, and Rane). Amsted Rail produces, for example, bogies, axles, and other parts for freight cars. Nabtesco and Yujin offer door control systems, with the latter also selling pantographs (i.e. the 'arm' on the roof of a train that connects to the electrical power that runs through the overhead line). Many of these companies also offer HVAC systems for trains and the railway couplers that attach train cars together. In addition to couplers, German company Voith also produces gear units, as does Yujin. While these are just particular examples among many, they help illustrate the complexity of the supply chain in terms of the inputs involved and the companies that produce them.

3.3. Trade patterns in the rolling-stock industry

International trade is only one channel through which companies buy and sell rolling stock and related parts and components. Another is through the establishment of production units abroad to serve foreign markets through physical presence. Depending on the size of markets and the costs of transporting rolling stock and related components, the latter channel may be more meaningful, as can be seen by the number of production units that leading rolling-stock manufacturers have outside their home markets. Cross-border trade remains, however, important along the value chain, especially before final assembly.

To provide a brief overview of trade patterns in the rolling-stock industry, this report uses Chapter 86 of the *Harmonized System* (HS) in collecting data on trade flows and import tariffs. This particular section of the HS covers locomotives, railway and tramway cars, freight cars, maintenance or service rail vehicles (e.g. shunters), but also important parts and components such as axles, wheels, bogies, air brakes, couplers, etc. Further adjustments are made by removing HS 86.09 ("Containers […] specially designed and equipped for carriage by one or more modes of transport") and adding instead HS 8530.10 ("Electrical signalling, safety or traffic control equipment […] for railways or tramways"). In doing so, the data assembled cover all relevant categories of rolling-stock equipment as well as signalling devices. Trade data are from the CEPII's BACI database and import tariffs (discussed in the next section) are from UNCTAD's TRade Analysis and INformation System (TRAINS[28]).

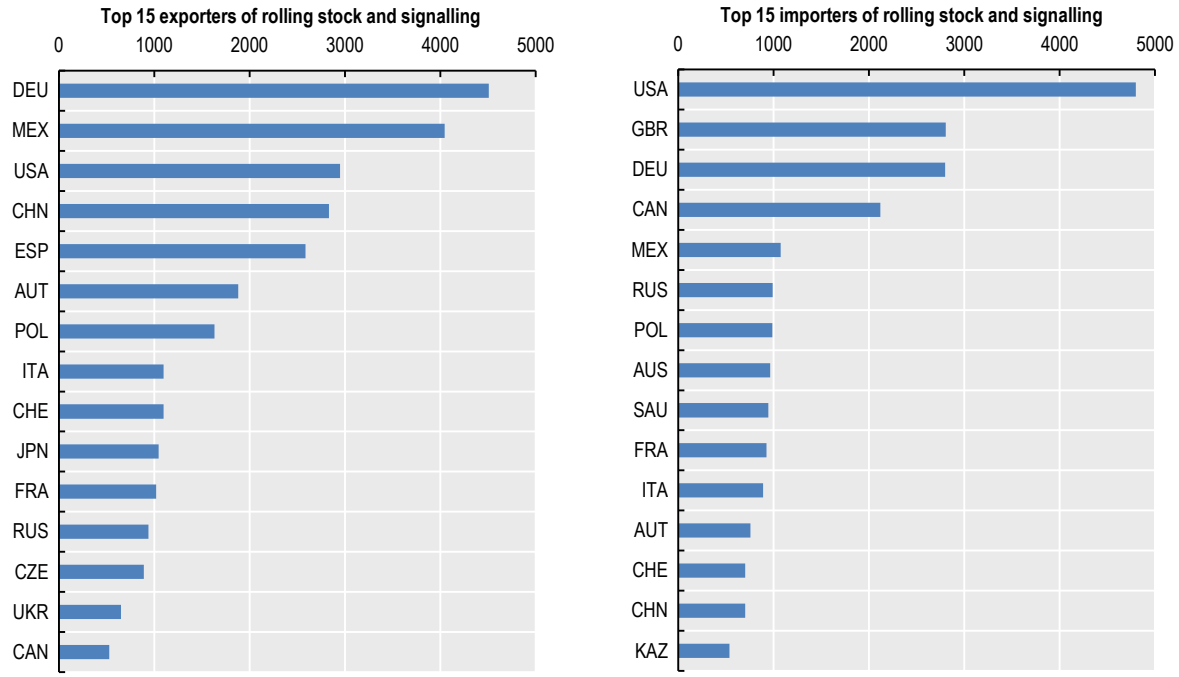
The largest exporters and importers of rolling stock and signalling equipment tend to be OECD countries (Figure 7). China is also a large exporter in absolute terms, even though domestic sales ("China Mainland") accounted for about 92% of CRRC's total revenue over the years 2016-20. Regional integration is clearly visible in the large amount of two-way trade taking place between EU Member States (e.g. France, Germany, Italy, and Poland), but also between Canada, Mexico, and the United States. As noted earlier, some large US manufacturers of freight cars have production facilities in Mexico and commodity markets in North America generate substantial demand for freight equipment. The top three exporters are thus Germany, followed by Mexico and the United States. The top three importers are, meanwhile, the United States, followed by the United Kingdom and Germany again.

Other economies are large exporters but do not appear to import large amounts of rolling stock and signalling equipment. This is notably the case of China, Japan, and Spain, which all have large domestic producers of rolling stock. By contrast, other economies are large importers but have little or no exports. This is particularly the case of commodity oriented countries that do not have a significant manufacturing base for transport equipment, e.g. Australia, Kazakhstan, and Saudi Arabia.

[28] A very fitting name.

Figure 7. OECD economies are both the largest exporters and importers of rolling stock and signalling equipment

Current USD millions, data are for 2019



Source: OECD, based on the BACI database.

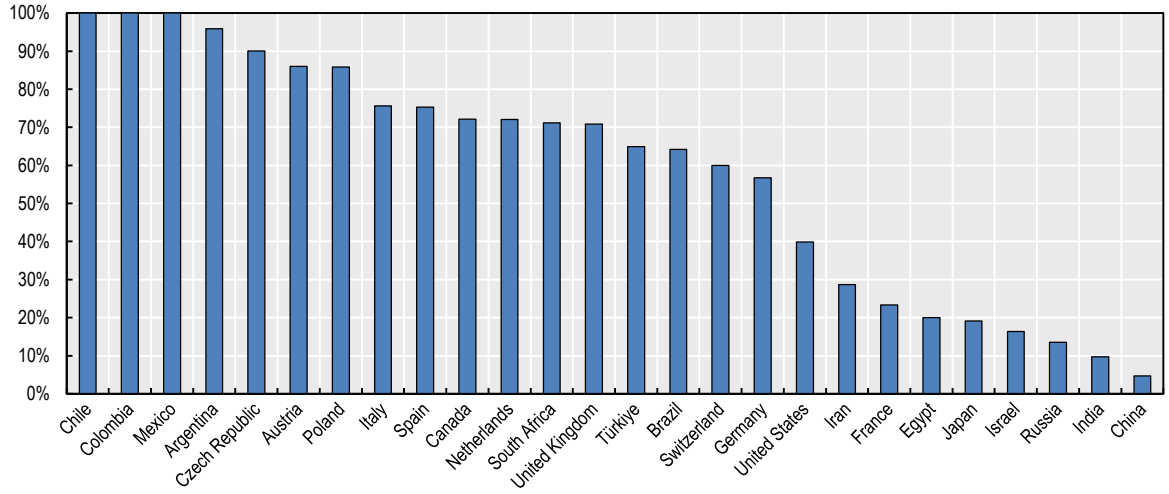
Countries' shares of global exports and imports have generally been relatively stable over the period 2007-20. One exception is China, which increased its share of global exports from 4% in 2007 to a high of 18% in 2015, before settling at 11% in recent years. Over the same period, the country saw its share of global imports go from 7% in 2007 to 2-3% in recent years, corresponding to a halving in the absolute value of its imports. As a result, China's net exports of rolling stock and signalling equipment increased rapidly starting in 2010 but have since stagnated, beginning in 2016. This is consistent with the stagnating share of revenue that CRRC generates domestically, and which hovers around 92% as mentioned earlier. Other economies that have witnessed significant changes over the same period (2007-20) include Russia, which decreased its share of global imports from around 7-10% to 2-3%, and the United Kingdom, which increased its share of global imports from 2-3% to 8-9%.

While different countries have different market sizes in rolling stock,[29] the degree to which they are dependent on imports for satisfying their domestic demand varies, notably with the size of their domestic production and policies affecting market access. Major economies in Latin America appear, on the one hand, to be entirely or largely dependent on imports for meeting their demand for rolling stock and related parts and components, which could be explained by the absence of large domestic suppliers. At the other end of the spectrum are China, followed by India and Russia, which do not import much rolling stock in proportion to their domestic demand. In China's case, imports (including parts and components) only account for about 5% of its estimated market size. Besides purely economic factors, this suggests that policies might also be playing a role in limiting access to countries' rolling-stock markets. These policies are discussed in the next section.

[29] Including due to geographical factors as noted earlier.

Figure 8. Countries differ widely in how dependent they are on imports of rolling stock and signalling equipment

Average import penetration ratio, 2015-19



Note: Imports include rolling-stock parts and components (e.g. bogies and axles) and not just finished products, which are more difficult to transport. Import penetration ratios are calculated by dividing countries' total imports of rolling stock by their estimated market size.
Source: OECD estimates, based on the BACI database (imports) and UNIFE and Roland Berger GmbH (2020[4]) (market size).

4. Government intervention and policies affecting competition in the rolling-stock value chain

Governments have been involved in the development of rail transport ever since its birth in the 19th century. Rail was notably perceived at the time to be an engine for the unification of young nations such as Belgium, Germany, Italy, or the United States (Wolmar, 2010[5]). Rail projects on a continental scale, such as the United States' first Transcontinental Railroad[30] or Russia's Trans-Siberian railway, were actively promoted by their respective authorities for reasons that went far beyond simple economics and profits. Even then, government involvement varied dramatically across jurisdictions. British authorities largely kept a hands-off approach, while the US Government relied on subsidies, land grants, and monopoly concessions to entice private entrepreneurs to build and operate railways (Ibid). Governments in continental Europe, for their part, were more directly involved through larger state ownership, central co-ordination and control, and subsidies (e.g. guaranteed rates of return for railways).

Some of these historical patterns survive today, with implications for the demand side of the rolling-stock market. This explains partly, for example, why government involvement tends to be less extensive in freight than in passenger transport, particularly in North America.[31] This also explains how France, in particular, became a world leader in rail electrification in the mid-20th century when the SNCF embarked on a large-scale programme to electrify rail lines using overhead wires (Wolmar, 2010[5]). HS and VHS projects continue today to require some amount of government support and planning given the significant commitments they entail. Finally, yet importantly, the fact that rail infrastructure forms a natural monopoly

[30] The joining of the Central Pacific and Union Pacific railways linking the Atlantic to the Pacific occurred in 1869 in Promontory, Utah.

[31] As noted by the ITF: "[i]n most countries rail freight is operated as a commercial enterprise. There is a business relationship between the owner of the freight and the company responsible for moving that consignment" (Worsley, 2020[26]).

implies that government intervention in rail transport will remain a necessity, if only through the regulatory channel to organise network usage.

Historical trends have also partly shaped the supply of rolling stock and how different countries specialise in different segments of the market. As mentioned earlier, there is a large 'home-market effect'[32] at play in rolling stock, so that larger domestic demand translates into larger production and net exports. This home-market effect may be amplified, nevertheless, by government support (discussed in the next section) and by policies that restrict access to the home market for foreign competitors. These policies can take the form of outright import tariffs or local-content requirements, which mandate that railway operators procure part or all of their rolling stock locally. Technical specifications and requirements may also serve to ring-fence a market for local companies. Besides policies, vertical integration between rolling-stock manufacturers and railways may act to limit foreigner manufacturers' market penetration. In the end, the combination of a large home market and market-access restrictions on foreign competition can be a potent driver of support for local rolling-stock manufacturers (Kratz and Oertel, 2021[10]; Cory, 2021[11]).

4.1. Import tariffs on rolling stock and signalling equipment

As noted in the previous section, there is considerable heterogeneity in the extent to which countries depend on imports for satisfying their domestic demand for rolling stock (Figure 8). Economic factors undoubtedly play a large role, including the home-market effect, but this does not rule out the possibility that certain policies also restrict market access for foreign producers. This section first discusses import tariffs before turning to other types of policy interventions hampering market access 'behind the border'.

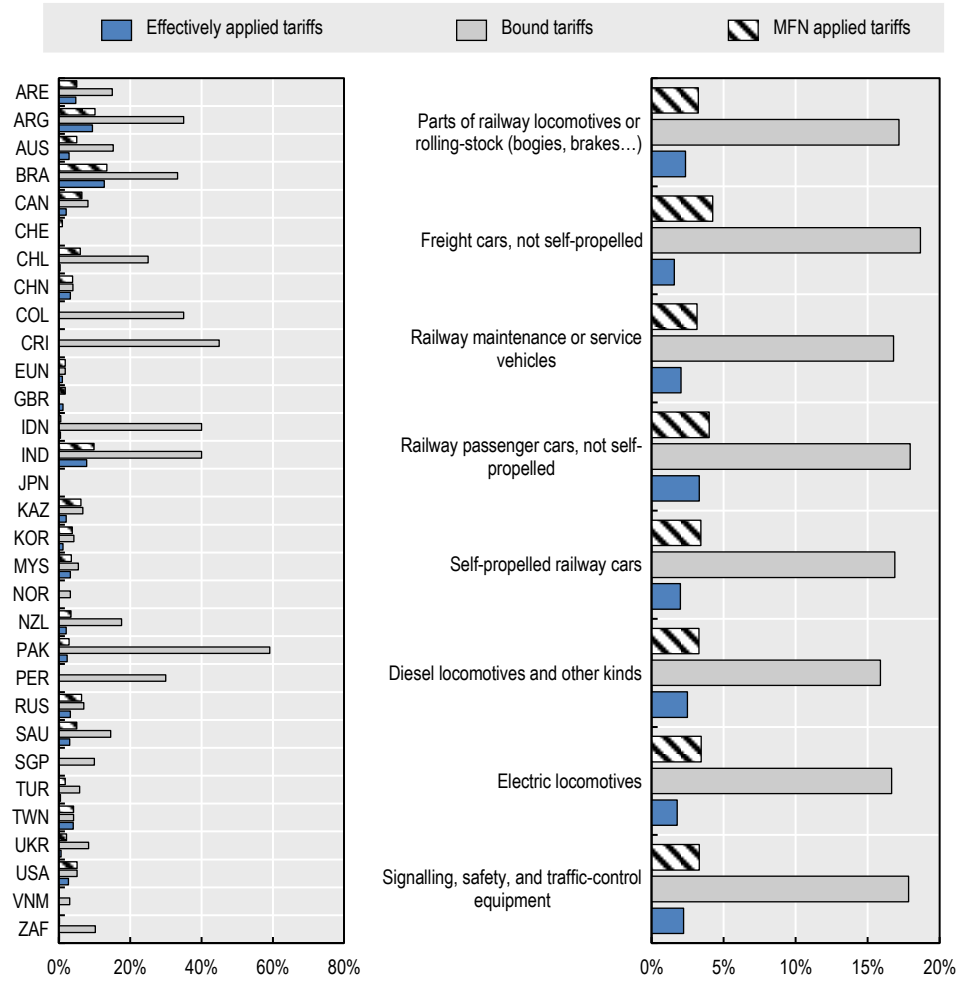
Applied import tariffs on rolling stock and signalling equipment are generally low but there is significant water in the tariff, i.e. a significant gap between bound tariffs and those effectively applied (Figure 9; left). This is particularly the case for Costa Rica, India, Indonesia, and Pakistan that all have average bound tariffs of at least 40%. In terms of effectively applied tariffs, Argentina (9%), Brazil (13%), and India (8%) have the highest rates among the jurisdictions covered in Figure 9. All other jurisdictions covered, including key emerging economies such as China, Indonesia, and South Africa, have applied rates below 5%. These rates have been fairly stable over the period 2007-20, with only Argentina having increased its applied tariffs significantly (from 2% to 13% starting in 2013) and Colombia having lowered them to zero.

At the product-group level, applied tariffs are on average slightly higher for railway passenger cars that are not self-propelled and for diesel locomotives (Figure 9; right). While the difference is not large on average, there can be more visible differences for particular jurisdictions. Indonesia maintains, for example, non-zero applied tariffs only on signalling products and certain kinds of self-propelled railway or tramway cars. Korea applies higher tariffs on certain kinds of self-propelled railway or tramway cars and bogies, while the United States does so on freight cars. Japan and Norway have, meanwhile, zero tariffs on all product groups considered here.

[32] The home-market effect originates in new trade theory and posits that economies of scale and transport costs will lead "countries […] to export those kinds of products for which they have relatively large domestic demand" (Krugman, 1980[27]). Empirical evidence generally supports the theory in the case of differentiated products like cars and rolling stock (Hanson and Xiang, 2004[28]).

Figure 9. Import tariffs on rolling stock and signalling equipment are generally low and do not vary much across product groups

Average import tariffs in 2020



Source: OECD, based on TRAINS.

Altogether, these findings would suggest that import tariffs are not the main reason behind countries' varying levels of import penetration. While bound tariffs can be high in certain cases, applied tariffs remain generally low at levels that should not constitute a major impediment to trade.

4.2. Government procurement in the rolling-stock industry

Government procurement plays a key role in the rolling-stock industry with public-transport authorities often being the principal buyers of rolling stock. Policies having the effect of giving preference to domestic firms in government procurement contracts can thus constitute important barriers to market access. The distortions these barriers cause can in turn limit consumer choice, increase prices, and undermine 'value for money'.

The plurilateral Government Procurement Agreement (GPA) negotiated under the WTO introduces legally binding rules requiring signatories[33] to establish open, fair, and transparent conditions of competition in government procurement within the scope of their market-access schedules of commitments. In parallel, in the last two decades, countries have increasingly included provisions disciplining government procurement in their preferential trade agreements (PTAs) (Anderson, Mueller and Pelletier, 2015[12]; Hoekman, 2018[13]).[34] Although most PTAs incorporating far-reaching disciplines on public procurement involve GPA members, the EU, as a GPA member, has, for example, recently concluded PTAs containing public-procurement rules with non-GPA members.[35]

Despite the progress made in opening up public markets to foreign competition, few statistics are available to understand the size of public procurement within countries, the trade flows taking place through procurement, and the types of discriminatory procurement measures that governments choose to implement (Gourdon and Messent, 2017[14]). Assessing the extent of discrimination taking place through government procurement would require data on procurement awards over time that distinguish between winning bids on the basis of the nationality of the supplying firms. Yet, with the exception of contracts in the EU[36], no jurisdiction seems to be publishing information in data form on the public tenders that government authorities issue, the tender procedure used, the number of participants to the tender, and the country of origin of the winning participant.

Measuring government-procurement transactions in the rolling-stock industry

To address this evidence gap, the OECD has collected information, where available, on the individual contracts awarded by national and subnational public authorities to the various rolling-stock manufacturers covered in this study (Annex A) between January 2015 and May 2022. This exercise has drawn mainly on the press releases issued by rolling-stock manufacturers and public-transport authorities, along with information published by specialised websites[37] and press articles. More than 1 000 press releases were examined. On that basis, the OECD has recorded more than 850 individual contracts awarded to the sampled rolling-stock manufacturers over the period 2015-22[38] for the supply of rolling stock,[39] rail-control equipment (e.g. signalling and communication equipment), as well as the provision of various associated services (e.g. maintenance services and supply of spare parts). This includes several transactions that have not been subject to competitive bidding.

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[33] Armenia, Australia, Canada, the EU-27, Hong-Kong (China), Iceland, Israel, Japan, Korea, Liechtenstein, Moldova, Montenegro, New Zealand, Norway, Singapore, Switzerland, Chinese Taipei, Ukraine, United Kingdom, and the United States.

[34] The EU went further through the adoption of the International Procurement Instrument (IPI) on 23 June 2022, which came into force on 29 August 2022. It aims to tackle market protection in public procurement by third countries. Under the IPI, the Commission will launch investigations and consultations if a third country adopts or maintains any measure, procedure or practice which seriously and recurrently undermines EU goods, services and companies' access to the third country's procurement market.

[35] The two agreements in principle reached between the European Union and Mexico in 2018 and the EU and Mercosur in 2019 contain a specific chapter on public procurement. Similarly, the future trade and investment agreement between the EU and Chile should, according to the draft negotiating mandate, include provisions aimed at improving mutual access to government procurement, including by central and subcentral authorities, as well as by state-owned enterprises and undertakings with special or exclusive rights operating in the public utilities sector.

[36] See the EU's TED Database, available at: https://ted.europa.eu/TED/browse/browseByMap.do (accessed on 12 September 2022). While the information therein allows measurement of the volume of direct cross-border procurement in the European Union, it does not permit to assess the extent of indirect cross-border procurement. TED does not identify whether a winning bidder is an affiliate of a foreign firm (Hoekman, 2018[13]).

[37] These include, among others, the *International Railway Journal* website (www.railjournal.com/) and the *Railway Technology* website (www.railway-technology.com/).

[38] Note that the figures included below cover the period 2015-21 but exclude the year 2022, which had not ended at the time of drafting of this report.

[39] Contracts for the specific supply of rolling-stock components, such as axles or bogies, are not covered under the present exercise.

While this data-collection exercise enables a better understanding of the scale of government-procurement transactions in the rolling-stock industry, certain rolling-stock manufacturers fail to systematically publish information on all individual contracts they have been awarded by public-transport authorities. This is especially the case for CRRC, which inconsistently discloses the contracts it has won with China Railway Corporation as well as Chinese provincial or municipal public-transport authorities. Between 2015 and May 2022, CRRC supplied various types of rolling stock in China. In most cases, however, the company did not specify the identity of the tenderer, the precise date of the contract awards, the number of rail vehicles supplied, nor the amount of these contracts. As a result, drawing on information published on the website of CRRC and specialised websites, which would often only mention delivery or entry into service of vehicles without indicating the contracts being addressed, it is estimated that at least 70 individual contracts awarded to the Chinese rolling-stock manufacturer were not publicly available and hence could not be included in the data sample. The OECD also encountered difficulties, albeit less significant, in accessing information on contracts awarded to other rolling-stock manufacturers, such as Nippon Sharyo.

Given the difficulties encountered in seeking to obtain the value of several individual contracts, the analysis looked at the total number of contracts rather than their amount, as well as at the cross-border nature of the transactions. Figure 10 (left) shows that some countries sell more than they buy and vice versa. In the case of Canada, Spain, and Switzerland these are relatively small or saturated markets, which could explain their reliance on foreign markets for growing their rolling-stock activities. The total number of contracts bought for these countries is thus likely indicative of their relatively small domestic markets. Some larger economies, such as the United States, are seemingly larger contract buyers than sellers while others, like Japan, are larger contract sellers than buyers. This in part arises from the data-sampling method, which looks only at government-procurement transactions. Many Japanese railways and buyers of US-made freight cars are private companies with the result that transactions do not fall within the scope of the present exercise. It is important to note, however, that issues related to transparency and gaining access to contracts has meant that some absolute numbers may be skewed and may not show the entire set of contracts bought and sold within the time period.

Looking at whether a government contract involves a cross-border transaction assists in understanding the extent to which various countries rely on non-domestic rolling-stock manufacturers. Figure 10 (right) shows the government contracts involving a supplier based in a different country than the customer as a percentage of all the government contracts for rolling stock respectively bought or sold by that country. Many countries can thus be seen buying and selling a significant proportion of their rolling stock from or to foreign entities, as is the case for the United States, Germany, and Canada. By contrast, Chinese, Japanese, and Korean public-transport authorities appear to rarely buy from foreign rolling-stock manufacturers while their domestic rolling-stock manufacturers have seemingly gained a strong foothold in foreign markets. This observation is particularly salient for China, which has the largest domestic market globally (UNIFE and Roland Berger GmbH, 2020[4]),[40] government-owned railways, and has made large state-led investments in rail for more than a decade. The reported presence of discriminatory procurement measures in China (discussed in the following sub-section), which impede access of foreign manufacturers to the Chinese rolling-stock market, may explain the low number of cross-border transactions taking place in China.[41] Market-access barriers in Japan and Korea have, in the past, hampered access to the Japanese and Korean rolling-stock markets for foreign rolling-stock manufacturers (see following sub-section). In the case of Japan, the seeming absence of government contracts awarded to foreign rolling-stock manufacturers may also be due to the nature of the data, which include neither contracts concluded with private transport authorities, nor contracts for the supply of rolling-stock components.[42]

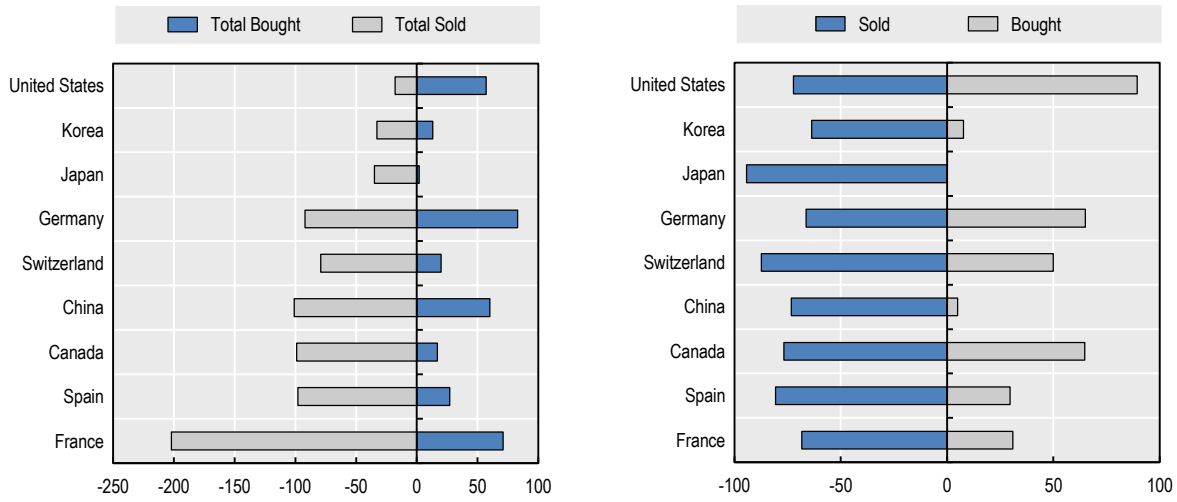
[40] While lack of transparency implies that the data do not fully reflect the size of the Chinese domestic market, the implied bias is more likely to underrepresent the domestic bias of China's rolling-stock procurement market.

[41] Note that under Figure 10, contracts awarded by Chinese public-transport authorities to joint ventures located in China consisting of a foreign rolling-stock manufacturer and CRRC or one of its subsidiaries were counted as domestic contracts.

[42] As mentioned in the second section of the report, there are many private transport authorities in Japan (e.g. JR Central, JR East, JR West, or Nagoya Railroad). In addition, Japan has reportedly purchased rolling-stock components from foreign rolling-stock manufacturers (Griek, 2016[31]). This last observation is consistent with the average import penetration ratio shown in Figure 8.

Figure 10. The total number of government contracts bought and sold shows that some countries buy less of their rolling stock from abroad

Left: Aggregate number of government contracts for the supply of rolling stock bought and sold between 2015-21
Right: Cross-border contracts as a percentage of all government contracts for the supply of rolling stock between 2015-21



Note: The data do not take into account consortia, as these were difficult to quantify in terms of the role each manufacturer played in the venture. Cross-border transactions show only contracts involving a supplier based in a different country than the customer, thus excluding transactions awarded to joint ventures located in the buying country. Data for CRRC are incomplete due to a lack of transparency as to the exact number of contracts awarded to the company.
Source: OECD research.

The cross-border nature of the contracts as defined here does not indicate, however, whether a given contract involves the actual cross-border movement of rolling stock and related products. Quantifying the true scale of trade flows resulting from contract awards would require establishing whether the supplier has one or several production sites within the country of purchase, either for logistical reasons or to comply with a local-content requirement, and whether rolling stock is in fact produced there.[43] Hence, while deciding on the cross-border character of government contracts is a straightforward exercise, determining the actual cross-border movement of products can be significantly more complex. Moreover, and as noted earlier, the final assembly of rolling stock involves many inputs and components, not all of which are produced by the same supplier. Even where a supplier has a manufacturing facility in the country of the buyer, there could still be some cross-border movement of intermediates.

The data collected also make it possible to break down government contracts by product segment, namely rolling stock, services, and rail control and signalling.[44] For every such segment, information was collected on the particular type of rolling stock, services, or rail-control equipment procured. Figure 11 shows the proportion of each product segment for the top nine supplying countries from which rolling-stock manufacturers originate. The data suggest that China (CRRC), Switzerland (Stadler), Canada (Bombardier), Spain (CAF and Talgo), and Korea (Hyundai Rotem and Woojin Industrial Systems) supply mainly rolling stock, followed by services. For Japan (Hitachi Rail, Kawasaki Heavy Industries, and Nippon

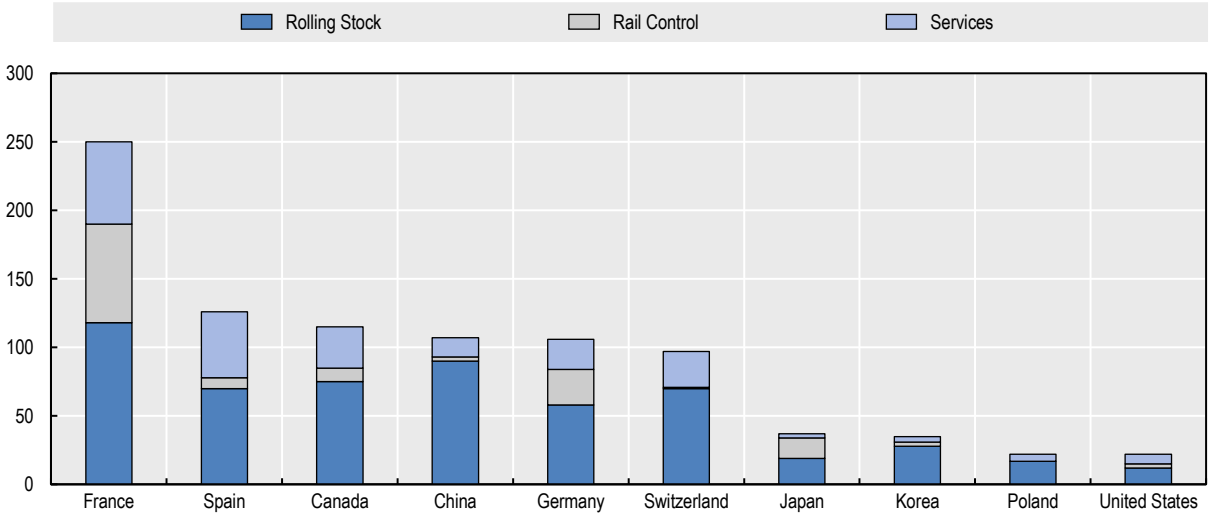
[43] Investments by the foreign supplier in a local manufacturing or assembly facility may signal the absence of a cross-border movement or, at the very least, indicate that the existence of trade flows for the procurement of a product does not necessarily and only depend upon the signature of a cross-jurisdictional contract.

[44] In turn, the rolling-stock segment further distinguishes between high-speed trains, multiple units, locomotives, freight cars, light rail vehicles, metro vehicles, and automated people movers. The segment of services covers maintenance services, electrification, supply of spare parts, and other types of services. The segment of rail control encompasses the provision of signalling equipment and other rail-control equipment.

Sharyo), the share rail control appears to be more significant while France (Alstom) and Germany (Siemens) supply equally services and rail-control equipment. That said, there are obvious complementarities between the three product segments, with companies often offering combined equipment and services as a package.

Figure 11. The segments catered to by the countries of origin of manufacturers vary

Number of government contracts by country of origin of manufacturers between 2015-21



Note: Where one contract caters to several segments, they are all recorded as individual mentions. Data for CRRC are incomplete due to a lack of transparency as to the exact number of contracts awarded to the company.
Source: OECD research.

Figure 12 shows the type of rolling stock produced by the six leading rolling-stock manufacturers between 2015 and 2021. The left graph illustrates how the overall distribution of types of rolling stock sold to public-transport authorities has changed over time. This shows that the overall contracts ordered peaked in 2018, with multiple units also peaking around that time. Contracts for high-speed trains, nevertheless, increased in 2021. By contrast, the demand for freight cars has also slowed down significantly since 2019. The right graph meanwhile shows that the sales of Alstom, Bombardier, and Stadler are in large part composed of multiple units while those of Talgo and CAF are mainly for LRVs. As for CRRC, a large proportion of their contracts come from the sale of metro vehicles.[45] High-speed trains account overall for a limited number of contracts.

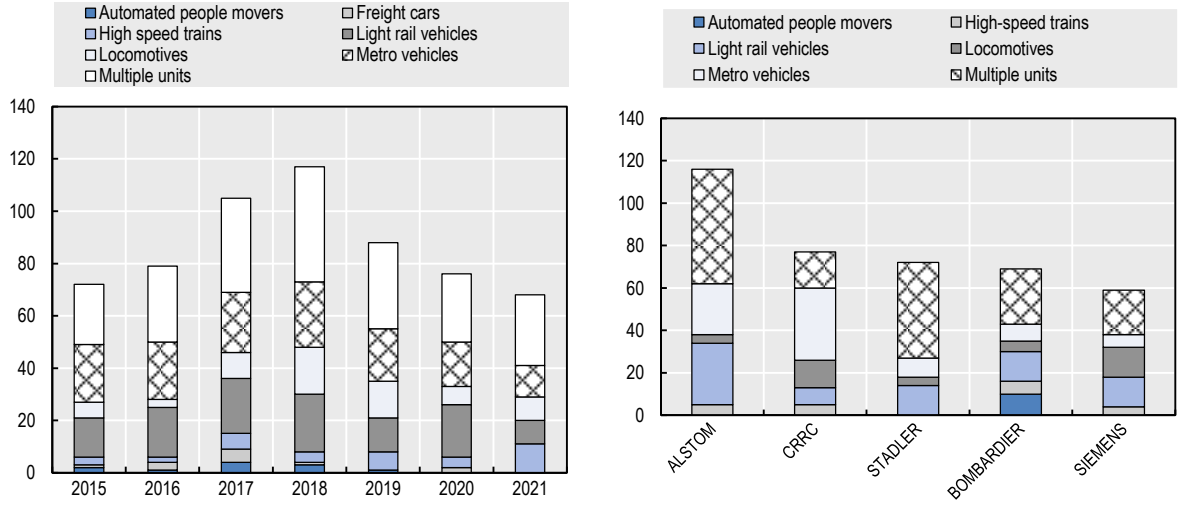
To look at the relationship between GPA membership and contract award notices in the rolling-stock industry, the OECD has mapped each country's GPA membership status and the presence of PTAs between countries. This shows a slight positive correlation between transactions involving entities whose countries of origin are parties to the GPA but does not enable strong conclusions on whether the GPA has

[45] Note that, as mentioned earlier, due to a lack of transparency, the data-collection exercise could not account for most of the contracts awarded to CRRC in China for the manufacture of metro vehicles. Between January 2015 and November 2022, more than 160 metro lines have reportedly been opened across 42 cities in China. While some foreign rolling-stock manufacturers supplied a few metro components (e.g. traction systems) and rail-control equipment (e.g. signalling, train control monitoring systems, etc.), CRRC appears to have produced most metro vehicles. Although the OECD was able to collect secondary evidence that CRRC has supplied rolling stock for more than 50 metro lines, insufficient information as to the identity of the tenderer and the precise award date of the individual contracts awarded to CRRC during the period 2015-21 did not permit the recording of these contracts in the dataset.

contributed to increasing market access for foreign suppliers. The same is true in determining whether PTAs with provisions on procurement have had an impact on changing procurement sourcing.[46]

Figure 12. The type of rolling stock supplied depends on the manufacturer and changed between 2015-21

Left: Annual breakdown of the number of government contracts by type of rolling stock supplied
Right: Type of rolling stock supplied cumulatively per manufacturer



Note: Data for CRRC are incomplete due to a lack of transparency as to the exact number of contracts awarded to the company.
Source: OECD research.

Policy concerns relating to government procurement in the rolling-stock industry

Governments have at times resorted to either explicit or implicit discriminatory policies to favour their own industry, thus creating a 'home bias' in public procurement. These policies hinder access to the government-procurement market and thus constitute a barrier to trade and international competition.[47] While they are in principle prohibited by the GPA and many PTAs, the extent of such prohibition, however, depends on the specific commitments made by countries under these agreements, as well as whether they are signatories.

In certain countries, *explicit discriminatory policies* have had the effect of foreclosing foreign rolling-stock manufacturers from entering the market altogether. In China, for instance, only Chinese majority-owned companies holding the full ownership of intellectual property rights required for the project's execution may reportedly bid for rolling stock tenders.[48] Where foreign firms wish to participate in a tender, they need to associate with local companies in a joint venture, of which they cannot have the controlling share. Additionally, it appears that companies must have a state-delivered license to participate in rolling-stock tenders. In the absence of pre-defined criteria, however, such licenses are seemingly granted to Chinese controlled companies only.[49] These measures have had the effect of reserving China's rolling-stock market to CRRC and its predecessor companies (i.e. CSR and CNR, see next section).

[46] A robust quantitative assessment of the impacts of the GPA and PTAs on the rolling-stock procurement market would require further work beyond the scope of this report.

[47] Many elements can affect home bias in government procurement without constituting trade barriers. They cover *inter alia* the size of the domestic market, the distance to main partners, and trade-facilitation issues (e.g. shipping and infrastructure limitations) (Gourdon, Bastien and Folliot-Lalliot, 2017[30]).

[48] Case M.8677, Siemens/*Alstom*, para 129.

[49] Ibid, para 108 and 129.

Foreign producers have encountered in the past other difficulties when seeking to enter the Japanese and Korean rolling-stock markets. In Japan, foreign suppliers have argued that the Operational Safety of Transportation Clause (OSTC) contained in Japan's Annexes to the GPA has been used to prevent them effectively from participating in the procurement market for railway equipment.[50] Since 2 February 2020, the EU-Japan Economic Partnership Agreement has, however, opened to EU suppliers the procurement of goods and services covered by the OSTC.[51] In Korea, discriminatory policies included a licensing requirement and the express exclusion of EU suppliers from tenders until 2015.[52]

In some cases, explicit discriminatory policies take the form of local-content requirements, which require firms to use domestically manufactured goods (or domestically supplied services) when procuring a specific good or service to the public authority that issued the tender. Various national governments have introduced 'Made in XX' or 'Buy XX' programmes in their regulations governing public procurement and, more specifically, the public procurement of rolling stock, including the United States, India, and Türkyie. The presence of an already established national incumbent may also amplify the effects of local-content requirements, as do market-access barriers in the government-procurement market (e.g. mandatory joint venture requirements, prior licensing requirements, or preference for the national state-owned rolling-stock manufacturer).

Implicit discriminatory policies can also have the effect of undermining market access, although they are harder to detect and document (Gourdon and Messent, 2017[14]). These may include the contracting public authorities' preferences for suppliers having a track record in the geographical market concerned, informal localisation requirements, or the existence of historical relationships between certain national train operators and the domestic rolling-stock manufacturer. Certain public authorities may, for instance, informally favour bidders that have or intend to have local production facilities even though domestic procurement rules prohibit customers from disqualifying bidders that do not have or do not plan to invest in local manufacturing assets. In addition, standards in the rail and rolling-stock industry that originate from previous state investments may have the effect of locking in technical specifications, thereby potentially stifling new market entries as entrants can face significantly higher costs than the incumbents.

While *low-price strategies* by bidders are not inherently anti-competitive, firms may resort to predatory bidding to enter a third-country market by submitting aggressive bids at significantly lower prices than their competitors. Although this strategy may stem from the firm's ability to use the profits gained in another branch of its business (Alexandersson and Hultén, 2006[15]), it may also arise from distortive practices, such as the company receiving government support. These practices can undermine trade and competition by weakening competitors and excluding them from the market or preventing their entry.

In recent years, policy makers and industrial stakeholders alike have voiced concerns with respect to predatory bidding by state enterprises (SEs), whose price and costs may be distorted by state-backed financing. This issue could be especially relevant in the rolling-stock sector, where competitive tendering plays a pivotal role. More specifically, there have been allegations that the Chinese rolling-stock SE, CRRC, which benefits from substantial government support (see next section), may have won public contracts in third-country markets by submitting particularly low bids.[53] CRRC has notably made inroads into the markets for metro trains and multiple units in the United States (Box 1), Canada, and Europe by winning important tender contracts at prices that were reportedly 20 to 30% lower than the prices proposed by their competitors (Cory, 2021[11]).

[50] See, for example, https://ebc-jp.com/digital-white-paper/issues/transportation-communications/railways/operational-safety-clause-osc-and-public-procurement/ (accessed on 23 September 2022).

[51] See https://trade.ec.europa.eu/doclib/docs/2020/november/tradoc_159028.pdf (accessed on 23 September 2022).

[52] Case M.8677, *Siemens/Alstom*, para 129.

[53] See Bundeskartellamt Case Summary, clearing the acquisition of Vossloh Locomotives GmBh by the Chinese company CRRC Zhuzhou Locomotives Co. https://www.bundeskartellamt.de/SharedDocs/Entscheidung/EN/Fallberichte/Fusionskontrolle/2020/B4-115-19.pdf?__blob=publicationFile&v=5 (accessed on 23 July 2022).

Box 1. Examples of low-pricing strategies in the United States

In October 2014, the Massachusetts Bay Transportation Authority (MBTA) awarded CRRC MA, a CRRC subsidiary, a contract worth USD 566 million to supply 284 metro cars for Boston's subway network.[1] CRRC MA won against competitors Bombardier, CAF, Hyundai Rotem, and Kawasaki. While the company overtook competitors on technical factors, past performance, and quality assurance, the price proposed was also significantly lower than the prices submitted by the other bidders: CRRC MA's bid was more than USD 150 million below the bid of Hyundai Rotem (USD 721 million), the second lowest bid, and Bombardier's bid (USD 1.08 billion) was almost twice CRRC's (Ker, 2017[16]; Cory, 2021[11]).

In March 2016, CRRC subsidiary CSR Sifang America won a USD 1.3 billion contract to build 400 new 7000-series railcars for the Chicago Transit Authority (CTA), with an option for another 446 cars. CRRC again submitted the lowest bid, i.e. USD 226 million less than the bid submitted by Bombardier (Ibid).

In December 2016, the Los Angeles County Metropolitan Transportation Authority (Metro) awarded a contract to CRRC MA to design and manufacture 64 new subway cars for the city of Los Angeles, with a possibility of purchasing 218 additional cars. In total the contract amounted to USD 647 million. Compared to the other proposal submitted by its competitor Hyundai Rotem, CRRC MA proposed the lowest price while offering the most robust Local Employment Programme and the highest US component content.[2] The price difference is not known, however.

In 2017, the Southeastern Pennsylvania Transportation Authority (SEPTA) awarded a USD 137 million contract to CRRC for 45 commuter rail cars, with a possibility to order 10 more rail cars in the future. Relying on technical rating and pricing, SEPTA considered that the CRRC proposal, as compared to the ones of Bombardier and Hyundai Rotem, constituted the best value and most advantageous for SEPTA.[3] CCRC's bid was USD 34 million less than the bid submitted by Bombardier and USD 47 million less than Hyundai Rotem's proposal.

Notes:
* The contracts and amounts mentioned in this box were verified by the OECD using the website of CRRC.
** See www.reuters.com/article/us-crrc-usa-idUSKBN16Y0ZA (accessed on 23 September 2022).
*** See www5.septa.org/septa-board-approves-purchase-of-multi-level-coaches-for-regional-rail/ (accessed on 23 September 2022).

Bid rigging constitutes another serious issue in public procurement. It is a form of collusion where two or more competitors agree they will not genuinely compete with each other for a given tender, allowing one of these competitors to win the tender. This practice may take a variety of forms, including: (i) bid suppression, where one or more parties agree not to bid to ensure that the pre-agreed party will win the contract; (ii) cover bidding, where all parties but one pre-agreed participant submit a bid at an artificially high price; (iii) bid withdrawal, where a company withdraws its winning bid, thus allowing an agreed competitor to win the contract instead; (iv) bid rotation, where competitors agree in advance to bid in rotation depending on the number and value of contracts; and (v) non-conforming bids, where certain parties deliberately propose terms and conditions that will prove unacceptable to the purchaser. This may also involve subcontracting part of the main contract to the losing bidder(s).

Bid rigging is normally considered an unlawful anti-competitive practice in all OECD member countries. In 2012, the OECD Council adopted a Recommendation on fighting bid rigging in public procurement, calling on governments to assess their public procurement laws and practices to reduce the risk of bid rigging.[54] Over the past decade, bid-rigging agreements have seemingly taken place in the rolling-stock industry, prompting national competition authorities to issue fines against the companies involved (Box 2). This shows the important role that competition authorities can play in ensuring a level playing field in the market for rolling stock.

[54] See https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0396.

Box 2. Bid rigging in the rolling-stock industry

In July 2019, Brazil's competition watchdog, CADE, fined 42 individuals and 11 companies, including Alstom Brasil Energia, Bombardier Transportation Brasil, and Mitsui & Co Brasil, for rigging at least 26 public tenders to manufacture metro vehicles and trains between 1999 and 2013 in four Brazilian states. The total fines imposed amounted to USD 136 million and included additional measures such as a ban on receiving public subsidies and tax concessions.[1] CADE's investigation followed a leniency agreement signed by Siemens in 2013 with the Brazil competition authority, although the accused companies have always denied participation in the cartel.

More recently, in July 2022, Korea's Fair Trade Commission (FTC), the Korean competition regulator, fined Korean rolling-stock manufacturers Hyundai Rotem, Woojin Industrial Systems, and Dawonsys after it found that they had colluded on rolling-stock contracts worth up to USD 1.83 billion.[2] According to the FTC, Woojin Installation Systems agreed with Hyundai Rotem between January 2013 and November 2016 to refrain from bidding for contracts, allowing Hyundai Rotem to win six rolling-stock awards. Hyundai Rotem agreed in exchange to subcontract work to Woojin Inudustrial Systems, including the manufacture of components. In so doing, Hyundai Rotem prevented competition not only in the downstream market, i.e. the manufacturing of rolling stock, but also in the upstream market, i.e. the production of their components.

Notes:
1. See www.allenovery.com/en-gb/global/news-and-insights/global-cartel-enforcement-control (accessed on 23 September 2022).
2. See www.railjournal.com/rolling-stock/korean-manufacturers-fined-for-collusion/ (accessed on 4 September 2022).

4.3. Consolidation in the rolling-stock industry and competition policy

In the past few years, rolling-stock manufacturers have used M&As to integrate both horizontally and vertically. While the sector already witnessed a first wave of consolidation between 2010 and 2015[55], M&A transactions have seemingly increased since then. As a result, there are now fewer players in the rolling-stock sector but they have expanded in size.

While some M&As can bring benefits, others may reduce competition in the market, notably by creating or strengthening a dominant player. Competition authorities thus normally assess whether any given transaction harms businesses and consumers through higher prices, reduced choice, lower quality, or reduced innovation. Competition authorities increasingly focus on the impact of mergers on technological innovation in the rolling-stock industry, with implications for the future of rail transport. Should competition enforcers determine that a merger raises any competition issues, they either prohibit such a transaction or conditionally approve the transaction subject to the parties committing to comply with structural or behavioural remedies.

In China, the SASAC of the State Council decided in 2015 to merge China South Rail Corporation (CSR) and China North Rail Corporation (CNR), the then world's two largest manufacturers of rolling stock, to create a rolling-stock national champion, CRRC, owned at 53% by the China Railway and Rolling Stock Group Corporation – a holding company entirely owned by the SASAC. The merger represented one of the first examples of a broader trend of mergers and acquisitions among China's SEs, which has led to the emergence of large industrial SEs in various industrial sectors, ranging from aluminium to steel, cement, shipbuilding, and rare earths (forthcoming Trade Policy Paper). Before 2000, CSR and CNR belonged to one state company, the China National Railway Locomotive & Rolling Stock Industry Corporation. In September 2000, China's State Council approved the splitting of the company to encourage domestic competition in locomotive and rolling-stock manufacturing. Despite this stated goal, CSR and CNR mainly served two separate geographical markets south and north of the Yangtze River in central China (Cory,

[55] See, for example, www.mckinsey.com/industries/automotive-and-assembly/our-insights/how-rolling-stock-manufacturers-can-lay-track-for-profitable-growth (accessed on 23 September 2022).

2021[11]). The two companies, however, engaged in competition domestically and internationally, notably in the context of competitive tenders in Türkyie and Argentina in 2011 and 2013, respectively (Ibid).

Consistent with China's Anti-monopoly law, the merger creating CRRC was notified to China's Ministry of Commerce (MOFCOM). On 31 March 2015, although it led to the creation of the world's largest rolling-stock manufacturer, MOFCOM unconditionally approved the merger between CSR and CNR.[56] It bears mentioning, however, that under other jurisdictions such as the EU, a merger between two entities that have a common state ownership may not be considered as a merger between two independent economic entities but rather as an internal restructuring. Were the same reasoning to be followed, it could partly explain why MOFCOM and, since 2018, the State Administration for Market Regulation have unconditionally approved all mergers between SOEs.[57]

The European Commission has, at times, prohibited or approved M&As involving rolling-stock manufacturers or their suppliers. Between 2015 and August 2022, the Commission has reviewed seven mergers in the rolling-stock industry (see Annex B). Four of these mergers were unconditionally cleared. The Commission, however, negotiated structural remedies with the merging companies in two transactions (*Wabtec Corporation/Faiveley* and *Alstom/Bombardier*). It also prohibited the proposed merger between Siemens and Alstom, which some deemed necessary at the time to create a European industrial champion able to compete against China's CRRC.[58] The Commission considered that the transaction would have produced anticompetitive effects in the markets of (i) high-speed and very high-speed trains; and (ii) mainline signalling systems.

Alongside merger control, the rolling-stock industry has also been subject to recent market investigations. In its prohibition decision in Siemens/Alstom, the European Commission had identified competition concerns in the signalling market of the United Kingdom. This prompted the UK Office of Rail and Road (ORR), to examine more closely competition within the UK signalling market following the Commission's decision to block the transaction (ORR, 2021[17]). The ORR subsequently formulated various remedies to address competition issues in the UK signalling market.

Competition policy therefore plays a key role in the context of M&As and in ensuring a level playing field in the rolling-stock industry more broadly. Competition concerns arising from the merging of two domestic companies may, nevertheless, be amplified by the presence of trade barriers affecting foreign competition, which competition rules do not necessarily capture. This could include government support received by the merging entities (discussed in the next section), as well as restrictive public-procurement rules impeding foreign companies' access to the domestic market (discussed above).

4.4. Forced technology transfers in the rolling-stock industry[59]

While international technology transfers (ITT) by multinational enterprises can contribute to enhancing knowledge diffusion and gains from trade, there are concerns with respect to policies and measures restricting market access to 'force' technology transfer. Forced technology transfers commonly occur in situations where the owner of a technology (e.g. an investor or licensor) is required to transfer technology to access a foreign market or obtain the necessary permits to operate under the same conditions as local firms.

[56] Prior to MOFCOM's approval, in early March 2015, the SASAC of the State Council, which is the very same body that pushed for the transaction, had already granted its approval for the merger. See www.railjournal.com/financial/cnr-csr-merger-moves-forward/ (accessed on 10 August 2022).

[57] See forthcoming Trade Policy Paper on state enterprises and industrial subsidies.

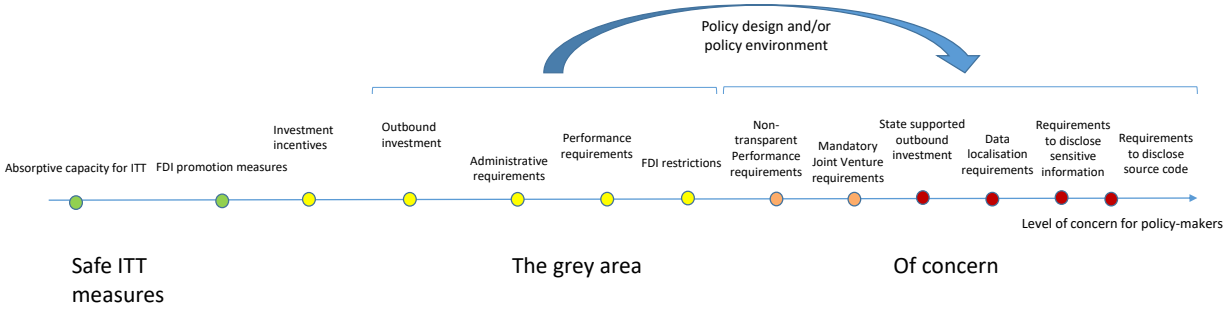
[58] In December 2018, during the in-depth investigation of the European Commission, 18 Member States issued a joint statement calling for an update of the EU merger rules to facilitate the creation of European industrial champions.

[59] This sub-section draws heavily on earlier work undertaken for the OECD Trade Committee on international technology transfers, unless otherwise specified. See Andrenelli et al. (2019[18]).

Efforts to identify and constrain domestic policies that force technology transfer may represent a complicated task. While certain foreign-investment restrictions might signal the presence of a state-led policy to compel technology transfer, the frontier could be elusive between technology transfer taking place under voluntary and mutually agreed terms and that which may be forced. In addition, even absent foreign-investment restrictions, the steering role of the state in an economy, notably through stakes in companies competing or partnering with foreign firms, may raise doubts as to the voluntary character of such transfer. Information on government-induced transfers is generally hidden, such as where it is located in private confidential contracts between firms or in confidential agreements with authorities, local or central. The hidden nature of these practices is exacerbated by the fact that companies may be reluctant to report publicly on them, particularly if they fear losing access to valuable markets.

For the purpose of informing policy discussions on this issue, the OECD has organised measures related to ITT along a continuum that differentiates between three groups of policies (Andrenelli, Gourdon and Moïsé, 2019[18]) (Figure 13). These range from policies aimed at creating an appropriate supporting environment for ITT, to policies that may have the effect of imposing ITT to varying degrees, and, ultimately, policies that clearly result in the forced transfer of technology. This ITT continuum further classifies policies according to two main factors, namely (i) the degree of compulsion the policies impose on foreign firms when they interact with local counterparts; and (ii) the effect they have on the extent of foreign firms' control over their proprietary technology.

Figure 13. The OECD's continuum of ITT-related measures



Note: Green measures aim at creating an appropriate supporting environment for ITT. Yellow measures may have the effect of imposing ITT to varying degrees. Orange and especially red measures have the potential to result in the forced transfer of technology.
Source: Andrenelli et al. (2019[18]).

Certain policies may have resulted in the forced transfer of technology in the rolling-stock industry over the past three decades, even though evidence is often scarce and inconclusive. Policies setting up a 'quid pro quo' between market access and technology transfer may have the effect of forcing a transfer of technology, notably when combined with other explicit or implicit measures restricting market access. Foreign rolling-stock manufacturers seeking to access China's vast and growing rail-supply market in the early 2000s were, for example, required by central authorities to enter into joint ventures (JVs) with domestic state enterprises and sign technology-transfer contracts (Box 3). Establishing that a technology transfer is forced may nevertheless prove difficult where foreign companies (as was the case in China) agree with the country's conditions to access its domestic government-procurement market and accept the terms of the technology-transfer contracts. Often, it is the association of a mandatory JV requirement with other policies[60] that can help draw the line between mutually agreed and forced technology transfers.

60 For example, the obligation to partner with a state enterprise holding the JV's controlling share and potentially receiving privileged access to regulatory information or the obligation to obtain a state-delivered license without pre-defined criteria to participate in rolling stock tenders. On the reported market-access restrictions in China, see Case M.8677 – *Siemens/Alstom*, para 129.

Box 3. Technology transfers and the development of high-speed rail in China

Although China's central government began planning for the country's high-speed rail network in the 1990s, it did not initiate any actual construction until the early 2000s, by which time conventional train lines were experiencing serious congestion (Lin, Qin and Xie, 2021[19]; Ker, 2017[16]). Following the introduction in 2003 of a new strategy for high-speed lines in China, the Ministry of Railways unveiled in 2004 the Medium to Long-term Railway Network Development Plan. The Plan specified that the country's total operating rail network should reach 120 000 km by 2020 and that 16 000 km of the rail network should be covered by high-speed rail lines.

In the 1990s, various attempts to develop indigenous high-speed rail technologies had remained unsuccessful. Less than two years after China had unveiled its first high-speed train, the 'China Star', the Ministry of Railways declared that the train's core technology was immature, thereby halting its production (Ker, 2017[16]).[1] As a result, China's Ministry of Railways adopted a 'quid pro quo' approach aimed at facilitating the acquisition by Chinese companies of advanced technologies from foreign multinationals by requiring technology transfers in return for access to the domestic market (Holmes, McGrattan and Prescott, 2015[20]; Lin, Qin and Xie, 2021[19]). Between 2004 and 2006, the then two state-owned rolling stock manufacturers, CSR and CNR, awarded contracts to foreign companies under the condition that they form local joint ventures, assemble the trains in China, as well as transfer their technological expertise (Lin, Qin and Xie, 2021[19]; Ker, 2017[16]). Alstom, Siemens, Bombardier, and Kawasaki Heavy Industries, among others, agreed to these conditions and signed technology transfer contracts with CSR and CNR. More specifically, the four foreign rolling-stock manufacturers agreed to design train modes based on foreign prototypes jointly with their local partners, provide access to train blueprints and instructions on manufacturing procedures, as well as train Chinese engineers (Lin, Qin and Xie, 2021[19]).

In 2007, China introduced its first high-speed service, which featured high-speed trains manufactured in China. Two years later, the Ministry of Railways ordered to CSR a fleet of 100 16-car and 40 eight-car high-speed trains (CRH3801 model) in a contract worth CNY 45 billion (USD 6.7 billion). The model, running at a maximum operating speed of 380km/h, entered service in September 2010. Hence, following a process of 'digestion and re-innovation' conducted at record pace, Chinese engineers had assimilated high-speed trains' core technologies, including engines, dynamos, and electricity transmissions to railway signal control systems, which had formed part of the technology-transfer contracts (Lin, Qin and Xie, 2021[19]). Furthermore, technology-transfer contracts signed during the 2004-06 period with suppliers of key rolling-stock components (e.g. Mitsubishi, Hitachi, and ABB) enabled CSR and CNR to integrate other critical parts of high-speed trains, notably traction motors, braking systems, and series pantographs (Lin, Qin and Xie, 2021[19]; Ker, 2017[16]).

Note
1. See also www.ft.com/content/2b843e4c-c745-11df-aeb1-00144feab49a (accessed on 14 September 2022).

5. The scope and scale of government support in the rolling-stock value chain

As mentioned in the previous section, governments have long been involved in rail transport, including by providing support to railways for economic and strategic reasons. Less common – though also less documented – is government support for the production of rolling stock itself. This is not to say that rolling-stock manufacturers do not obtain subsidies and other forms of government support, but rather to highlight that attention has generally focussed more on competitive conditions in rail transport than on rail equipment. Yet a number of rolling-stock manufacturers and rail-industry representatives have expressed concerns over what they see as 'unfair' competition caused partly by government support benefitting their competitors. US company Greenbrier noted, for example, in its annual report for 2020 that: "[some of its] competitors are owned or financially supported by foreign governments and may sell products below cost or otherwise compete unfairly."

5.1. Supply-push policies supporting rolling-stock manufacturers

To shed light on the scale of government support in the rolling-stock industry, this report analyses information collected for a sample of some of the largest rolling-stock manufacturers. This sample contains 22 firms of all sizes and geographical regions, including two firms that do not produce rolling stock but specialise in signalling and rail control (Table 2). Although it does not comprehensively cover all of the rolling-stock industry, data from Table 1 suggest nevertheless that the combined revenue of the sampled companies represented more than 70% of the global rolling-stock market in 2020. The period considered in this study covers 2016 to 2020 so that companies that recently exited the rolling-stock industry are still included in earlier years (e.g. GE and Vossloh). The analysis focuses on support provided by governments in the form of grants, tax concessions, and below-market finance but was not able to look into the sale of intermediate inputs and land to manufacturers at below-market prices due to lack of data.

As mentioned earlier, most rolling-stock manufacturers offer an integrated suite of goods and services, which makes it difficult to separate clearly the sector from other related activities in the broader rail supply market. As is apparent in Table 2, some of these companies are also large industrial conglomerates that have activities unrelated to rail supply. This problem already presented itself in earlier OECD studies on government support in the aluminium and semiconductor value chains (OECD, 2019[2]; OECD, 2019[3]), but is particularly acute in rolling stock. Before GE sold its remaining rail activities (locomotives mostly) to Wabtec, this segment only represented 4% of the company's consolidated revenue. Likewise, Kawasaki Heavy Industries' rail business only accounts for less than 10% of the conglomerate's activities, which span shipbuilding, aerospace, industrial equipment, and power plants. Siemens and Thales are two other notable cases in the sample, with the latter largely focused on defence and aerospace activities.[61] It is precisely for this reason that the report is not able to cover Hitachi Rail, for which only group-level consolidated information could be found for the variables of interest.

The diversified nature of some of the companies in Table 2 poses significant challenges for the analysis. This implies that a large or even dominant portion of the government support they receive may not be related to rolling stock, nor even to rail supply. Wherever possible, the analysis has therefore tried to only count the portion of companies' government grants and tax concessions that could reasonably be considered to pertain to rolling stock or rail control and signalling. Only the grants benefitting Siemens Mobility are, for example, included under total grants for Siemens, thus excluding the amounts received by Siemens Health or Siemens Energy. This adjustment has, at times, required assumptions where detailed information was lacking for certain companies. The adjustment was also impossible in the case of below-market borrowings since this particular type of support depends on companies' consolidated debt and their overall financial standing as assessed by credit-rating agencies.[62] This caveat should be borne in mind when interpreting the results below. Moreover, information on grants could not be located for Bombardier and Nippon Sharyo, thereby making it impossible to judge whether the absence of such information is because these two companies did not receive any support, or rather because they failed to disclose the grants they have obtained.

[61] Hitachi Rail announced in August 2021 that it had entered an agreement to acquire Thales's ground-transportation activities, leaving the French conglomerate to focus on aerospace and defence-related activities. See www.hitachirail.com/press/#/pressreleases/hitachi-rail-enters-agreement-to-acquire-thales-ground-transportation-systems-business-3119538 (accessed on 9 September 2022).

[62] Group-wide financials were thus used in estimating below-market borrowings.

Table 2. The sample contains 22 firms of all sizes and geographical regions

Firm name	Home jurisdiction	Government ownership?	Consolidated revenue in FY2020 (USDmn)	% of rail-related activities in consolidated revenue
Alstom	FRA	No	9 870	100
Bombardier(1)	CAN	No	14 331	55
CAF	ESP	No	3 104	74
CRRC	CHN	>50%	36 425	70
CRSC(4)	CHN	>50%	6 420	75
GE(2)	USA	No	89 038	4
Greenbrier	USA	No	2 792	100
Hyundai Rotem	KOR	No	2 312	52
Kawasaki HI	JPN	No	12 950	9
NEWAG	POL	No	331	91
Nippon Sharyo	JPN	No	865	78
PT INKA	IDN	100%	162	100
Siemens	DEU	No	64 201	16
Stadler	CHE	No	3 363	100
Talgo	ESP	No	547	100
Tatravagonka	SVK	No	464	100
Thales(4)	FRA	<50%	19 089	10
Titagarh Wagons	IND	No	198	99
Transmashholding	RUS	No	3 970	100
Trinity	USA	No	1 999	100%
Vossloh(3)	DEU	No	977	100%
Wabtec	USA	No	7 556	99%

Note: (1) Bombardier finalised the sale of its rail activities (Bombardier Transportation) to Alstom in January 2021; (2) GE sold its rolling-stock business to Wabtec in 2019 so that data for GE are for the year 2018; (3) Vossloh sold its locomotive business to CRRC in 2020; (4) signalling and rail control supplier.
Source: OECD, based on firms' annual reports and financial statements.

Looking at the government grants, tax concessions, and below-market borrowings that rolling-stock manufacturers obtained over the period 2016-20 indicates that these amounted to about USD 5 billion, i.e. an annual average of USD 1 billion (Figure 14). Of this amount, grants represented 34% of all support, tax concessions 54%, and below-market borrowings (including implicit and explicit government guarantees) 12%. This confirms the findings of a recent OECD report on below-market finance, and which found below-market borrowings to be relatively modest in rolling stock (OECD, 2021[1]). That being said, CRRC alone obtained almost 60% of all the below-market borrowings that this study has identified and quantified. This is the case even as government loan guarantees play a limited role in rolling stock, with CRRC's standalone rating by Moody's and Fitch closely tracking its all-in rating, which factors in the assumption of government support in case the company runs into financial difficulties.[63]

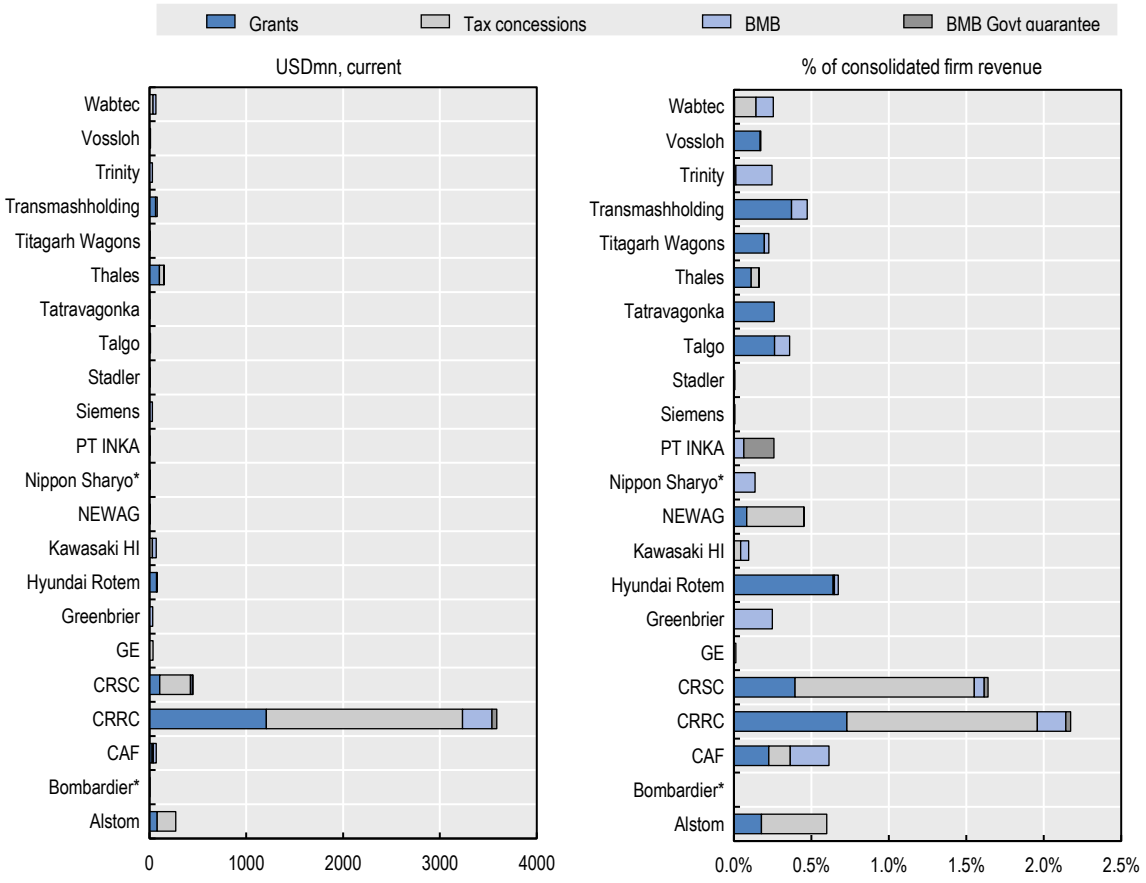
Looking at recipients shows that CRRC obtained as much as 72% of all absolute support, followed by Chinese signalling producer CRSC (9%), and French company Alstom (5%). This implies that the top three companies obtained 86% of all support identified in this study between 2016 and 2020. Two of them, CRRC and CRSC, are also state enterprises. As a percentage of annual revenue, CRRC received support equivalent to 2.2%, CRSC 1.6%, and Alstom 0.6%, similar to the level of support obtained by competitors

[63] See www.moodys.com/research/Moodys-affirms-CRRCs-A1-rating-outlook-stable--PR_468047 (accessed on 13 September 2022): "CRRC's A1 issuer rating incorporates its standalone credit profile and a two-notch uplift reflecting Moody's expectation of a very high likelihood of extraordinary support from the Government of China (A1 stable) through CRRC's parent, CRRC Group Corporation (CRRCG), in times of need. CRRCG is 100% owned by the State-Owned Assets Supervision and Administration Commission of the State Council of China."

CAF and Hyundai Rotem. Other companies received modest amounts of support representing 0.5% or less of their revenue.

There are also notable differences in the type of support that companies obtained. In particular, support measures for R&D play an important part behind the numbers presented in Figure 14. The amounts of support that Alstom received consist, for example, entirely of grants and tax concessions in relation to R&D, in a context where the group spends 3-4% of its revenue to develop, among other things, new HS trains, battery electric multiple units (BEMU), and new bogie designs. Spanish company CAF has received, for its part, R&D funding from both local and central authorities in Spain (e.g. the Provincial Government of Guipúzcoa and the Spanish Ministry of Science and Innovation) and the European Commission. The projects thus co-financed concern *inter alia* improvements to the company's offer of rolling-stock products, digitalised services, and signalling technology. Wabtec obtained, meanwhile, R&D tax credits from the US Federal Government that are widely available to US firms. Figure 15 shows how much of the grants and tax concessions that companies obtained has been estimated by the OECD to concern R&D. While R&D subsidies may often serve a valid purpose in overcoming market failures, they should still be designed such that they are transparent, proportional, and conducive to competition (forthcoming *OECD Trade Policy Paper*).

Figure 14. Total government support for the sampled companies amounted to about USD 5 billion over the period 2016 20

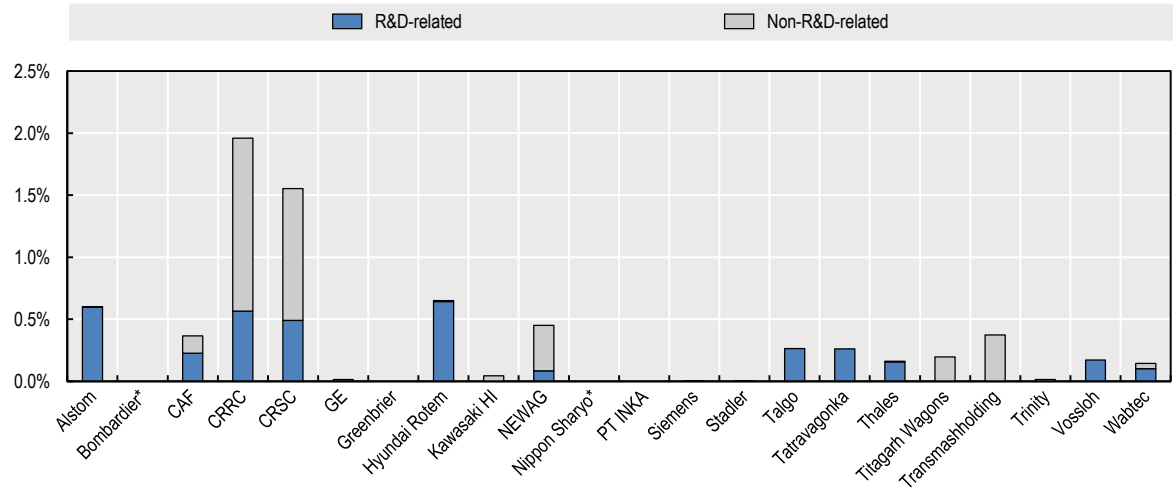


Note: BMB = below-market borrowings. Data could not be located on the government grants obtained by firms marked "*". Data for GE only concern the period 2016-18 as the company exited the rail segment in 2019.
Source: OECD research.

Yet R&D alone does not explain why tax concessions formed the largest support instrument among the measures identified in rolling stock over 2016-20. Some of the support included under tax concessions takes the form of tax reductions or investment incentives. Polish company NEWAG received, for example, partial income-tax relief in 2019 in relation to the expansion of its production plant within the Special Economic Zone of the Cracow Technological Park.[64] CAF also benefitted from tax incentives from local Spanish authorities conditional on the company making certain additional investments. As is the case with some other Chinese manufacturing groups, several of CRRC's subsidiaries have obtained from provincial authorities the 'high-technology new enterprise' status that lowers income-tax rates from 25% to 15%. Together with other tax incentives in relation to the company's R&D expenses, this conferred CRRC tax support of more than USD 400 million in 2020 alone.

Figure 15. A sizable portion of the grants and tax concessions received by companies are R&D-related

% of consolidated firm revenue, 2016-20



Note: The proportions of grants and tax concessions that are related to R&D are estimated based on firms' own reporting and government databases. Amounts are assumed to not be related to R&D where the necessary information is not available from companies or authorities. Data could not be located on the government grants obtained by firms marked "*".
Source: OECD estimates.

The support amounts presented in this report do not include the grants and tax concessions that companies might have received in the context of the COVID-19 pandemic. Corporate reporting on COVID-related support appears to be inconsistent across companies and countries, so that counting these measures only where the data are available would skew the results and provide a misleading picture of structural support in the rolling-stock industry. Of those companies that disclosed COVID-related support, one is Bombardier Transportation (the rail unit that Bombardier sold to Alstom in 2021), which mentioned having received USD 87 million in COVID-related wage subsidies from Canada and other governments. Another example is US company Trinity, which reported a tax benefit of USD 180 million in 2020 on account of certain provisions[65] of the US CARES Act (Coronavirus Aid, Relief and Economic Security Act). These measures are not counted in the above numbers.

[64] See www.newag.pl/en/newag-to-increase-its-manufacturing-capacity/ (accessed on 11 February 2022): "[t]he Special Economic Zone of the Cracow Technological Park will support NEWAG by granting it a right to be exempted from the income tax in the amount of 35% of qualified costs after special conditions are met."

[65] This refers to the exceptional carry-back of prior tax losses, which allows for the recovery of taxes previously paid.

Because below-market borrowings are estimated rather than obtained directly from corporate or government sources, they are subject to more caveats[66] and do not enable the analysis to isolate COVID-related aid from more structural support. Even then, below-market borrowings benefitting rolling-stock manufacturers do not appear to be a major channel of support outside China. A few examples could be found, such as Spanish producer Talgo obtaining advances refundable at zero or reduced rates under the European Commission's "Shift2Rail" research project and Spain's Center for Development of Industrial Technology. Yet the amounts involved appear relatively small overall.

This report, meanwhile, has not found below-market equity to be an important channel of support in the rolling-stock industry. There are only a handful of rolling-stock manufacturers and suppliers of rail-control equipment in which governments are large shareholders. Of those covered in this study, only one has had relatively low returns on its assets, namely Indonesian state enterprise PT INKA. The company noted in 2019 that: "[b]ased on Government Regulation no. 67 of 2016, PT INKA (Persero) received an additional State Capital Participation (PMN) for the 2016 fiscal year amounting to IDR 1,000,000 million which is planned to be used for investment and revitalization of production facilities, financing for driven trains and the construction of a new workshop in Banyuwangi." Applying the methodology detailed in earlier work on below-market finance (OECD, 2021[1]), the resulting below-market equity returns would correspond to support of less than USD 100 million over the period 2016-20. While this is significant for a company the size of PT INKA, it does not represent much compared with the total support shown in Figure 14.

The results presented in this section suggest that CRRC is a significant recipient of support both in absolute and relative terms, as is signalling company CRSC. This finding is consistent with policy developments: China's "Made in China 2025" ten-year plan, announced in 2015, has set detailed quantitative targets for the production and export of rolling stock and other rail equipment.[67] The plan calls notably for overseas sales to reach 40% of total sales for 'advanced rail transportation equipment' and 20% for railway services, backed with financial support from the government and state banks.[68] To the best of the authors' knowledge, China is unique among the countries covered here in having aspirational quantitative targets set by the government for selling rolling stock abroad.

5.2. Demand-pull policies in the rolling-stock industry

Together with a protected domestic market, the support that rolling-stock manufacturers receive could help them scale up their operations not only domestically, but also internationally. While the discussion so far has concerned government support benefitting rolling-stock manufacturers directly (i.e. supply-push policies), below-market funding for their customers in the form of export credits at non-market rates (i.e. an instance of demand-pull policies) may also prove to be another important other channel of support for the industry. The ability to secure financing for projects is indeed key in the rail-supply industry, which eventually affects not only railways but their equipment suppliers too.

The export credits offered by Participants to the OECD *Arrangement on Officially Supported Export Credits* are normally subject to this Arrangement and should therefore reflect market terms and conditions.[69] A growing and large number of transactions involve, however, countries that are not Participants to the OECD Arrangement (Dawar, 2020[21]) and may therefore offer terms that are more generous than the market. In the case of the rail-supply industry, many transactions have taken place in the context of China's Belt and

[66] A full description of the methodology can be found in earlier OECD work on below-market finance (OECD, 2021[1]) and government support in semiconductors (OECD, 2019[3]).

[67] See www.uschamber.com/assets/documents/final_made_in_china_2025_report_full.pdf (accessed on 13 September 2022). See also the Chinese Government's own "'Made in China 2025' -- technology roadmap for key areas" (《中国制造2025》重点领域技术路线图), which was released by the National Manufacturing Power Construction Strategy Advisory Committee in October 2015.

[68] See www.gov.cn/xinwen/2016-02/16/content_5041671.htm (in Mandarin Chinese; accessed on 13 September 2022).

[69] See www.oecd.org/trade/topics/export-credits/. The OECD guideline notably stipulates transparency requirements; limitations on financing terms and conditions (maximum repayment terms, minimum interest, and premium rates); social, environmental and governance standards; as well as limits on the use of tied aid.

Road Initiative (BRI), including through non-Arrangement loans offered by the Export-Import Bank of China (China Eximbank), but also other international lending from the China Development Bank (another policy bank) and, to smaller extent, from state-owned commercial banks (e.g. Industrial and Commercial Bank of China).

State banks can therefore be involved on both sides of a transaction: on the supply side, where they provide financing to rolling-stock manufacturers; and on the demand side, where they offer loans to buyers of rolling stock. In the latter case, the loans do not appear on the balance sheet of rolling-stock manufacturers but may nonetheless provide support to them if the transactions occur outside of competitive market terms. Longer-term maturities, for example, have often been observed for loans offered by China Eximbank even as the OECD Arrangement sets the maximum repayment term at 12 or 14 years for rail infrastructure projects [TAD/PG(2022)1].[70] The Lao-China Railway, a BRI project, has obtained financing from China Eximbank with a 25-year maturity and a five-year grace period (World Bank, 2020[22]).[71] Nigeria's Abuja Light Rail Project and the Lagos-Ibadan Railway modernisation project have received loans from China Eximbank with a maturity of 20 years and seven-year grace period.[72] Likewise, the Philippine National Railways's South Long-Haul Project has obtained financing from China Eximbank with a 20-year maturity and seven-year grace period.[73]

Competing export-credit agencies have at times expressed concerns over the interest rates at which Chinese policy banks offer loans for purchasing Chinese equipment. In certain cases, the interest rates offered by China Eximbank were found to be lower than the minimum interest rates required by the OECD Arrangement for providing official export credits at fixed interest rates, and which are known as Commercial Interest Reference Rates (CIRRs). It should be noted that the Arrangement further requires that export-credit agencies charge minimum premium rates on top of the CIRRs to account for the credit risk of a borrower. There are several instances, however, where the rates offered by China Eximbank have been lower than CIRRs (taking into account currencies and maturities), including the Lao-China railway mentioned above, Egypt's inter-urban light rail line,[74] the Lagos-Ibadan railway modernisation project, and at least a portion of Pakistan's Lahore Orange Line Metro Train,[75] to list a few.

Many of these loan agreements have, moreover, strict confidentiality clauses that prevent the disclosure of an agreement's terms and conditions or, in certain cases, the existence of the deal itself (Gelpern et al., 2021[23]). Some loan contracts offered to foreign buyers by the China Development Bank (CDB), another of China's policy banks, also have a notable characteristic in that they tie seemingly unrelated projects using a cross-default clause that can be triggered when a borrower's actions are deemed 'adverse' to any Chinese entity. One example is the CDB-funded Belgrano Cargas Railway project in Argentina, which CDB threatened to cancel when the Argentinian authorities moved to suspend the construction of dams in the Santa Cruz River Hydroelectric complex (partly CDB-funded) following an environmental impact assessment. The Argentinian Government eventually proceeded with the construction of the Santa Cruz River dam (Ibid).

[70] The maximum repayment term is 12 years for project contracts in high-income countries and 14 years for all other countries.

[71] Other sources mention a maturity of 35 years. See, for example, https://asiatimes.com/2021/12/6-billion-laos-china-railway-on-track-to-somewhere/ (accessed on 13 September 2022).

[72] See www.dmo.gov.ng/debt-profile/external-debts/3768-status-of-china-loans-as-at-september-30-2021/file (accessed on 14 September 2022).

[73] See www.pna.gov.ph/articles/1079154 (accessed on 14 September 2022).

[74] See https://egyptindependent.com/egypt-exim-sign-electric-train-loan-executive-agreement/ and https://dailynewsegypt.com/2019/01/16/egypt-signs-1-2bn-worth-agreement-with-exim-bank-of-china-to-finance-1st-electric-train/ (accessed on 14 September 2022).

[75] A first portion of the package (CNY 1.2 billion) has a 2% interest rate and another portion (USD 203 million) has 5.2% while the interest rate for a third portion (USD 1.24 billion) is unknown according to https://china.aiddata.org/projects/37280/ but other sources indicate an overall rate of 3% for the USD 1.6 billion contract according to https://pma.punjab.gov.pk/system/files/pcI.pdf (accessed on 14 September 2022).

Evidence on the effects that export credits offered on non-market terms have on the rolling-stock industry remains anecdotal at best, largely because information is scarce about individual transactions. Industry participants and export-credit agencies have noted nevertheless that non-market transactions contribute to tilting the playing field and undermine fair competition. Importantly, this impact does not seem confined to OECD countries but also affects emerging economies. As acknowledged by Indonesian state enterprise PT INKA in its annual report for 2018:

> *"For Indonesia to be able to enter the global market, we must be able to compete with India and China, where the two countries besides being able to offer competitive prices are also accompanied by funding package offers. The railroad industry in India and China is fully supported by their respective government Exim Banks. For the Indonesian railroad industry without government support it will be difficult to take advantage of export opportunities to other regions and developing countries because they cannot compete with the prices of products from India and China."*

6. Conclusion

Overall, this report has documented the different and complex ways in which governments support their rolling-stock industry. From government grants to tax concessions, below-market borrowings, government equity injections, non-market export credits, local-content requirements, forced technology transfers, selective enforcement of competition policy, and discriminatory government procurement, the range of tools employed is broad and does not always lend itself to quantification and economic analysis. Information is also scarce about each individual measure, making it difficult to offer a single, comprehensive assessment covering the full range of policy interventions. The findings in this report should nevertheless help governments identify the main areas of concern, with a view to reforming trade rules and disciplining the most harmful practices.

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Annex A. Firm sample used in collecting data on government procurement awards

The data collected by the OECD include individual government contracts awarded to the following rolling-stock manufacturers:

- Alstom (France)
- Bombardier Transportation (Canada)
- CAF (Spain)
- CRRC (China)
- Greenbrier (United States)
- Hitachi Rail (Japan)
- Hyundai Rotem (Korea)
- Kawasaki Heavy Industries (Japan)
- Newag (Poland)
- Nippon Sharyo (Japan)
- PT Inka (Indonesia)
- Siemens Mobility (Germany)
- Stadler (Switzerland)
- Talgo (Spain)
- Wabtech (United States)
- Woojin Industrial Systems (Korea)

Note that individual contracts awarded to the Italian rolling-stock and signalling companies Ansaldo Breda and Ansaldo STS have been recorded as contracts granted to Hitachi Rail since their acquisition by the group in 2015. Likewise, this work has recorded individual contracts awarded to Vossloh locomotives to CRRC since the acquisition of Vossloh's locomotive business by CRRC in 2020.

Annex B. Merger and acquisitions in the rolling-stock industry reviewed by the European Commission since 2015

Please note the list below only includes M&As between rolling-stock manufacturers or between rolling-stock manufacturers and suppliers of rolling stock. It does not cover joint ventures, which the Commission reviewed, between rolling-stock manufacturers and other companies.

Case name and number	Details of the transaction	Companies' activities	Commission's decision date	Commission's decision	Proposed remedies
Hitachi/Ansaldobreda and Ansaldo STS (M.7581)	Acquisition of sole control over AnsaldoBreda S.p.A. and Ansaldo STS S.p.A. by Hitachi Ltd	**Ansaldo breda**: railway and rolling stock **Ansaldo SPS**: signalling and integrated transport systems for passenger traffic and freight operation **Hitachi Rail**: rolling stock	29 April 2015	Unconditionally approved No or minor overlaps between the companies' activities in the European Economic Area)	N.A.
Vossloh/Knorr Bremse (M.7538)	Acquisition of sole control over Vossloh Aktiengesellschaft (Vossloh) by KB Holding GmbH, the holding company of Knorr-Bremse AG	**Vossloh**: locomotives, trains, and their subsystems **Knorr-Bremse**: train brakes and other components and subsystems for rail and commercial vehicles	15 September 2015	Unconditionally approved The merging companies' combined market shares generally remained modest and a number of competitors remained active on all levels of the value chain where the merging parties were active	N.A.
Wabtec/Faiveley Transport (M.7801)	Acquisition of Faiveley Transport of France by US-based Wabtec	**Faiveley Transport**: various types of train equipment such as brakes, friction materials and pantographs **Wabtec**: various types of train equipment such as brakes, friction materials and pantographs	4 October 2016	Conditionally approved The merger would eliminate one of only three strong suppliers in the aftermarket for sintered train friction brake materials. The presence of a single remaining competitor (Knorr-Bremse) would have been insufficient to maintain adequate competition	Divestment of Faiveley Transport's sintered friction material business, Faiveley Transport Gennevilliers
Siemens/Alstom (M.8677)	Acquisition of Alstom by Siemens	**Alstom**: rolling stock; related services (maintenance and modernisation); as well as products dedicated to signalling solutions, passengers and infrastructure, rail electrification systems and digital	6 February 2019	Prohibited Serious concerns that the proposed transaction would significantly impede effective competition in two main areas: (i) signalling systems, and (ii) very high-speed trains	The remedies offered by the parties did not adequately address the Commission's competition concerns

Case name and number	Details of the transaction	Companies' activities	Commission's decision date	Commission's decision	Proposed remedies
		mobility **Siemens**: rolling stock, rail automation and signalling solutions, rail electrification systems, road traffic technology, IT solutions, as well as other products and services concerning the transportation of people and goods by rail and road.			
Alstom/Bombardier Transportation (M.9779)	Acquisition of Bombardier Transportation by Alstom	**Alstom**: rolling stock; related services (maintenance and modernisation); as well as products dedicated to signalling solutions, passengers and infrastructure, rail electrification systems and digital mobility **Bombardier Transportation**: rolling stock; sub-systems and signalling, to complete turnkey transport systems, and services	31 July 2020	Conditional approval	- Divestment of Bombardier's assets in its joint very high-speed platform with Hitachi, the "Zefiro V300 - Various divestments in the market of multiple units - Supply of signalling equipment to *inter alia* other signalling competitors
Voith/PSCH/TSA (M.9911)	Acquisition of Traktionssysteme Austria GmbH (TSA) by Voith and PCS Holding AG (PSCH) of Switzerland	**TSA**: electric traction motors and generators **Voith Group**: machines for a range of industrial applications, including gearboxes and control systems for trains and busses **PCSH**: rolling stock and special purpose vehicles	19 November 2020	Unconditionally approved No competition concerns, given the limited foreseen activities of the joint venture in the European Economic Area, as well as given the limited combined market positions resulting from the proposed transaction.	N.A.
CAF/Coradia Polyvalent Business/Talent 3 Business (M.10616)	Acquisition of Bombardier Transportation's platforms (Coradia Polyvalent Business and Talent 3 Business) by CAF	**Bombardier Transportation's platforms**: Multiple units' platforms **CAF**: rolling stock	25 May 2022	Unconditionally approved No competition concerns as the parties have limited market shares, are not closed competitors and would continue facing credible competitors.	N.A.

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Comments are welcome and can be sent to tad.contact@oecd.org.