Policy Brief

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Will Chinese Auto Export Boom Transform into Local Production in Europe?

Thierry Mayer, Vincent Vicard & Pauline Wibaux

Summary

The automotive industry faces two disruptions: China's emergence as a leading global auto exporter, and the transition from internal combustion engine (ICE) to electric vehicles (EVs).

Detailed data on sales by origin/destination/model show that the automotive market is primarily local or continental, with limited sales originating from distant countries for both ICE and EV. Accordingly, foreign direct investment (FDI) is an important mode of supply for foreign markets.

Insights from Japanese and Korean brands' market penetration in the 2000s and 2010s suggest that successful models are primarily sold through local assembly; the most successful Chinese EV models in Europe are close or above the investment threshold.

Examination of potential differences between EV and ICE indicates evolving comparative advantages: while EVs are not inherently more traded compared to other vehicles, China currently leads in cells and modules, but not yet in assembly.

Down the value chain, the median distance between battery production and assembly is 215 km in 2022, suggesting localized sourcing in EV similar to combustion engines and larger than ICE transmissions.

With close to 5 million vehicles exported in 2023, China is now the leading global auto exporter, taking over from Germany and Japan in terms of number of vehicles shipped abroad.[1] Its emergence as an export base over a very short period – China exported almost 10 times fewer vehicles in 2019 – challenges the traditional core producer countries of the car industry, a sector that employs 2.6 million workers directly in the manufacturing of motor vehicles in Europe (8.5% of EU manufacturing employment).[2] It was also in 2023 that the EU adopted the ban on sales of new internal combustion engines (ICEs) by 2035, confirming the challenge of the rapid transition to electric vehicles (EVs) for European carmakers (electric vehicles represented 12% of sales in the EU in 2022).[3]

China's emergence has spurred dedicated economic policy reactions in both the US and the EU. The Inflation Reduction Act in the US sets up subsidies of up to $7,500 for the purchase of an EV, with a local content requirement in favor of facilities located in the US and countries with which the US has a free-trade agreement. It explicitly bars from the subsidy vehicles that source battery components or critical materials from a "foreign entity of concern", which includes China. In May 2024, US President Joe Biden announced a tariff increase from 25% to 100% on EVs imported from China, and from 7.5% to 25% on lithium-ion EV batteries.[4] The European Commission has initiated an anti-subsidy investigation into Chinese-made EVs exported to the EU and announced provisional countervailing duties up to 38.1%.[5]

Against this backdrop, this policy brief aims at providing an overview of the automotive market and its prospects, focusing on the recent emergence of China, and putting it in perspective regarding how other emerging actors in the past have come to gain market shares in European markets.

We start by documenting three stylized facts about the automotive industry. First, while it is true that Chinese brands have become major new actors in the EV market, foreign brands producing in China still account for a large share of Chinese auto exports. Second, the automotive market is first and foremost local or continental; small shares of sales come from long-distance countries, for both ICE and EV. Third, the geography of automotive sales differs widely when looked at through the lens of the country of assembly or the brand nationality; foreign brands largely serve distant markets through foreign direct investments and local production.

Box – Data

We primarily use data from IHS-Markit, which provides information on sales, local as well as exports, by origin, destination and model. These data are unique in the following dimensions: i) including details on all origins of sales, domestic as well as imported, ii) providing information at the car model (variety) level (including EV, ICE or hybrid vehicles) and iii) it can be used to document the nationality of the brand (allowing FDI measurement). The downside of these data is that they are quantity-driven: sales are documented as the number of units sold and not their value. We consider passenger vehicles and light trucks, including pick-up trucks. We have data over the 2000-2023 period (2023 being projections based on sales for the first 7 months).

Finally, for EVs we have separate information on production at the plant level (origin), over the 2015-2022 period. We convert the production figures into sales by origin/destination, matching with our sales data for each car model/plant combination (for instance, the Nissan Leaf produced in the UK has different destinations from the one produced in the USA, as revealed by the sales data).

We define the nationality of the brand at the time of its creation and keep it time-invariant. This definition is different from the nationality of the firm owning the brand, *e.g.* Volvo is considered as Swedish while its owner Geely is Chinese. Similarly, MG is considered a British brand although owned by Chinese SAIC Motor, and Peugeot and Citroen are considered as French, Fiat as Italian and Chrysler as US while all are currently owned by Stellantis.

To gain some "historical" insights on the prospects of Chinese exports on the European market, we use the experience of Japanese and Korean brands in Europe and North America during the 2000s and 2010s. The Japanese and Korean brands gained market shares in the European and North American markets mainly through FDI and local assembly. We show that successful models are mainly sold through local assembly, while models exported from the base country (the country from which the brand originates) have low average sales. It is interesting in this respect that Chinese EV car models with large sales, like the Polestar 2 or the MG4, have sales close to the threshold that we measure for when FDI becomes the privileged mode of sales.

the automotive market is first and foremost local or continental

Finally, we look at potential differences between EV and ICE that could change the equilibrium patterns of global automotive sales/exports. Overall, EVs are not more traded than other vehicles, suggesting limited scope for larger economies of scale or export platform investments. Trade costs are not largely different: tariffs on Chinese imports are now larger for EVs than ICEs (but lower for batteries), and transport costs are not lower for heavier EV vehicles. The geography of comparative advantage is evolving for EV compared to ICE, with China currently having a better positioning, especially for cells and modules[6] but not yet for assembly. Finally, the median distance of battery production to

(1) In terms of value, China still ranks third due to the lower range of its exported vehicles.

(2) https://single-market-economy.ec.europa.eu/sectors/automotive-industry_en

(3) While EVs make up a large share of Chinese auto exports to Europe, ICE also contributed to the Chinese export boom, mainly to other markets such as Russia, Mexico, Chile and Saudi Arabia (see graph A.1 in appendix).

(4) https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/14/fact-sheet-president-biden-takes-action-to-protect-american-workers-and-businesses-from-chinas-unfair-trade-practices/

(5) https://ec.europa.eu/commission/presscorner/detail/en/ip_24_3231

(6) An EV battery, called a pack, includes a number of modules, which in turn incorporate battery cells.

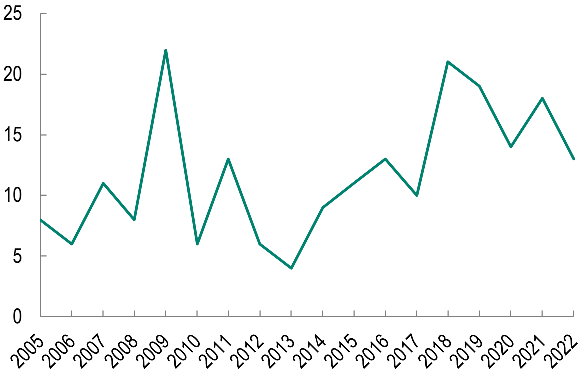
assembly is 215 km in 2022, down from 307 in 2015, similar to combustion engines and lower than transmissions used in ICEs.

1. Three stylized facts on the global automotive industry

1.1. Stylized fact #1: New Chinese brands emerge but foreign brands still contribute largely to Chinese exports.

The creation of new automobile brands has accelerated over the last 5 years (Figure 1). We define new brands as those with sales in *t* but no sales in *t-1* to *t-5*. The average number of new automotive brands per year is 17 over 2018–2022 against 10 over 2005–2017. Most new brands are from China: 39 out of 49 over 2020–2022 and 159 out of 210 over 2005–2022. Over 2020–2022, 4 new brands were created in the US, including some pure EV producers like Rivian and Lucid. The 3 new European brands are traditional automakers (*e.g.* Cupra and Ineos).

Figure 1 – New brands in the automotive sector



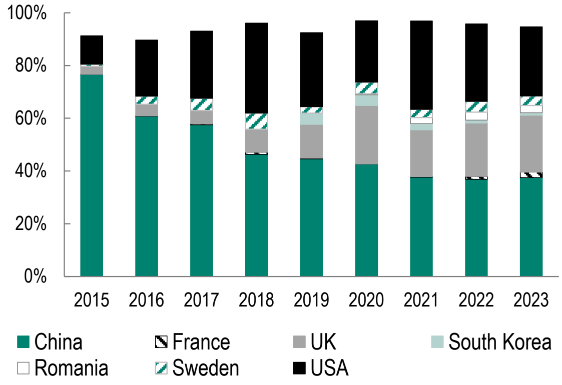
Source: IHS-Markit.

Chinese brands play a key role in the emergence of China as an export engine, but foreign brands still represent a large share of exports from China (Figure 2). In 2022, Chinese brands represented 37% of Chinese exports, while US brands accounted for 29% and British brands for 20%. Note that we classify MG, which represents the bulk of British brands' exports from China, as a British brand.

foreign brands represent a large share of exports from China to Europe

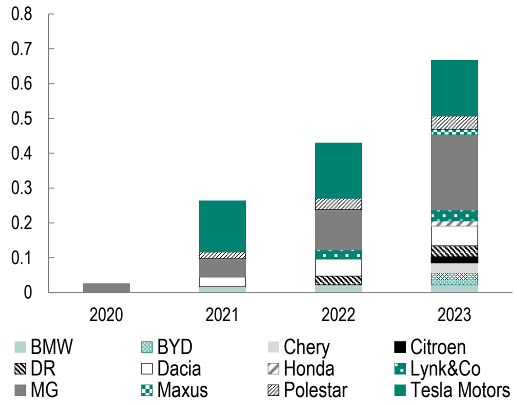
As is the case for global exports, foreign brands represent a large share of exports from China to Europe. Focusing on the European market and specific brands, Figure 3 shows that since 2021 Tesla has exported more than 150,000 vehicles to Europe annually from its Shanghai factory, while MG increased its sales from 30,000 in 2020 to more than 120,000 in 2022. Polestar and Dacia have also been exporting from their Chinese factories to Europe since 2021, and since then have doubled their sales.

Figure 2 – Chinese exports by brand nationality
(share of Chinese exports)



Source: IHS-Markit.

Figure 3 – Chinese exports to Europe by brand



Note: Only brands selling more than 15,000 vehicles in Europe are included. Total exports in million units.

Source: IHS-Markit.

1.2. Stylized fact #2: The automotive market is local/continental.

Cars and light trucks are part of the main products traded globally but are specific in that trade occurs predominantly within continents. Local sales are particularly important, along with intra-continental imports. In 2022, 26 out of 77.5 million vehicles sold globally were traded, of which fewer than half between continents.

Sales in the automotive industry are mostly local or continental, meaning that vehicles do not travel much across continents, due to large transport costs and trade barriers in general. In Europe, intra-continental sales represent more than 84% of total sales in Germany and Italy, and 82% in France (Table 1). Most vehicles sold on European markets are not produced locally (less than a third in Germany, less than a fifth in France and Italy) but in another European country (around two thirds for France and Italy). The same pattern is observed in North America for Canada and the US; Mexico stands here as an exception, with over half of vehicles coming from outside North America. In Asia, extra-continental imports also play a limited role, particularly in China and Japan where local production accounts for more than 90% of sales.

Table 1 – Origins of vehicles sold by country in 2022
(total sales, %)

	Home	Intracont	Extracont	Zone
Germany	31	53	16	Europe
France	19	63	18	Europe
Italy	17	67	16	Europe
China	97	1	2	Asia
Japan	93	0	7	Asia
South Korea	82	2	17	Asia
Canada	10	66	24	America
Mexico	32	12	55	America
USA	58	21	21	America
World	66	18	16	

Source: IHS-Markit.

This local/continental pattern holds in the emerging EV market (Table 2).[7] Overall, EVs travel less than other vehicles: in 2022, 25% of EVs sold worldwide were imported, against 34% for all vehicles. The lower tradability of EVs is largely due to the large and closed Chinese market for EVs (Table 2). In Europe, extra-continental imports represent a quarter of total sales, a number slightly larger than for total car sales, but continental sales remain dominant. Imports from China represent a larger market share in EVs than in ICEs: they account for 17% of EV sales in Germany, 21% in France and 17% in Italy, against 3% for total sales.

25% of EVs sold worldwide were imported

Table 2 – Origins of vehicles sold by country in 2022
(EV sales, %)

	Home	Intracont	Extracont	Zone
Germany	35	38	26	Europe
France	22	51	27	Europe
Italy	9	67	25	Europe
China	100	0	0	Asia
Japan	68	10	22	Asia
South Korea	70	12	19	Asia
Canada	0	75	25	America
Mexico	1	7	92	America
USA	75	5	20	America
World	85	7	7	

Source: IHS-Markit.

This pattern is also observable at the brand level. Among brands selling more than 500,000 vehicles in 2022, only three (MG, Subaru and Lexus) sold more than a third through exports to extra-continental markets (Figure A.2 in Appendix). Some brands also use their foreign plants as an export platform to extra-continental markets but, overall, most large producers sell less than a fifth of their vehicles through long-distance exports. Several brands, such as Nissan, Jeep, Honda, Volkswagen and Ford, sell less than 10% through extra-continental exports.

(7) The market for hybrid vehicles is similar to total sales in Table 1.

1.3. Stylized fact #3: Global sales by country of assembly and by brand nationality are not the same – given the role of FDI.

Part of the explanation for the continental nature of the automotive industry is the importance of foreign direct investment as a mode of supply of distant markets. To avoid transport costs or tariffs, foreign producers may invest in an assembly facility on other continents to serve the local or continental market.

Such horizontal FDI changes the pattern of production by nationality compared to country of assembly. Figure 4 shows that global market shares by assembly location or by brand nationality differ widely. By country of assembly, China increases its global market share (including domestic sales) from 3% in 2000 to 23% in 2010 and 32% in 2022/2023 (Figure 4, left panel). At respectively 12%, 9%, 6% and 5% market shares, the US, Japan, India and Germany rank second to fifth in terms of number of vehicles sold by country of assembly.

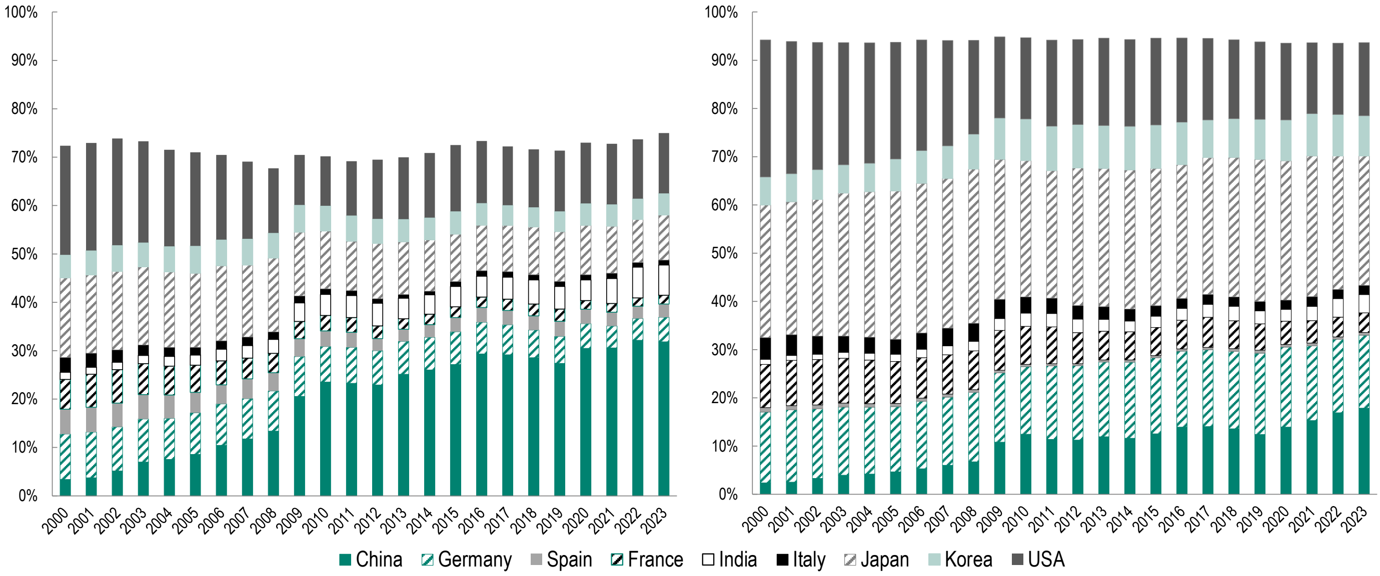
The list of countries ranked by the sales of their brands' nationality, however, differs widely: Japan ranked first in 2022/2023, with 28% of global sales by number of vehicles, with China second (17%), Germany third (15%), the US fourth (15%) and Korea fifth (9%). The concentration of market shares is also larger when considering the nationality of the brand than when considering the country of assembly (the top 5 countries represent 83% of global market share by nationality, and only 64% by country of assembly). The market share of French brands is twice as large as France's share as a country of assembly.

foreign subsidiaries hold large market shares in distant markets

These differences indicate that FDI is key in the automotive industry: brands set up foreign subsidiaries to produce close to consumers, and economize on trade costs. These subsidiaries hold large market shares in distant markets, explaining the wide difference between market shares as a country of location versus brand country of origin.

The role of foreign brands in Chinese exports, the local/continental dimensions of sales and the major role of FDI in serving distant markets are all important stylized facts for analyzing the future of the European auto market and the prospects for Chinese exports and sales by Chinese brands. In the following section, we draw on the experience of Japanese and Korean brands' penetration of the European and North American markets during the 2000s and 2010s to provide more insight into the mode of entry of new competitors.

Figure 4 – Market shares by location of assembly (left) and brand nationality (right)



Source: IHS-Markit.

2. Korean and Japanese brands gained market share in Europe and North America primarily through FDI

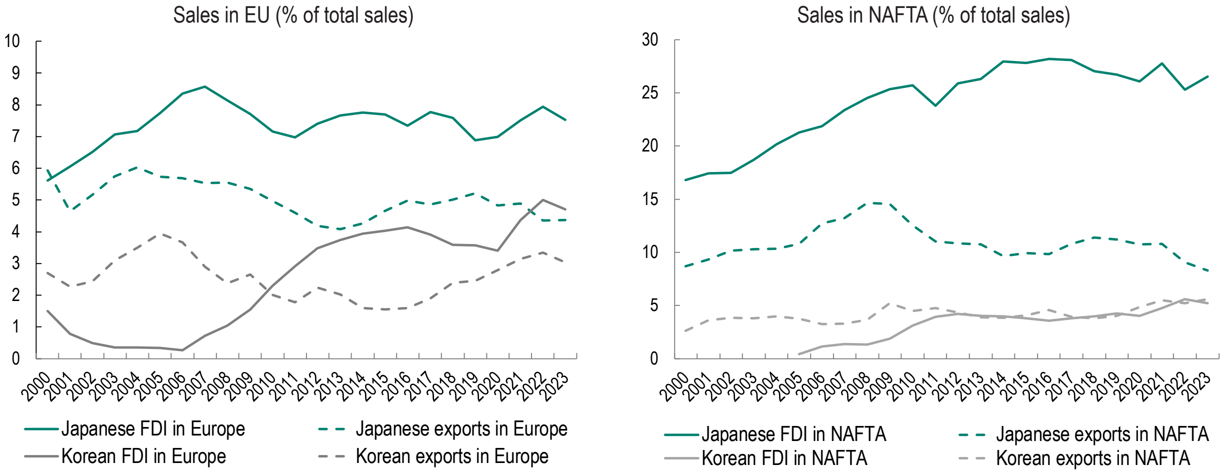
When do firms decide to invest abroad to produce and to sell locally? What is the number of cars sold that is needed to pay for the fixed cost of FDI (in comparison to the variable cost of export)? Does the FDI decision depend on prior presence? In this section, we investigate FDI decisions in the automotive market by using the experience of Japanese and Korean brands on the European and North American markets. They gained market share and introduced new models in Europe and North America in the 2000s and 2010s. In 2022, these brands represented 13% and 31% of total sales on the EU and NAFTA markets respectively.

The first wave of investment by Japanese car manufacturers in North America was triggered by a surge in US protectionism during the 1980s: the Voluntary Export Restraint (VER) program negotiated in 1981 by the Reagan administration with the Japanese government, which limited the number of Japanese cars that could be imported to the US. This came after 15 years of a drastic rise in imports, in particular from Japan: total imports made up about 5% of the US market in the early 1960s and peaked at 29% in 1982, before falling to 25% in 1984 (Tong and Bures, 2003). Japanese car manufacturers were experiencing similar export growth in most destination markets during that period. The VER program (which lasted until the early/mid 1990s) was a way for the US government to reduce the competition for US manufacturers, without resorting to tariffs. Qualitatively, this acted in the same way as a rise in protectionism. Among the consequences were a wave of investments in local plants: "The VER agreement also led several Japanese automakers to make manufacturing investment in the United States. Honda Motor Company began assembling cars in Ohio in 1982. Nissan opened an auto factory in Tennessee in 1983. Toyota and GM set up a joint venture in 1984 to build cars together in California. Toyota's Camry production began in 1988 in its wholly-owned plant in Kentucky; By early 1990, four other Japanese auto makers – Mazda, Mitsubishi, Isuzu, and Subaru – were also producing vehicles in America" (Tong and Bures, 2003).

Figure 5 presents the evolution of Korean and Japanese model sales both through export and local sales (FDI). In both markets, the market share of Japanese brands realized through local sales increased over time, while the market share of exports slightly decreased. In the case of Korean models, the share of sales made through FDI became larger than the share of sales made through exports. This highlights the strategy of car producers to get closer to the destination market, probably benefiting from the lower trade barriers inside each zone (both Europe and North America have regional trade agreements eliminating tariffs on intra-regional trade).

We consider all Japanese and Korean car models sold on the European and North American markets, and compute the average sales per year, starting from the first year the model is sold to these markets. Figure 6 presents the average sales per year, distinguishing between three cases: i) the model is only sold through exports; ii) the model is first exported, then produced locally (FDI); iii) the model is produced locally from the first year of its sales. We consider a timeline of 8 years, with time 0 being the first year of sales of the model on the market. For both cases, the life cycle of the model appears to be around 7 years. However, sales of models first exported before being produced locally are more than twice as large as the average sales of models exported over their whole life cycle. Confirming

Figure 5 – Japanese and Korean sales in European and NAFTA trade blocs

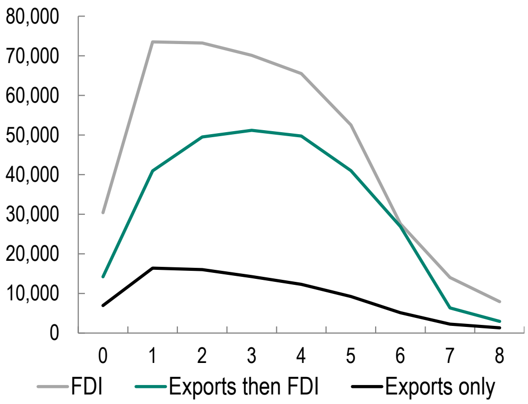


Source: IHS-Markit, authors' computations.

the pattern, sales of models directly produced locally are the highest, consistent with the fact that the most successful models are sold through local assembly.

Figure 6 – Average sales: export vs. FDI

NAFTA and Europe



Source: IHS-Markit, authors' computations.

We then focus on models produced locally through FDI, to better understand how foreign production decisions are related to sales level. Figure 7.A presents the average model sales in the years following the decision of investment, distinguishing between two cases: i) the model was first exported, then produced locally; ii) the model was produced locally without prior exports. Although both types of models reach the same level of average sales (around 40,000 units sold) the first year of the FDI, models sold through local assembly without prior exports show higher average sales in the years following the investment, reaching over 60,000 units the second year. Both categories exhibit decreasing sales after the third year, with a similar life cycle of roughly 8 years. The models produced locally without prior exports may be models for which the market taste is already known, suggesting a better fit with local demand (small cars vs pickup trucks or SUVs in Europe, and the reverse in the NAFTA zone, for instance).

the most successful models are sold through local assembly

To understand the investment decision, we turn to the second category of models, and investigate the decision to switch from exports to FDI. We plot in Figure 7.B the average sales realized through exports and local production of every model experiencing a switch, with a window of 5 years before and after the switch. We identify the switch as the first year of local production sales (time 0), in the case where the model was already sold on the destination market through exports. Conditional on being produced locally later, the switch will happen between two and three years following the first year of exports (2.2 years on average). Following the investment, local sales become larger than sales through exports. Rather surprisingly, local sales do not completely take over exports, as exports are still positive after the investment. Both sales slowly decrease two years after the investment, and the switch does not seem to extend the life cycle of the model as both local and export sales become quite small in the 8th year of the model.

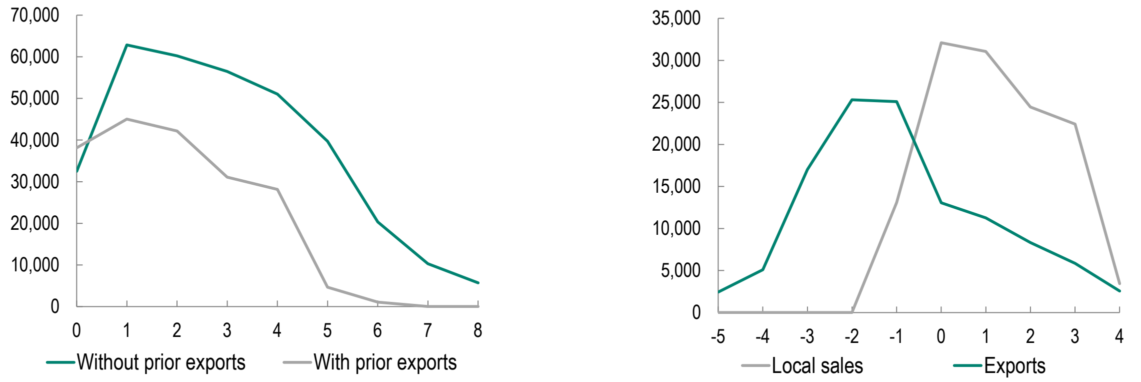
In Figure 8 we conduct a similar exercise, but consider in addition whether the investment is realized in an existing plant, or by creating a new plant. Sales are twice as large when FDI occurs in a new plant, both before and after the switch. This is consistent with the fact that establishing a new plant is associated with a larger fixed cost, implying that this investment strategy is implemented for successful models only. This also suggests that, after the first investment is realized, adding new models is less costly, hence investing in existing plants can be done for smaller sales models.

Comparing the sales of Chinese EV models recently launched on European markets against the average FDI threshold of Korean and Japanese brands during the 2000s and 2010s (at around 50,000 for new plants; Figure 8) shows that both

Figure 7 – Average sales – exporting before investing to test the market?

7.A – Local sales depending on prior export status

7.B – Sales before and after FDI

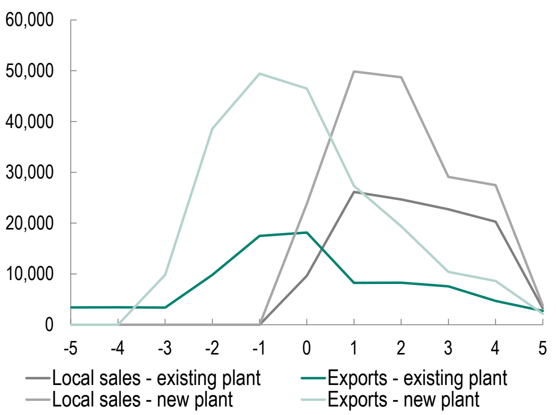


Note: European and NAFTA markets.

Source: IHS-Markit, authors' computations.

are already close. The MG4 already sells more after 2 years (72,212 vehicles sold in 2023) while the Polestar 2[8] is close to reaching the average FDI threshold after 4 years (35,696).[9] Both brands have connections to Europe that could facilitate their investment: Polestar, ultimately owned by Geely, shares platforms with Volvo models that have assembly lines in Sweden and Belgium, while MG has kept support activities in its historical assembly plant in Longbridge, UK. Finally, BYD announced an investment in a vehicle factory in Hungary in December 2023.[10]

Figure 8 – Investing in a new plant or an existing one



Note: European and NAFTA markets.

Source: IHS-Markit, authors' computations.

3. Are EVs different from ICEs?

The patterns presented thus far relate to global automotive markets still dominated by ICEs, on the eve of a structural transformation. In this section, we explore dimensions in which ICE and EV could differ and what could change the equilibrium mode of supply of distant markets. We investigate 4 dimensions: export platform/economies of scale, trade costs, differences in the geography of comparative advantage, and the role of intermediate inputs (battery vs engine and transmission).

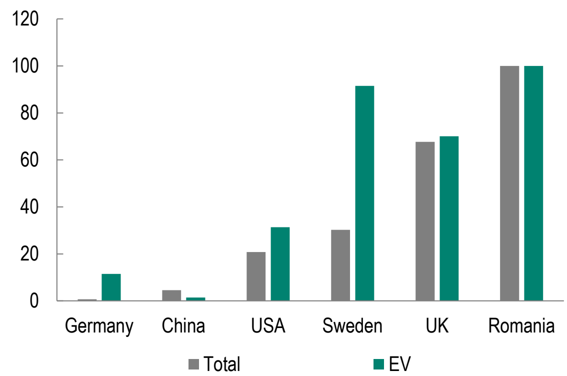
3.1. Export platform/economies of scale

A first question is whether larger economies of scale at the plant level could give rise to an export platform strategy from a home country specific to EV production, compared to ICE production. Currently, EVs are not more traded than other vehicles – in fact, even less so. In 2022, 34% of vehicles sold worldwide were traded internationally, while the corresponding figure for EVs is 25% (and 45% for hybrid vehicles).

currently, EVs are not more traded than other vehicles – in fact, even less so

Focusing on China, only a few foreign brands use their Chinese plant as an export platform (Figure 9). EV Chinese brands sell

Figure 9 – Domestic sales and exports by nationality for Chinese plants (thousands vehicles)



Note: Brand nationality, exporting more than 10,000 ICEs or EVs.

Source: IHS-Markit.

(8) EU and NAFTA markets.

(9) https://www.best-selling-cars.com/europe/2023-full-year-europe-top-20-best-selling-electric-car-models/

(10) https://www.ft.com/content/5a5b17ae-7ec1-431d-bc2f-0722889bf5f0

more locally than ICE Chinese brands (the Chinese market being the largest by far for EVs).

3.2. Trade costs

There are two main observable components of trade costs: tariffs and transport costs. Tariffs are heterogeneous across countries and now larger for EVs than ICEs for EU and US imports from China (Table 3). The US MFN (Most Favored Nation) tariff of 2.5% for finished cars was raised to 27.5% for cars imported from China following Trump's tariffs against Chinese products. The revision of the Section 301 tariffs announced on May 14, 2024 by President Biden will increase tariffs on EV imports from China to 100% in 2024. Note that, while the EU has a comparatively higher MFN tariff on cars (10%), it did not apply any additional tariffs on Chinese cars until the countervailing duties of up to 38.1% announced in June 2024. Finally, at 15%, Chinese MFN tariffs are higher than the European level.

tariffs are heterogeneous across countries and now larger for EVs than ICEs

Table 3 – Tariffs on automotive products

	HS code	MFN tariff (in %)		
		USA	EU	China
Car	870380	2.5	10.0	15
Trucks	870490	25.0	10.0	15
Pack and Module	850760	3.4	1.8	10
Cell	850650	2.7	4.7	8

Source: WTO.

One important difference regards the tariffs on batteries, which are lower than for cars: cells imports are taxed at 4.7% in the EU (2.7% in the US; in 2024, the tariffs on Lithium-Ion batteries imported from China will increase from 7.5% to 25%) and packs and modules at 1.8% (3.4% in the US).[11]

Regarding transport costs, roll-on roll-off (RoRo) vessels[12] used in the vehicle segment were in short supply in 2022,[13] leading to an increase in the freight rates for vehicles,[14] as had been experienced for container rates during the Covid period. Investments are being made and the order book for RoRo carriers has increased substantially, but actual capacity will only increase gradually. However, capacity constraints are not restricted to the RoRo vessels capacity but also depend on port infrastructures. In the EU, the main ports handling vehicles are Zeebrugge and Antwerp (Belgium), Bremerhaven and Emden (Germany) and Koper (Slovenia). But port capacities are limited for handling the increase in imported vehicles from China. Investments are under way (notably in Dunkirk, France) but port capacities and intra-national logistic capacities (rail, road) will take time to adapt. In the meantime, vehicles have been transported using containers, but this also creates challenges for the handling of vehicles once unloaded from a vessel. Note that EVs are heavier and generally wider in dimensions so that fewer cars fit into existing RoRo vessels, although they are not necessarily considered as riskier by carriers.[15]

3.3. How far do intermediate inputs travel: batteries vs engines?

The distance of battery production to vehicle assembly is small and decreasing. An electric vehicle uses one battery, called a pack. This pack includes a number of modules, which in turn incorporate battery cells. For instance, the battery pack of a Tesla model 3 consists of 4 modules of around 750 cells each.[16]
For the pack, the median distance was 215 km in 2022, down from 307 km in 2015 (Table 4). In 2018, for an ICE vehicle, the median distance from engine production to assembly was 172 km, and 682 km for transmissions. Up the value chain, cells and modules are very frequently produced in the same location as packs; in 2022, their median distance was 1 km.

the distance of battery production to vehicle assembly is small and decreasing

Table 4 – Distance between stages of the battery supply chain

	Year	Distance	
		Median	Mean
Pack to EV	2015	307	801
	2022	215	683
Module to pack	2015	1	956
	2022	1	806
Cell to module	2015	22	2022
	2022	1	456

Source: IHS-Markit, authors' computations.

(11) For comparison, EU tariffs on engines and transmissions are 2.7% and 3% respectively.

(12) Vehicles are loaded and unloaded by rolling on RoRo vessels.

(13) There were "750 car carriers globally by the end of 2022, with a total capacity of around 4 million vehicles"; https://www.hellenicshippingnews.com/china-expanded-car-carrying-vessel-fleet-spurs-shipping-capacity/ https://www.kar-tainer.com/post/vehicle-shipping-container-vs-roro-capacity-situation

(14) https://www.kar-tainer.com/post/vehicle-shipping-container-vs-roro-price-situation

(15) CMA-CGM considers EVs as dangerous goods only when moved in a refrigerated container with 40% battery charge; https://blog.trans-rak.com/how-transport-trends-impact-global-ro-ro-capacity

(16) https://en.wikipedia.org/wiki/Tesla_Model_3

Given the announced investments, the expected capacity of battery production in Europe is likely to match needs. According to the International Energy Agency (IEA, 2022), current announced investments would account for a quarter of battery production in Europe and the US by the end of the decade. This would be sufficient to meet expected European EV battery demand at the time.

3.4. A changing geography of comparative advantage

If electric vehicles have some features in common with traditional cars, notably regarding their cost of transport and the trade barriers faced, there are some major differences in terms of what is often called "core inputs", *i.e.* the engine and transmission in an ICE vs the battery pack and electric motor in an EV. Differences in the relative costs of those core inputs, as well as in the assembly of ICEs vs EVs, could result in new patterns of comparative advantage. One of the distinct features of the automobile industry is the quality of micro-level data on sales of the final product, together with the origin of some of its inputs. For ICEs, the data we use allows tracing of the plants where the engine and transmission were sourced for each car model produced in about 50 countries. For the batteries, we can go even into deeper detail, since we can trace the plants of the different components.

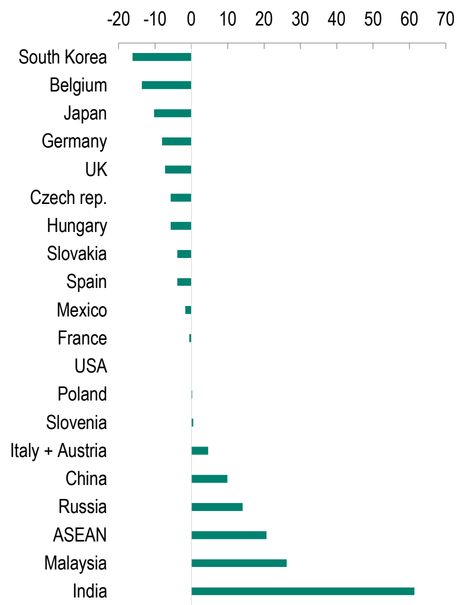
the really strong comparative advantage of China is in cells and modules

It is possible to use the sourcing decision of brands regarding their core inputs and assembled cars to reveal the underlying compared costs of different territories used as a production base (*i.e.* countries). The intuition is as follows.[17] Because car brands/firms have many plants or partners that they could use to source the car or parts, the frequency of those choices reveals something about "how good a country is" at producing this part of the production process. For instance, Japanese brands such as Toyota and Nissan have many assembly sites around the world. As emphasized above, they use those plants to serve demand locally (for instance, the French factory in Valenciennes for the Toyota Yaris, or the British plant in Sunderland for the Nissan Leaf serve the European markets). But in the cases where they do not do so, we observe that they most frequently use their home plants in Japan (and not a US-based plant to serve Europe). This reveals that Japan must be a great place to assemble cars (especially since it is so distant from the EU market and faces a 10% tariff there until the 2019 EU-Japan FTA phases in completely in 2027).

The logic extends also to batteries. A Megane E-tech assembled in Douai (France) chooses a French-made pack with Polish modules and cells (in 2022).[18] The pack could have come from plants in China, the UK or Japan, the modules and cells could have come from other plants that Renault already used as suppliers for other car models. The choice of the Polish module against a more proximate one is an indicator of comparative advantage (which includes all determinants that reduce costs, including low energy prices and production subsidies, for instance).

When estimated over 2015–2022 for EVs and battery components, and over a longer period for ICEs (2000–2018),[19] the choices reveal cost differences – see Figures 10 and 11. Figure 10 shows revealed costs estimated in percent difference with respect to the United States for EVs. Korea, Japan and Germany are revealed as low-cost locations for EVs. At the other extreme of the spectrum, India, Malaysia, Indonesia and Thailand are estimated to be high-cost sites of production. China is estimated to be higher-cost than the US, which might seem surprising. Two explanations: first, for EVs as for ICEs, Chinese plants mostly serve Chinese consumers. They are very rarely chosen by brands to serve foreign consumers (German brands, for instance, produce a lot in China, but almost never source from those plants to serve American or EU consumers). Second, the emergence of China as an export base is very recent (see above). Hence, for ICEs, China is among the worst cost producers because the recent emergence is not in the data yet.[20] For EVs, the years available feature only the Tesla Shanghai factory as a noticeable export base to many

Figure 10 – Percent difference in cost for EVs (USA = 0)



Source: IHS-Markit, authors' computations.

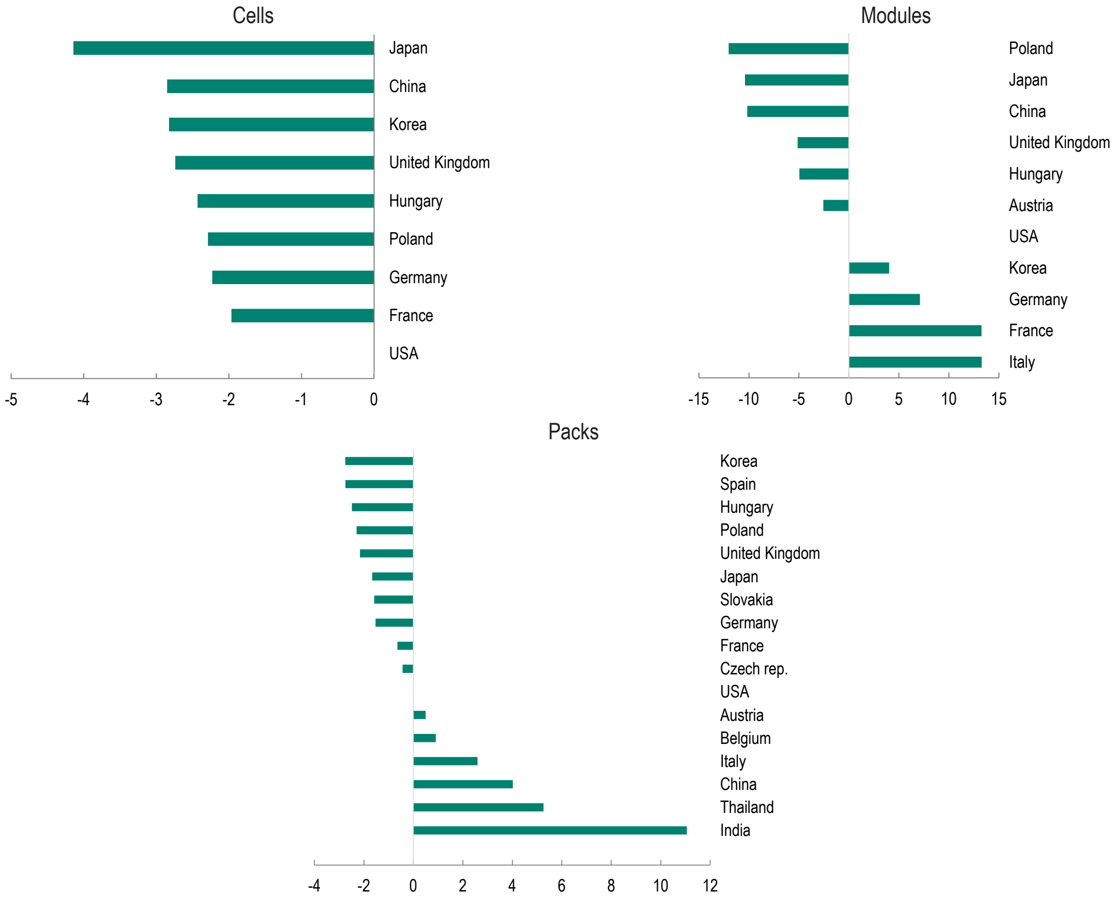
(17) For details, see Head, K. and T. Mayer (2019).

(18) https://www.automobile-propre.com/visite-de-lusine-de-douai-comment-est-fabriquee-la-renault-megane-e-tech-electrique/

(19) All results in this section are preliminary results based on ongoing work by Head, K., T. Mayer, M. Melitz and C. Yang (2024) and should be taken with caution.

(20) See Head, K. and T. Mayer (2019).

Figure 11 – Percent difference in cost for batteries



Source: IHS-Markit, authors' computations.

destinations (for the last 2 years of the sample). It is likely that, with more years of data, the rank of China will evolve as many more manufacturers use their Chinese plants as an export base (on top of local sales).

The really strong comparative advantage of China is in cells and modules, as revealed in Figure 11. The critical component of the battery (cells) is dominated by East Asia, since China is in the same group as Japan and Korea. This is because, unlike for assembled cars, Chinese plants are the source of cells used in many battery modules and packs around the world, even when the pack manufacturing takes place thousands of miles away.

Conclusion

The automotive industry is undergoing a period of disruptions because of the emergence of new actors – new brands and China's emergence as a leading global auto exporter – and the transition to EVs. Past experiences of emerging Korean and Japanese brands in the European and North American markets show how local production through FDI was prevalent in their gaining of market share. Given similarities between EV and ICE in terms of tradability, this suggests that, with the stabilization of the automotive markets, patterns of mode of supply should converge to more FDI by new Chinese brands. This is exemplified by BYD's announcement in December 2023 of an investment in Hungary to serve the European market.

Furthermore, the proximity between assembly and pack production also suggests that battery production should follow assembly to a significant extent. Chinese FDI data for 2023 already show investments abroad, in particular in Europe and Morocco, in battery manufacturing and battery material production (Sebastian *et al.*, 2024).

These peculiarities of the automotive industry have two consequences in the current landscape. First, the imposition of trade remedies by the EU may not shield European automakers from the competitive pressure exerted by Chinese producers if they serve the European market through local production. Competition between EU countries (and close locations with market access like Morocco or Turkey) for attracting new assembly and material production investments is likely to intensify in this respect. Secondly, given the prevalence of FDI, the geography of automotive production by nationality is more likely to be reshaped than the geography of production location. Beyond production activities, such an upheaval also has consequences for the location of business service activities (R&D, headquarter services) tied to automotive production, and may be consequential in the current geopolitical environment.

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About the authors

Thierry Mayer is scientific advisor at CEPII and professor of economics at Sciences-Po.

Vincent Vicard is deputy director of CEPII and head of the International Trade Analysis scientific program.

Pauline Wibaux is an economist at CEPII.

Contact: thierry.mayer@sciencespo.fr – vincent.vicard@cepii.fr – pauline.wibaux@cepii.fr

Policy Brief

CEPII

CEPII Policy Brief
CEPII's insights on international economic policy

CEPII (Centre d'Études Prospectives et d'Informations Internationales) is a French institute dedicated to producing independent, policy-oriented economic research helpful to understand the international economic environment and challenges in the areas of trade policy, competitiveness, macroeconomics, international finance and growth.

Centre d'études prospectives
et d'informations internationales
20, avenue de Ségur
TSA 10726
75334 Paris Cedex 07

contact@cepii.fr
www.cepii.fr – @CEPII_Paris
Press contact: presse@cepii.fr

EDITOR-IN-CHIEF:
VINCENT VICARD

EDITORIAL DIRECTOR:
ANTOINE BOUËT

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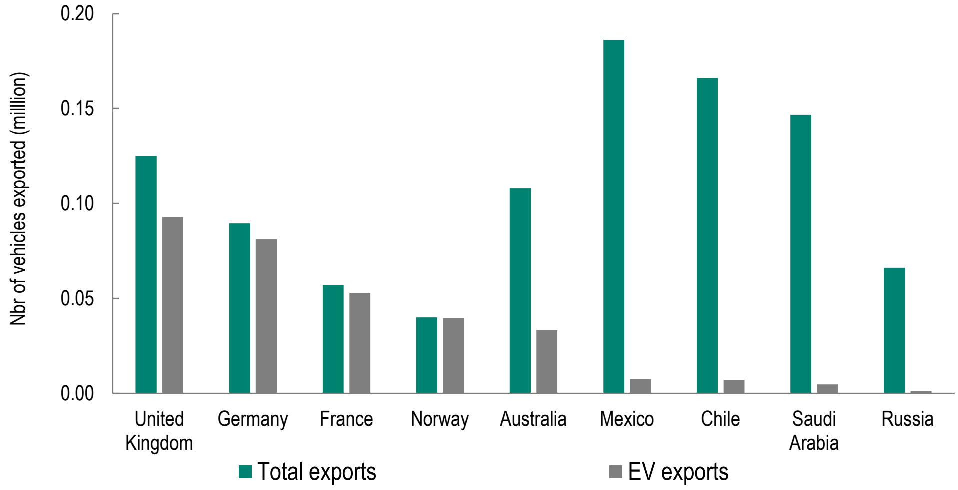
Appendix

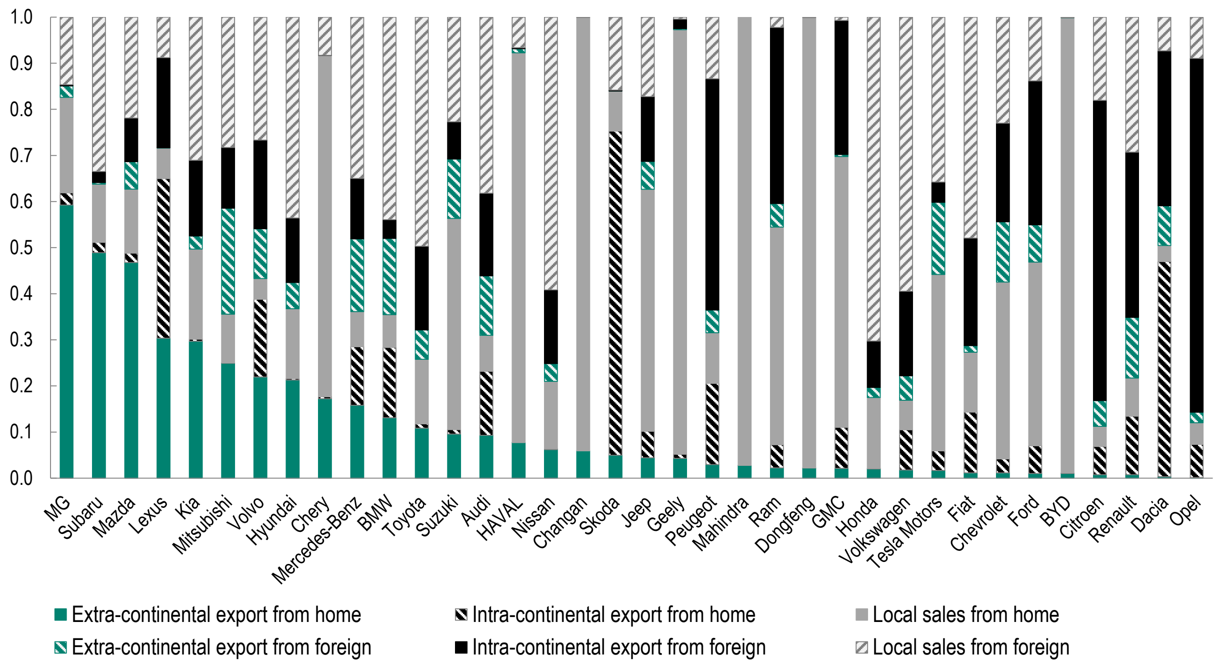
Figure A.1 – Total and EV exports from China by destination market in 2022



Source: IHS-Markit.

Figure A.2 – Sales by source and destination at brand level

In % of total sales by brand, 2022



Note: Brands selling more than 500,000 vehicles in 2022.

Source: IHS-Markit.