

National Automotive Competitiveness

January 2024

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Abstract

This paper compares the U.S. automotive industry's competitiveness relative to other major vehicle manufacturers using production, trade, investment information. Based on these data the United States sits squarely in the middle of major vehicle manufacturers, ranking high but not at the top in most categories for vehicles and automotive parts. Overall the United States appears more open to foreign investments and imports than many of its competitors, but is not as export-oriented.

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Introduction

The automotive industry is a key industry in the United States. Over one million people were employed in the production of motor vehicles and parts in the United States in 2022, representing more than 8 percent of U.S. manufacturing employment. Automotive exports are a major U.S. export, accounting for 8-10 percent of U.S. exports (depending on which automotive-parts related subheadings are included). Automotive assembly tends to be a multiplier in local communities, where every additional assembly job increases local jobs by 6.6.¹

Because of its domestic significance, understanding the relative global competitiveness of the U.S. automotive industry is important. This paper focuses on relative national automotive competitiveness using production and trade statistics for vehicles and automotive parts. In this paper, a country's vehicle competitiveness is analyzed using a variety of different statistics and metrics including quantity, value, imports' domestic market share, and revealed comparative advantage.

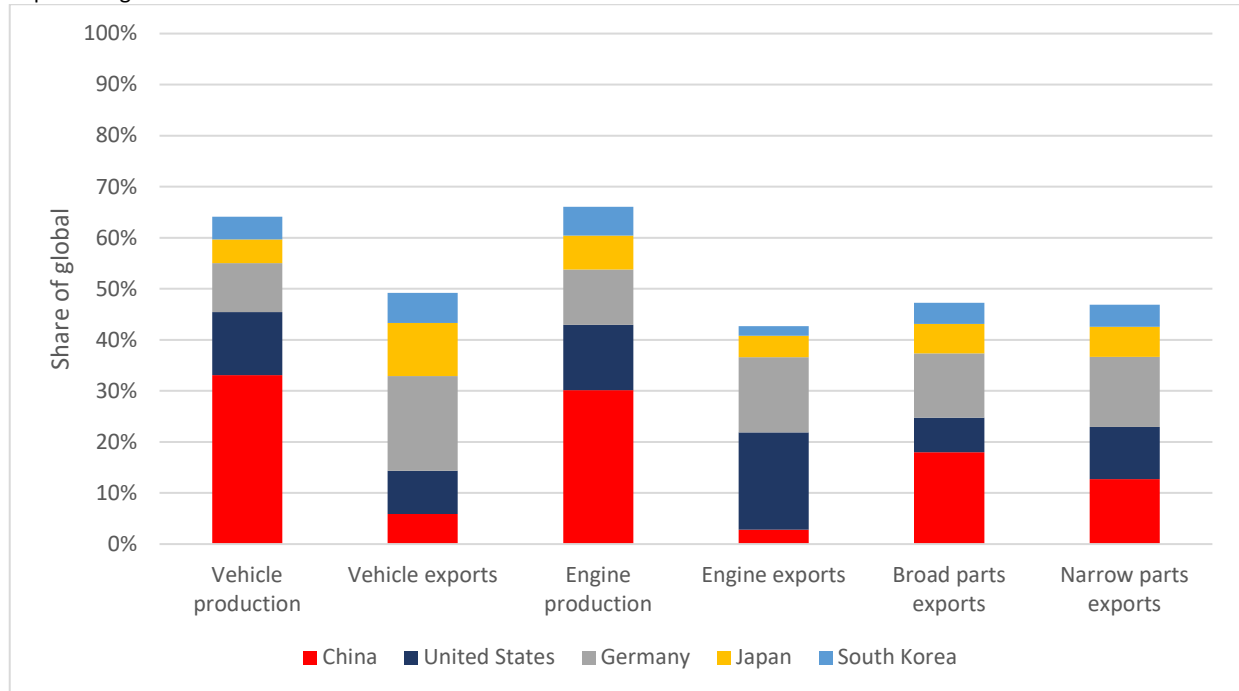
This paper compares U.S. automotive competitiveness with four major vehicle producing countries: China, Japan, South Korea, and Germany. These are five of the top six vehicle producing countries by volume, making up 62 percent of global vehicle production in 2022.² Each country is a major producer and exporter of vehicles and parts (figure 1). Comparing the United States to these countries, its share of exports is smaller than its share of production, leading to lower scores on some metrics of automotive competitiveness. These lower scores are due, at least in part, to a focus on the United States' large domestic market, rather than a lack of competitiveness.

¹ CAR, *Contribution of the Automotive Industry*, January 2015, 2.

² India is the other top six producer of vehicles, but it is not a major exporter of vehicles or parts. OICA, "World Motor Vehicle Production," accessed October 10, 2023.

Figure 1 Major vehicle producing countries' shares of vehicle and engine production and exports, and parts exports, 2022

In percentages



Sources: OICA, Production Statistics 2022, accessed August 3, 2023.; Automotive World, Engine Vehicle Plant Database, various years.; S&P Global, Global Trade Atlas, accessed August 28, 2023.

Note: See notes in later figures for descriptions of HS codes used for vehicle exports, broad parts exports, and narrow parts. Vehicle and engine production are in share of unit production, all four export categories are by value.

Since there is no single measure of national automotive competitiveness without limitations, this paper examines multiple measures to provide a clearer picture of automotive competitiveness. Popular coverage of the automotive industry often focuses on raw production or export numbers,³ but in the automotive industry, some vehicles are sold for less than \$10,000 and others are sold for hundreds of thousands of dollars making unit-level comparisons challenging. Some economists use metrics such as revealed comparative advantage (RCA), which compares a country's exports in a product or basket of products to the exports one would export for a country that trades a given amount. However, RCA and RCA-based metrics may overrate small export-oriented countries and underrate larger countries that produce more for their domestic markets.⁴

This paper begins by providing comparative statistics on automotive production, trade, and investment by country. Then it combines some of those statistics to look at metrics such as import dependence, revealed comparative advantage, and share of domestic consumption. These statistics provide the

³ See for example the many articles focused on China passing Japan to become the top vehicle exporter this year, or those in 2009 when China became the world's largest vehicle manufacturer. Shan, "China Is on Course to Overtake Japan," August 15, 2023; Tang, *The Rise of China's Auto Industry and Its Impact on the U.S. Motor Vehicle Industry*, November 16, 2009.

⁴ Jones and Bethmann, *Approaches of Measuring Revealed Comparative Advantage*, July 2023, 5–6.

reader with a broader understanding of the strengths and weaknesses of the different automotive manufacturers and their relative competitiveness.

National Competitiveness in Vehicle Production

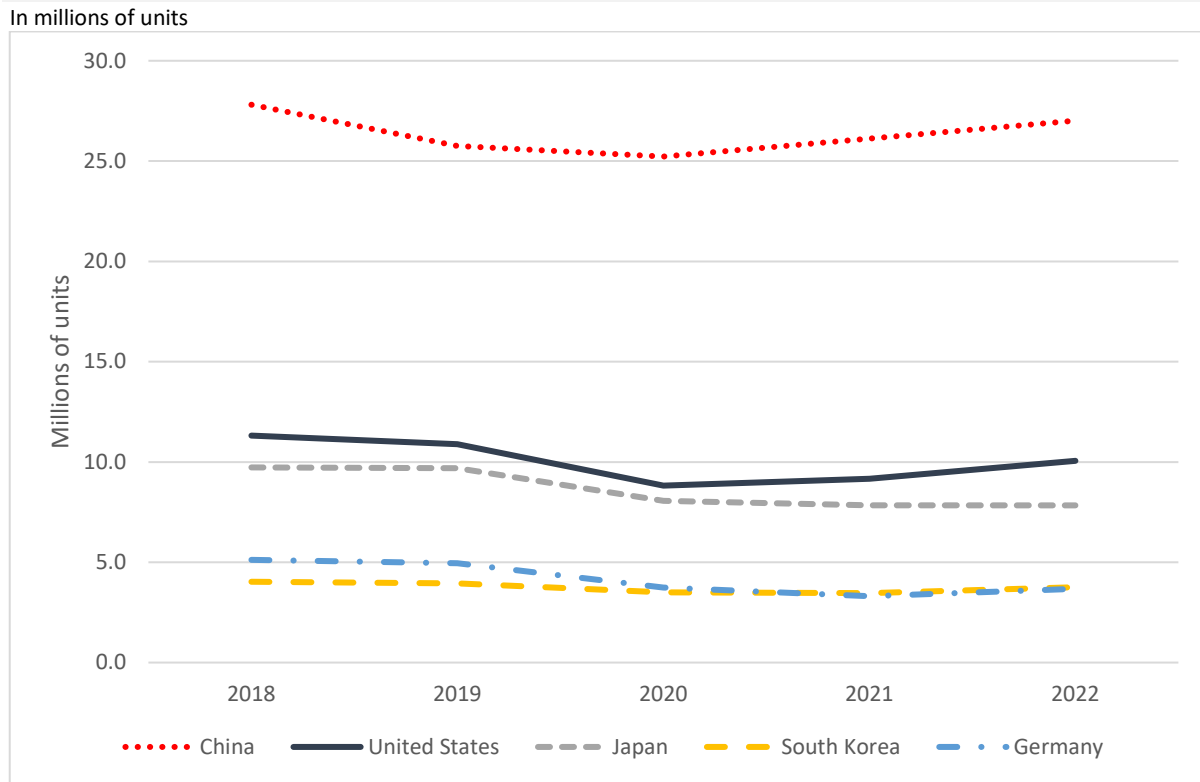
To measure competitiveness in automotive production, one must consider several elements: the volume of vehicle production; the value of vehicle production; the competitiveness of vehicle production in domestic markets, and the competitiveness of vehicle production in global markets. This section uses these elements to evaluate the competitiveness of U.S. vehicle production as compared to the other major vehicle producing countries. These data show that the United States is the second-largest vehicle manufacturer and a significant exporter of vehicles by value, but not by volume. Additionally, the United States is also a major destination for and source of automotive investment. The United States' score on a metric examining comparative advantage through relative export participation (revealed comparative advantage or RCA) may imply that the United States does not have a comparative advantage in vehicle production, or it may just show that U.S. production focuses on the domestic market.

Production

China is by far the top vehicle manufacturer, producing more than 25 million units annually, followed by the United States and Japan (figure 2). The order of the top three remained the same across all four years, but South Korea passed Germany in 2021 and 2022. More than 90 percent of production in China, Germany, Japan, and South Korea is by companies headquartered in that country.⁵ For the United States that number is 44 percent.⁶ Production by firms headquartered in another country, or “transplant” production, has some benefits and some costs for domestic automotive competitiveness. Transplant production brings foreign knowledge and expertise to a domestic context, as well as manufacturing, management, and (often) R&D jobs. On the other hand, transplant production may be more likely to use foreign inputs, particularly before the transplant establishes a local supply chain, and much of the design and development of the vehicle may occur in the manufacturers' home market.

⁵ For China, 51 percent is by wholly Chinese companies and 46 percent by joint ventures between Chinese and non-Chinese companies. Wards Intelligence, “Germany Vehicle Production, 1970-2022,” April 17, 2023; Wards Intelligence, “Asia Vehicle Production by Country and Manufacturer, 2022,” April 17, 2023; Wards Intelligence, “Asia Vehicle Production by Country and Manufacturer, 2022,” April 17, 2023.

⁶ This number would be 56 percent if Stellantis, a merger of Fiat-Chrysler and Peugeot, were included. Wards Intelligence, “U.S. Car and Truck Production by Manufacturer, 1985-2022,” March 21, 2023.

Figure 2 Global leaders in vehicle production by major vehicle producing countries, 2018–22

The United States is the second-largest producer of motor vehicles globally. U.S. vehicle production declined from 2019 to 2020 due to stoppages in production during the COVID-19 pandemic, as it did globally.⁷ U.S. production did not rebound fully in 2021 and 2022 due to semiconductor shortages.⁸

International Trade

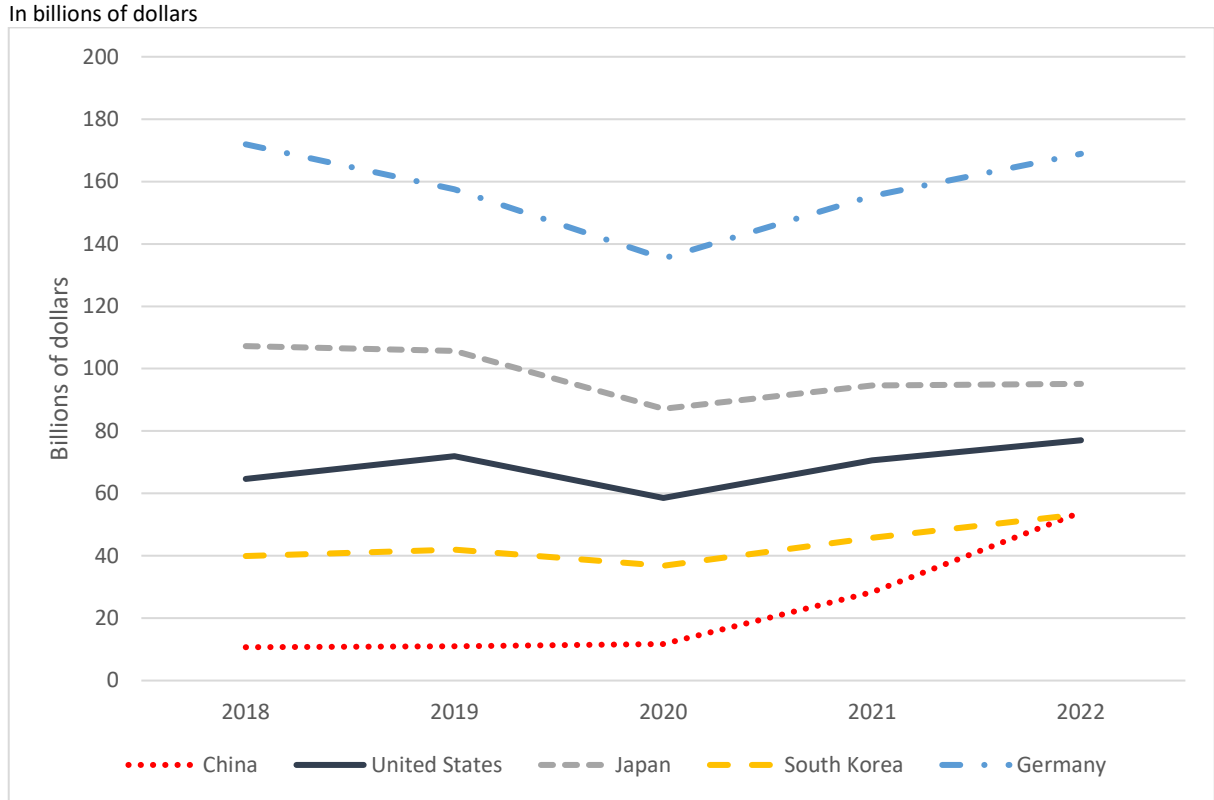
Vehicle exports are a good measure of competitiveness, as the most competitive countries are able to not only produce vehicles for a domestic market, but also in foreign markets, where they may face challenges in terms of competition from domestic vehicle production, tariffs, other trade costs, and consumer preferences.

Germany is the leader in vehicle exports by value and Japan led by volume, but Chinese vehicle exports increased rapidly over 2018 to 2022 (figure 3). Germany is the leader in global vehicle exports by value because they export a significant number of vehicles with relatively high unit costs, as German exports contain a high share of luxury brand vehicles including Audi, BMW, and Mercedes. China's increase in exports is led by a significant increase in exports of electric vehicles (EVs), a segment in which China has been the leading exporter since 2021.

⁷ Coffin et al., *The Roadblocks of the COVID-19 Pandemic in the U.S. Automotive Industry*, June 2022, 4–5.

⁸ USITC, *USMCA Automotive Rules of Origin*, June 2023, 39–40.

Figure 3 Global vehicle exports by major vehicle producing countries, 2018–22

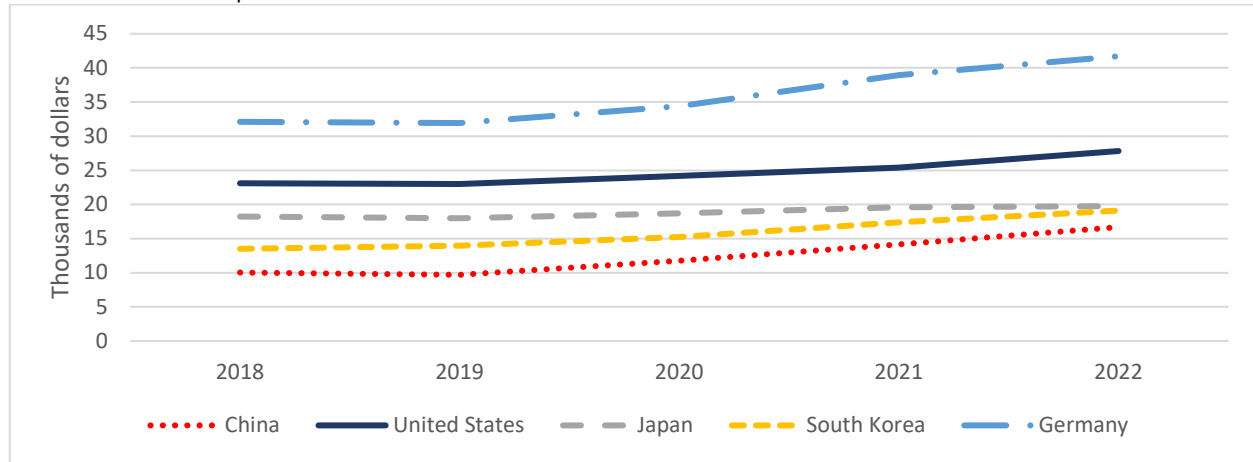


Source: S&P Global, Global Trade Atlas, accessed August 4, 2023. HS subheadings include 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.31, 8704.22, 8704.23, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

The United States, while not the top exporter, is a significant exporter of vehicles. U.S. vehicle exports increased from 2018 to 2022, primarily driven by an increase in unit value. This unit value is relatively high, implying that U.S. vehicles are worth more per unit than vehicles produced in many other countries (figure 4). Germany’s unit values are even higher, part of the reason why it had the highest exports of motor vehicles by value.

Figure 4 Unit cost of vehicle exports, major vehicle producing countries, 2018–22

In thousands of dollars per unit



Source: S&P Global, Global Trade Atlas, accessed August 4, 2023. HS subheadings include 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.31, 8704.22, 8704.23, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

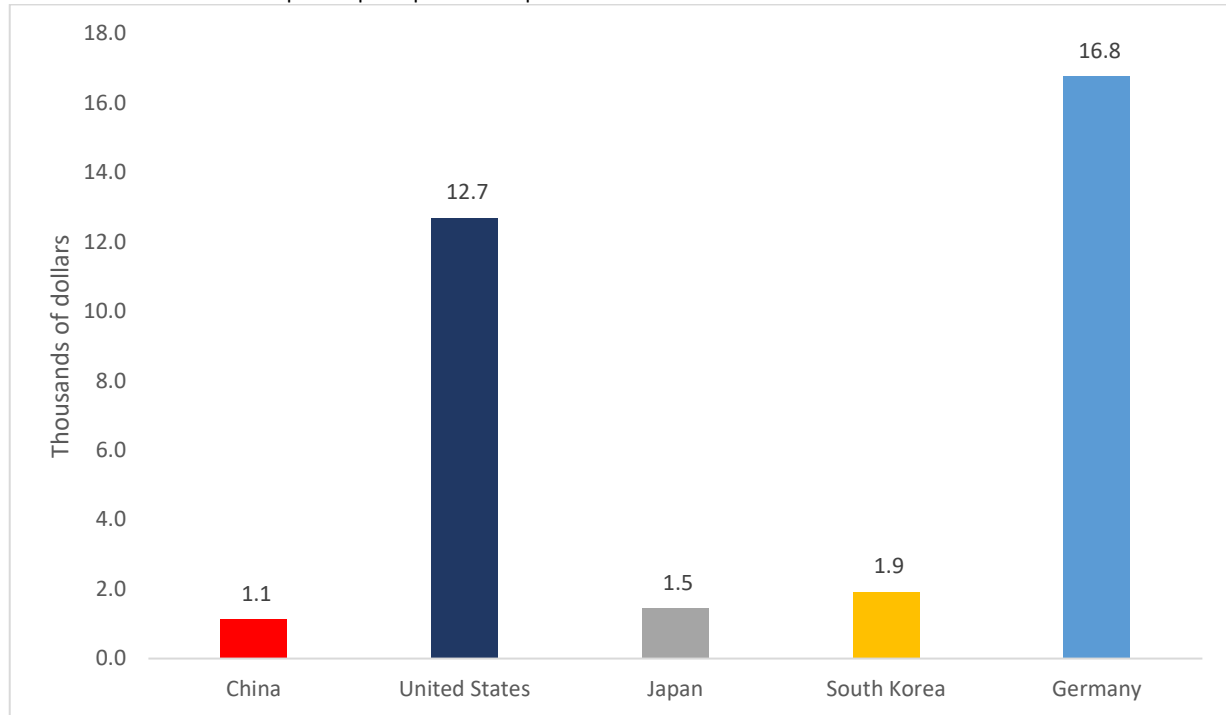
Competitiveness Metrics

In addition to data on production, trade, and investment, some metrics use a combination of imports, exports, or production data to compare competitiveness across countries. This section examines several such metrics including import dependence, revealed comparative advantage (RCA), and production share of domestic consumption. These metrics show that the United States relies more on imported automotive parts than major Asian vehicle manufacturers and is less reliant on exports for vehicle demand.

Major vehicle producing countries have varying dependence on imported parts. Germany and the United States import large numbers of automotive parts for each vehicle they produce, while top Asian manufacturers do not (figure 5). These data may show that these Asian producers are more vertically integrated and less reliant on imports. The United States and Germany have integrated their automotive supply chains with neighboring countries to take advantage of trade agreements that allow for duty-free trade between those countries.

Figure 5 Dependence on imported parts in major vehicle producing countries, 2022

In thousands of dollars of imported parts per vehicle produced



Sources: OICA, “2022 Production Statistics,” accessed September 18, 2023; and S&P Global, Global Trade Atlas, accessed September 18, 2023. Uses narrow automotive parts list.

Whether reliance on automotive parts imports increases or decreases a country’s automotive competitiveness is unclear. The availability of domestic automotive parts production to supply the domestic market would seem to imply a highly competitive domestic automotive parts industry. However, it could also show a lack of integration with global networks or that there are barriers preventing the development of such networks. For example, the European Union (EU) and U.S.-Mexico-Canada Free Trade Agreement (USMCA) both help facilitate the flow of automotive parts into (and out of) Germany and the United States, reducing the cost of imported inputs from their neighbors, and potentially increasing the competitiveness of the vehicles they produce. Integration also allows countries to specialize, and for more labor-intensive parts (such as wire harnesses) to be produced in countries with lower wage rates.⁹ Almost half (\$59.3 of \$127.7 billion or 46.5 percent) of U.S. automotive parts imports come from USMCA partner countries, and 80.8 percent (\$49.9 of \$61.7 billion) of German automotive parts imports come from EU partner countries.¹⁰

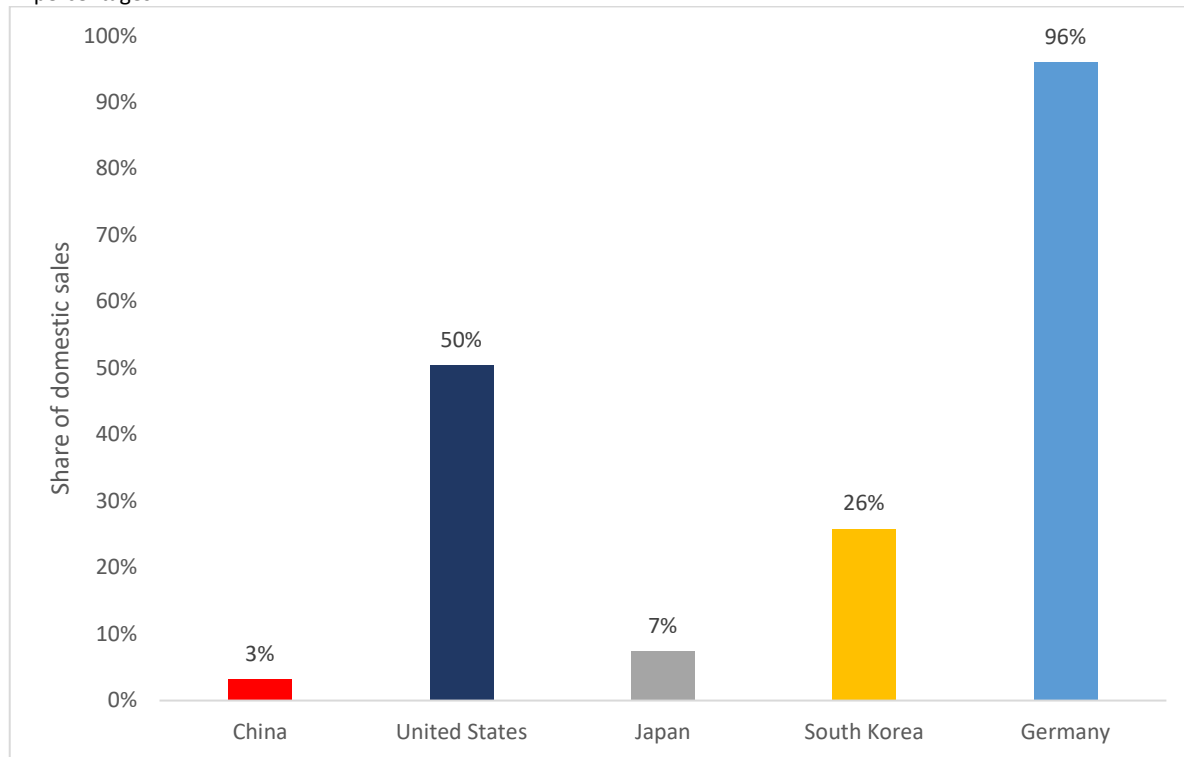
One might think that examining a country’s ability to compete in its domestic motor vehicle market would be useful for competitiveness, but it does not fit well with other measures. The figure below shows imports as a share of domestic sales for major vehicle manufacturing countries (figure 6). The United States’ vehicle imports equate to half of domestic vehicle sales. This number is significantly higher than major vehicle manufacturers in Asia, and significantly lower than Germany.

⁹ Maloney, “The Surprisingly Manual Process,” July 27, 2022.

¹⁰ S&P Global, Global Trade Atlas, (accessed September 19, 2023). Narrow automotive parts list. Seen Appendix for full list of HS subheadings.

Figure 6 Import share of domestic sales for major vehicle producing countries, 2022

In percentages



Sources: Wards Intelligence, "World Vehicle Sales by Company and Country, 2022," May 1, 2023; S&P Global, Global Trade Atlas, (accessed September 19, 2023). HS subheadings 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.31, 8704.22, 8704.23, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

Just looking at import dependence may not show the whole picture, because it treats all imports the same, and assumes similar levels of openness in each market. Over half of U.S. vehicle imports (50.9 percent) are from Mexico and Canada, which are USMCA partner countries.¹¹ Vehicles from USMCA partner countries likely contain a significant share of U.S. automotive content due to the integration of the region and USMCA regional value content requirements.¹² Similarly, 73.5 percent of German vehicle imports are from the EU, and likely contain a significant amount of German content.¹³

The high amounts of domestic content in imported vehicles from neighboring countries likely means they reflect less import dependence than imports of vehicles from countries with separate supply chains. Also, using each country's domestic market to examine competitiveness across countries ignores the

¹¹ S&P Global, Global Trade Atlas, (accessed September 19, 2023). HS subheadings 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.31, 8704.22, 8704.23, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

¹² USITC, *USMCA Automotive Rules of Origin*, June 2023, 30.

¹³ S&P Global, Global Trade Atlas, (accessed October 18, 2023). HS subheadings 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.22, 8704.23, 8704.31, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

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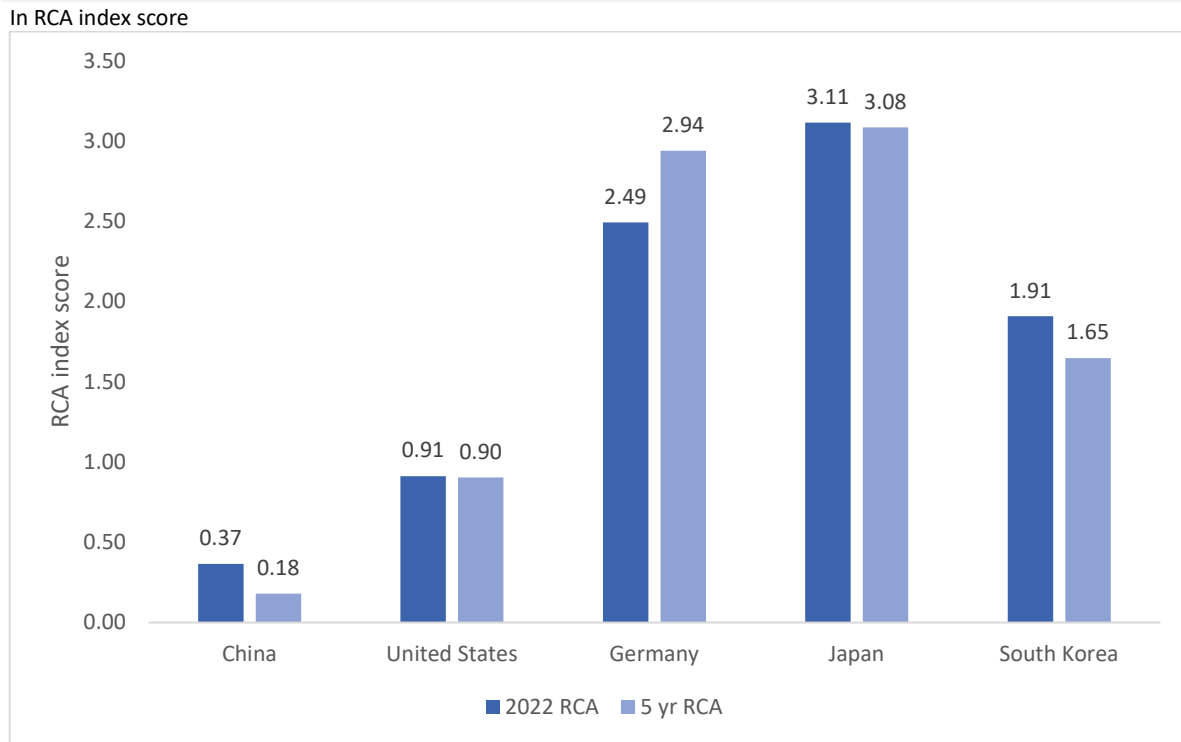
significant variation in openness to imports in different countries. For example, China has a 25 percent tariff on all imported motor vehicles, while the United States has 2.5 percent for most light vehicles.

Another way to look at competitiveness is revealed comparative advantage (RCA). RCA is calculated by dividing the share of domestic exports made up of a specific product (e.g., vehicles or automotive parts) by the share of global exports made up of the same product.¹⁴ For example, in 2022 U.S. vehicle exports made up 3.7 percent of U.S. exports. Global vehicle exports made up 4.1 percent of global exports, thus the U.S. RCA for vehicles is slightly less than one. Generally, a country with an RCA greater than one in a product is considered to have a comparative advantage, while a lower score reveals a lack of a comparative advantage.¹⁵

Figure 7 shows the RCA in 2022 for the five vehicle producing countries discussed in this paper. China and the United States both have an RCA of less than one for vehicles, while the other three have an RCA ranging from 1.91 to 3.11. China and the United States are also larger and more diversified economies, with significantly larger domestic markets. If instead of Germany, RCA were calculated for the EU, including intra-EU trade, then the vehicle RCA would be 1.53.

¹⁴ UNCTAD, "RCA Radar," accessed August 28, 2023.

¹⁵ Jones and Bethmann, *Approaches of Measuring Revealed Comparative Advantage*, July 2023, 4.

Figure 7 Vehicle RCA, 2022 and 5-year for major vehicle producing countries

Source: author calculation using data from S&P Global, Global Trade Atlas, accessed August 28, 2023. HS subheadings include 8701.21, 8701.22, 8701.23, 8701.24, 8701.29, 8703.21, 8703.22, 8703.23, 8703.24, 8703.31, 8703.32, 8703.33, 8703.40, 8703.50, 8703.60, 8703.70, 8703.80, 8703.90, 8704.21, 8704.31, 8704.22, 8704.23, 8704.32, 8704.41, 8704.42, 8704.43, 8704.51, 8704.52, 8704.60, 8704.90.

Despite being straightforward and easy to compare across countries, some have argued that RCA does not actually measure international competitiveness, but instead measures international specialization.¹⁶ This appears true among the automotive producers, as Germany, Japan, and South Korea are known for exporting vehicles rather than focusing on their (smaller) domestic markets. The domestic market is the most important market for producers in both the United States and China.

U.S. Sales Case Study

Light vehicle sales in the United States tend to be of larger vehicles, and in recent years have trended away from cars and sport-utility vehicles (SUVs) towards cross-utility vehicles (CUVs), which have the ride height of SUVs but the unibody frame (and thus smooth ride) of a car. Many in the automotive industry use the mantra in light vehicle production is “build where you sell”, or more specifically vehicle manufacturers tend to build vehicles in locations where they sell high volumes of those vehicles. Unsurprisingly, U.S. light vehicle production has tended to skew towards the more popular segments, larger vehicles and (in recent years) CUVs, with imports supplying a higher share in less popular segments such as small cars.

Examining U.S. sales by segment shows positive signs for U.S. competitiveness. Not only did the share of U.S.-produced vehicles in U.S. light vehicle sales increase, but this increase occurred across four of five

¹⁶ Jones and Bethmann, *Approaches of Measuring Revealed Comparative Advantage*, July 2023, 5–6.

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vehicle types, including the largest (cross-utility vehicles or CUVs) (table 1). During 2018–22 U.S. light vehicle sales declined by 3.5 million units (20.3 percent), primarily driven by a 2.5 million unit (45.8 percent) decline in U.S. car sales (figure 8). Despite these declines, the U.S.-produced share of U.S. light vehicles increased from 57.2 percent to 62.9 percent. During this same time U.S. brands' share of U.S. light vehicle production increased from 39.8 to 41.4 percent.¹⁷

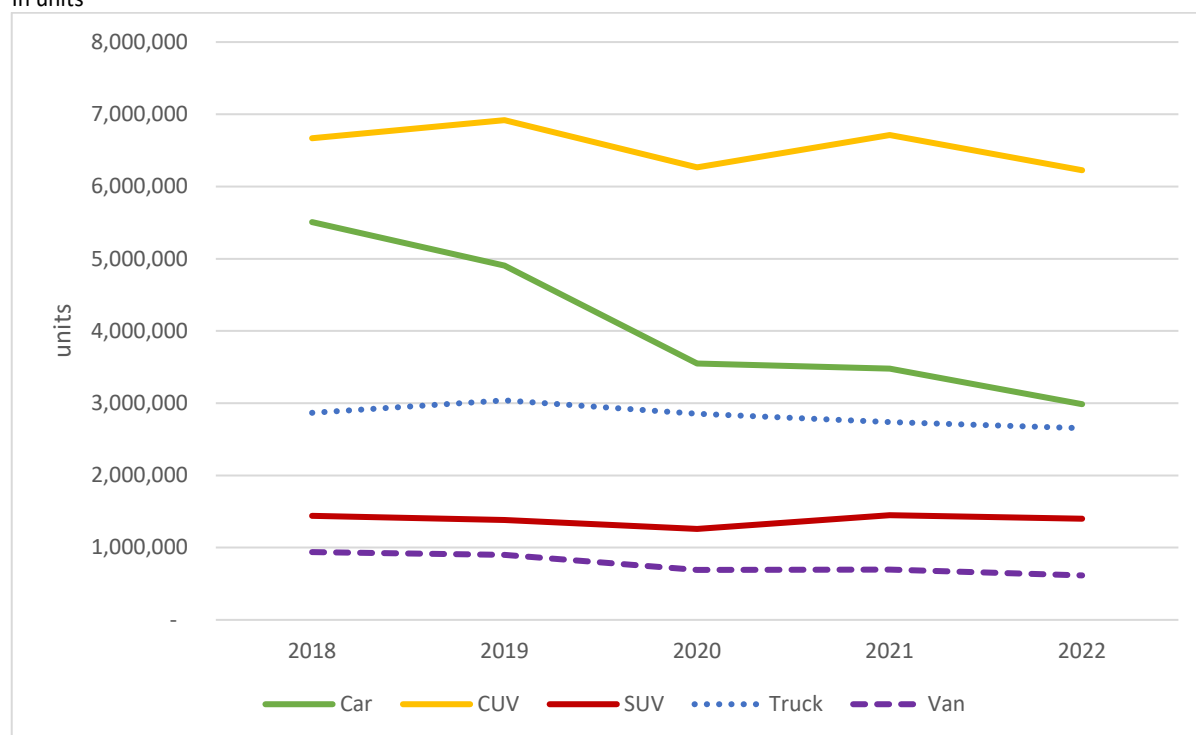
Table 1 U.S.-produced share of U.S. light vehicle sales by type, 2018–22

	2018	2019	2020	2021	2022
Truck	91.3%	91.7%	91.6%	90.3%	88.2%
SUV	80.3%	79.9%	80.2%	81.6%	85.3%
Van	51.2%	56.1%	57.2%	61.6%	63.4%
CUV	48.3%	49.8%	49.9%	51.8%	52.1%
Car	45.1%	45.1%	48.7%	49.2%	52.7%
Total	57.2%	58.7%	60.7%	61.5%	63.0%

Source: Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023; Ward's Intelligence, "U.S. Vehicle Production by Model by Month, 2022", March 21, 2023

Figure 8 U.S. Sales by Vehicle Type, 2018–22

In units



Source: Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023; Ward's Intelligence, "U.S. Vehicle Production by Model by Month, 2022", March 21, 2023.

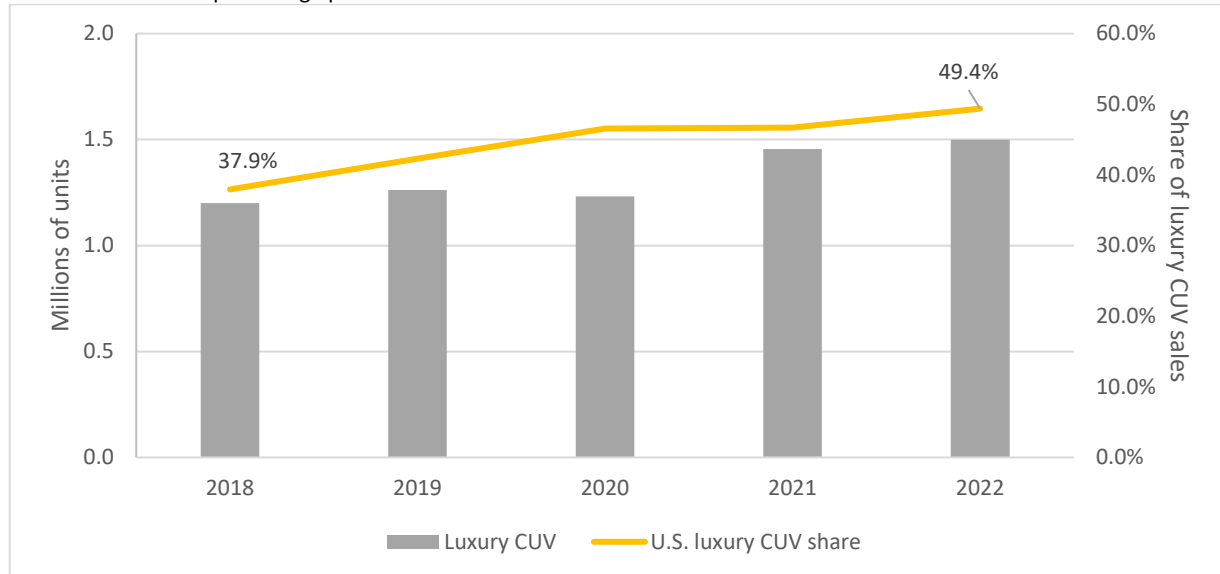
A closer examination shows that U.S.-produced vehicles made up an increasing share of U.S. sales in the fastest growing segments. For example, U.S.-produced CUVs gained market share, particularly in the fast-growing luxury CUV segment. Despite a 6.6 percent decline in U.S. CUV sales from 2018 to 2022, U.S.

¹⁷ Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023; Ward's Intelligence, "U.S. Vehicle Production by Model by Month, 2022", March 21, 2023.

luxury CUV sales increased by 24.9 percent (299,376) during 2018–22. At the same time the U.S.-produced share of U.S. luxury CUV sales increased from 37.9 percent to 49.4 percent (figure 9). The share of U.S.-produced luxury CUVs made by U.S. brands also increased from 23.6 percent of U.S. luxury CUV production to 49.1 percent. During this time vehicle manufacturers introduced seven new U.S.-produced luxury CUVs. The most popular of the new models (the Tesla Model Y) was also the top selling luxury CUV in 2021 and 2022.¹⁸

Figure 9 U.S. luxury CUV sales and U.S.-produced market share, 2018–22

Millions of units and percentage points



Source: Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023; Ward's Intelligence, "U.S. Vehicle Production by Model by Month, 2022", March 21, 2023.

The story is similar in U.S. car sales, where, despite a rapid decline in car sales, the U.S.-produced share in the two segments that fell the slowest (mid-sized and luxury) increased (11.5 and 14.7 percentage points, respectively). The share of mid-sized cars made in the United States by U.S. brands stayed relatively flat from 2018 to 2022, but the share of luxury cars made in the United States by U.S. brands increased from 59.3 percent to 77.6 percent of U.S. luxury car production.¹⁹ These trends support the idea that U.S. producers (and even more specifically U.S. producers with headquarters in the United States) are competitive in the U.S. automotive market, and that they can supply the fastest growing segments with domestic production, allowing imports to fill-in in less popular segments.

National Competitiveness in Automotive Parts Production

Automotive parts production is also a significant component of automotive competitiveness. Unfortunately, there is no global database of automotive parts production by country comparable to the previously discussed vehicle production data. Therefore, as a proxy for parts production, this section

¹⁸ Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023.

¹⁹ Ward's Intelligence, "U.S. Light Vehicle Sales by Segment, 2022," February 9, 2023.

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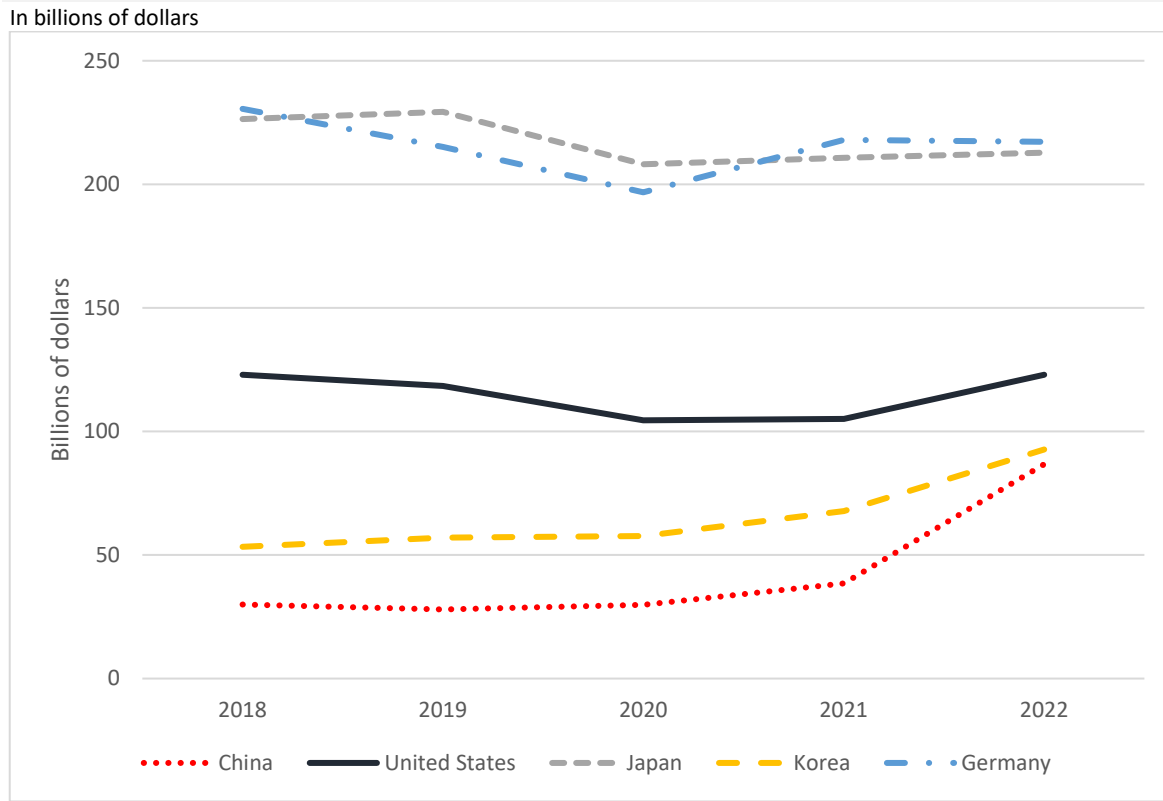
discusses trends in revenues of the top automotive parts suppliers by headquartered country, as well as exports. These trends provide measures that can be used to analyze competitiveness in automotive parts production. This section also has a case study on engines, where global production data is available.

The competitiveness analysis in this section finds that the United States appears to be a significant manufacturer and exporter of automotive parts, particularly when focusing on downstream automotive-specific parts. The United States also has an RCA above one for the narrow automotive parts list focused on downstream parts, implying that the United States has a comparative advantage in export of these parts.²⁰ The United States is a major producer of engines, and a major exporter of automotive parts.

Revenue

Global automotive parts revenue by the country where the supplier is headquartered shows Chinese and Korean suppliers' revenue increasing rapidly from 2018 to 2022 (figure 10). The increasing importance of EV batteries is one reason for increased revenue for Chinese and Korean suppliers. Revenue by U.S.-headquartered companies remained relatively stable with a dip from 2019 to 2020 and a bounce back from 2021 to 2022. The decline was likely related to production declines due to the COVID-19 pandemic and subsequent parts shortages, with revenue rebounding as shortages abated. These trends appear to show that while U.S. and Chinese production are significantly higher, Japanese and German companies have a wider reach. Also, Korean and Chinese companies appear to be closing the gap with U.S. automotive parts suppliers.

²⁰ See the "International Trade" section later in this paper for more on the automotive parts lists.

Figure 10 Global revenue of Top 100 global automotive parts supplier by headquarters country, 2018–22

Source: Automotive News Annual Top 100 Global Automotive Parts supplier list.

International Trade

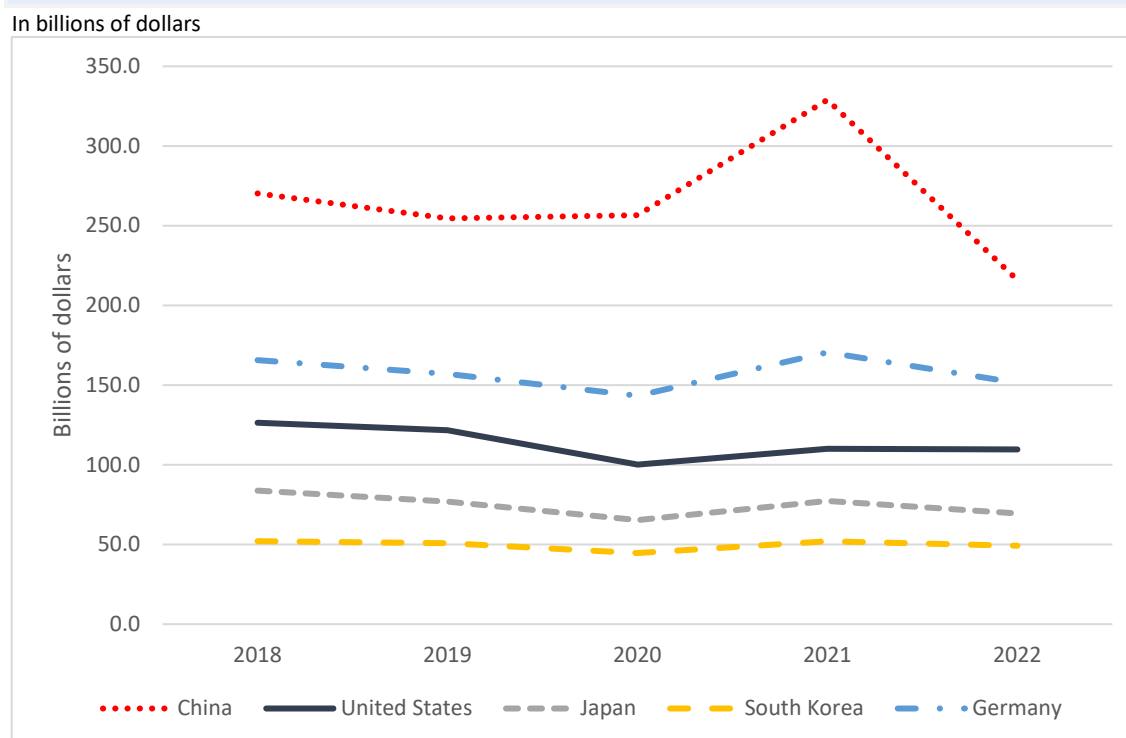
An examination of automotive parts exports shows that the U.S. automotive parts competitiveness may have declined relative to China, particularly among downstream automotive-specific products. Trade data in automotive parts faces an additional challenge, in that there is no globally accepted list of subheadings in the Harmonized System (HS) for automotive parts. This paper uses two sets of automotive parts lists. The “broad automotive parts” list below includes 100 six-digit subheadings that include at least one statistical reporting number in the Department of Commerce’s automotive parts list. While this list includes many products that are not specifically automotive, they tend to be products that are dual/multi-use and upstream. Products that are not specifically automotive include pistons, ball bearings, hoses, and friction material, that have automotive and non-automotive applications. The “narrow” list is a subset of the “broad automotive parts” list, that includes those 43 subheadings that are motor vehicle-specific. These subheadings tend to be for more downstream products (e.g., engines, transmissions, brakes, seats for motor vehicles, etc.).

China is the leading exporter of automotive parts under the “broad” list, but its exports declined during the five-year period from \$271 billion in 2018 to \$222 billion in 2022 (figure 11). However, this decline was entirely accounted for by separating out smartphones into a separate subheading that does not

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include cellular connections for motor vehicles.²¹ If that subheading were excluded, then China's exports would've started from a lower level, but increased over the period, with China becoming the leading exporter in 2021, and increasing the gap between it and Germany in 2022.

Figure 11 Automotive parts (broad) exports by major vehicle producing country, 2018–22



Source: S&P Global, Global Trade Atlas, accessed June 26, 2023. Includes wide range of automotive and upstream subheadings as described in automotive parts appendix.

U.S. exports under the broad list declined from \$126.4 billion in 2018 to \$109.7 billion in 2022, with a temporary drop from 2019 to 2020 due to the pandemic. Top U.S. exports were miscellaneous automotive parts (\$10.5 billion in 2022) and parts and accessories of bodies (\$8.8 billion in 2022). Overall, seven of the United States' top 10 most exported subheadings in 2022 were automotive-specific subheadings that are also included in the narrow list. Major destinations for U.S. exports were Mexico and Canada, making up 65.2 percent (\$71.5 billion) of U.S. exports in 2022.

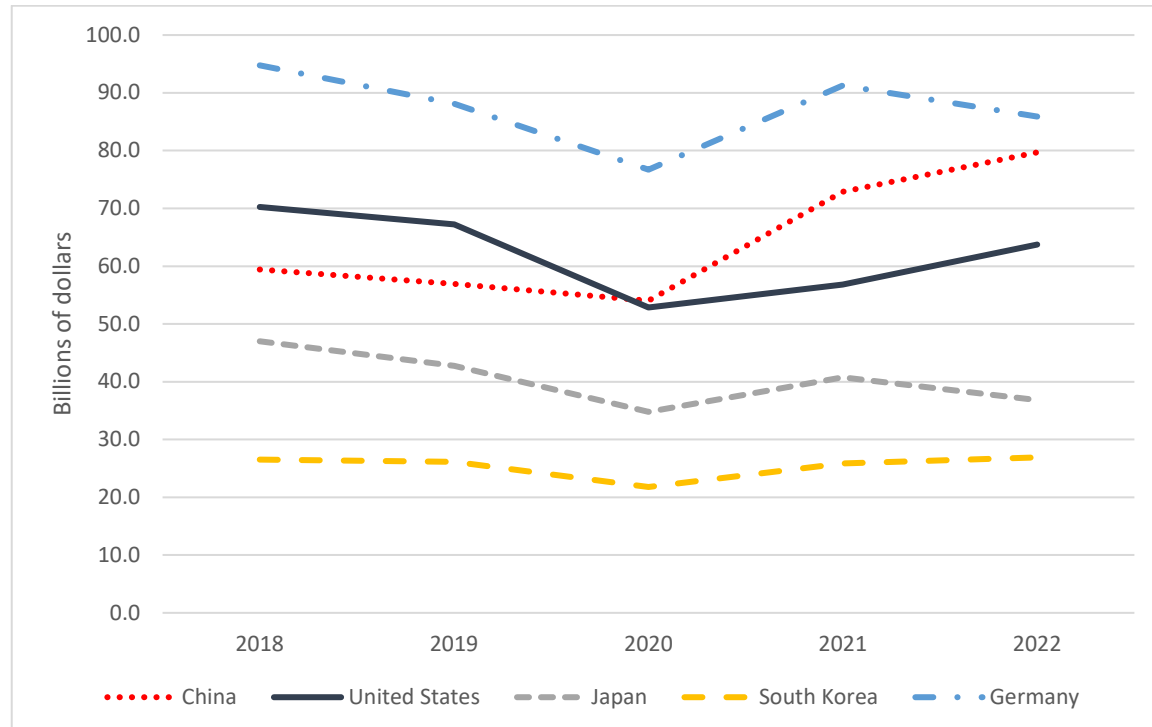
When looking at the narrow list of automotive parts exports, Germany replaces China as the largest exporter (figure 12). China, which was first in the broad list, was the second largest exporter under the narrow list, but exported fewer automotive parts than the United States in 2018 and 2019. U.S. exports under the narrow list declined from \$70.2 billion in 2018 to \$63.7 billion in 2022, with a temporary drop from 2019 to 2020 due to supply chain disruptions related to the COVID-19 pandemic. The top two exports were the same as in the broad list (miscellaneous parts and parts and accessories of bodies), but

²¹ In 2022 the WCO split HS 8517.12 into HS 8517.13 (smartphones) and HS 8517.14 (Other telephones for cellular networks or for other wireless networks). The pre-2022 code of HS 8517.12 included both smartphones and other cellular connections, which included those in vehicles. WCO, *Table II*, November 2020.

they made up a much larger share of U.S. exports (28.5 percent). The top two destinations for U.S. exports were Mexico and Canada, making up over 75 percent of U.S. exports in 2022.

Figure 12 Automotive parts (narrow) exports by major vehicle producing country, 2018–22

In billions of dollars



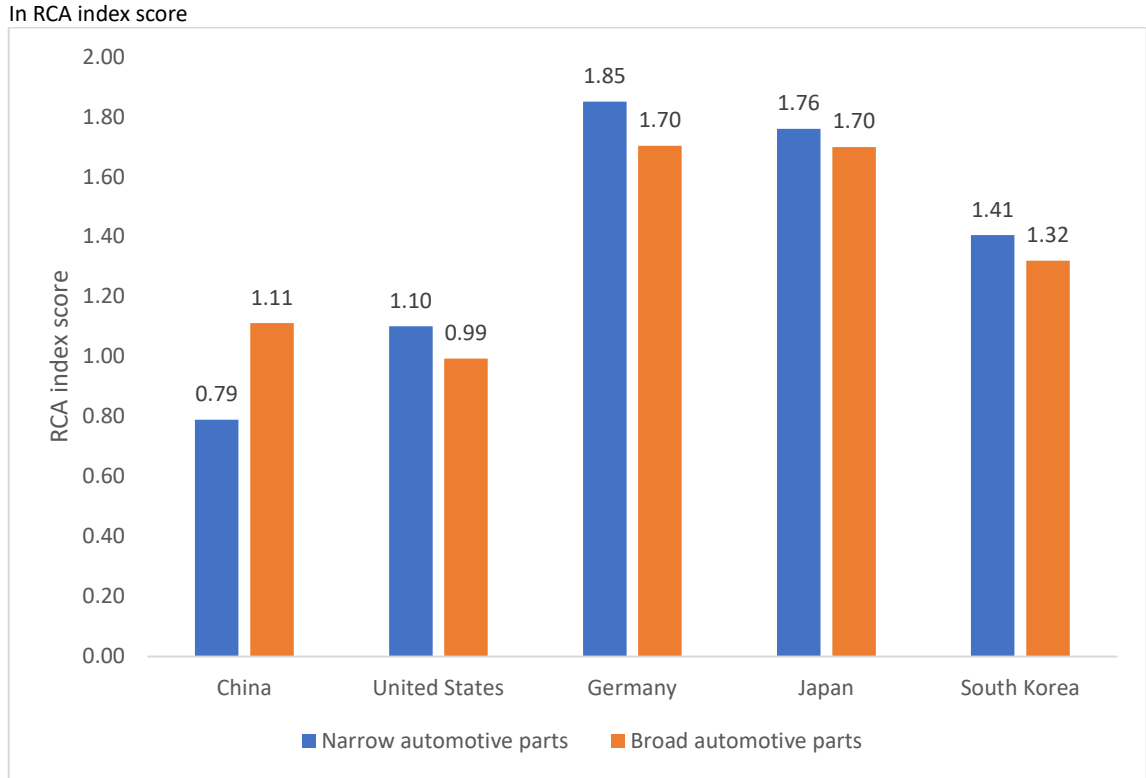
Source: S&P Global, Global Trade Atlas, accessed August 30, 2023. Includes all specifically automotive-subheadings as described in appendix.

Looking at both automotive parts lists, the United States is a significant exporter of automotive parts, but has lost ground relative to China, particularly in downstream automotive parts. Chinese manufacturers are already major suppliers of upstream automotive parts inputs, but Chinese automotive parts manufacturers are exporting an increasing amount of more downstream automotive-specific parts as shown in figure 12. Downstream automotive-specific parts are an area where the United States has maintained a relatively strong position, although one that's primarily focused on the North American automotive supply chain.

Competitiveness Metrics

The figure below shows RCA using the broad and narrow lists of automotive parts (figure 13). Interestingly, for most vehicle manufacturers their RCA was higher for the narrow list, with the exception of China. This may be because China has specialized in producing a wide range of upstream inputs. Downstream automotive parts tend to be made in close proximity to vehicle production, so most vehicle manufacturers are also significant manufacturers of downstream automotive parts. The United States' RCA for automotive parts shows a comparative advantage for downstream automotive parts, but a slight disadvantage in the broader category. The United States' RCA is markedly lower than many of the other vehicle manufacturers, possibly because of a focus on supplying automotive parts for domestic production and the diversity of U.S. exports.

Figure 13 RCA for automotive parts in major vehicle producing countries, 2022



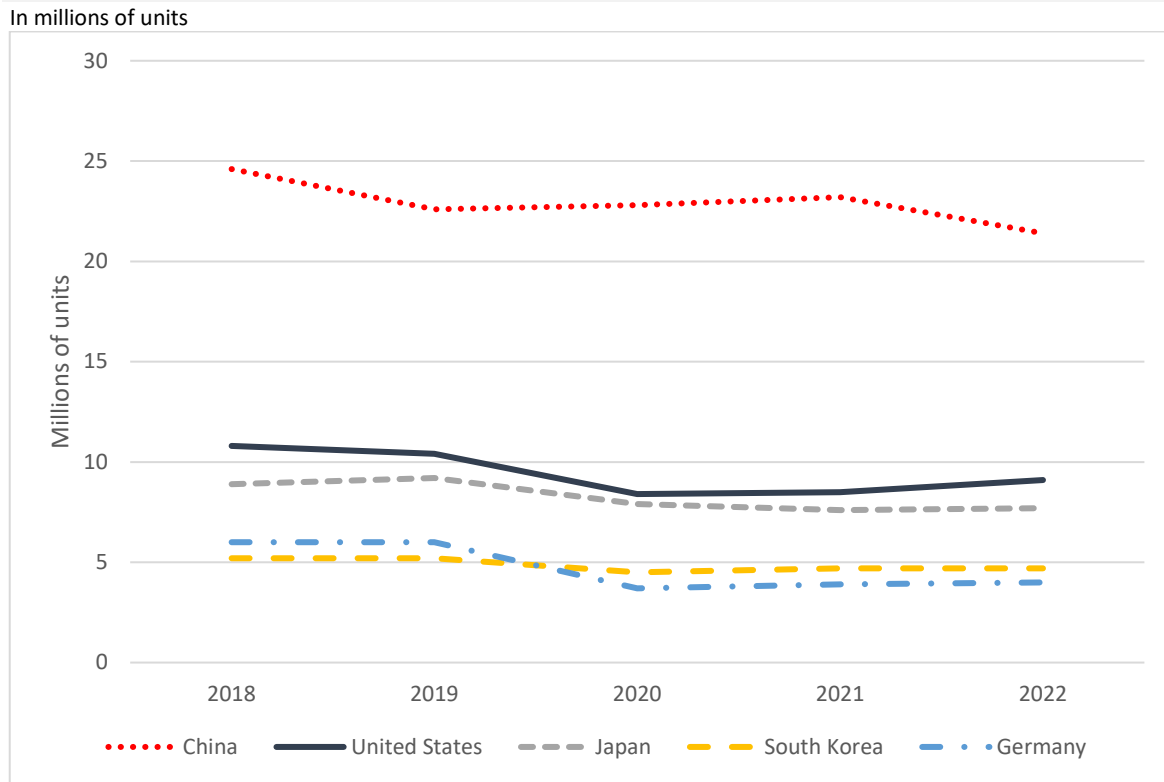
Source: Author calculations based on data from S&P Global, Global Trade Atlas, accessed June 26, 2023. Includes both lists of automotive parts-related subheadings as described in automotive parts appendix.

Engines Case Study

The United States holds a strong competitive position in engines, where it became the top exporter in 2022, and exports a larger share of its engines than other major engine manufacturers. For internal combustion engine vehicles, engines are the most important (and most expensive) part.²² Engines tend to be produced by vehicle manufacturers instead of purchased from suppliers. Figure 14 shows engine production by country from 2018 to 2022. The major vehicle manufacturing countries discussed in the previous section are also major engine producers, with similar levels of engine and vehicle production. South Korean engine production passed German production in 2020, a year earlier than South Korean vehicle production passed German vehicle production. Interestingly, engine production declined significantly during 2018–22, perhaps due to the EV transition.

²² Maloney, “The Surprisingly Manual Process,” July 27, 2022.

Figure 14 Engine production by major vehicle producing country, 2018–22

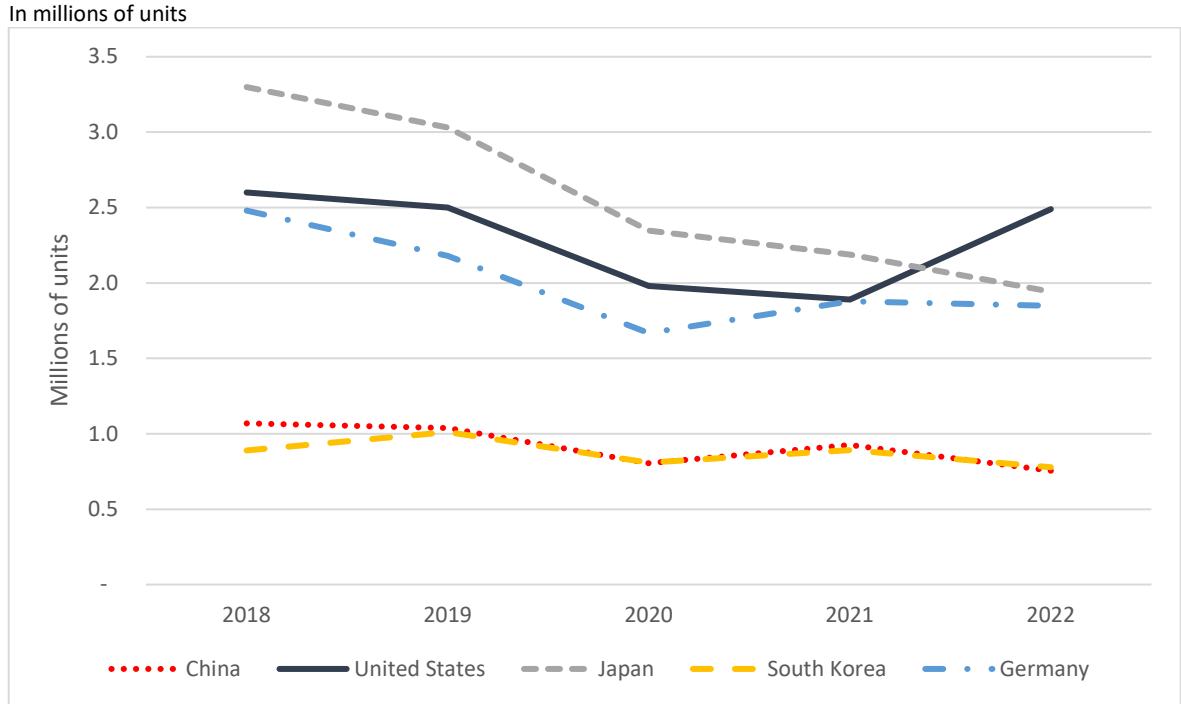


Source: Automotive World, Engine Vehicle Plant Database, various years.

Engine export data shows a different picture, with the United States and Germany leading in engine exports by volume (figure 15). U.S. engine production appears to be more export-oriented than U.S. vehicle production and parts production more broadly, with nearly 25 percent of U.S. vehicle engines exported annually. This may also point to U.S. engine production being globally competitive. The U.S. RCA for engines was also relatively strong: 2.07 in 2022; and 1.92 over the five-year period.²³

²³ Author calculations based on data from S&P Global, Global Trade Atlas, accessed June 26, 2023. HS subheadings 8408.20 and 8407.34.

Figure 15 Exports of engines by major vehicle country, 2018–22



Source: S&P Global, Global Trade Atlas, accessed September 22, 2023. HS subheadings 8407.34 and 8408.20.

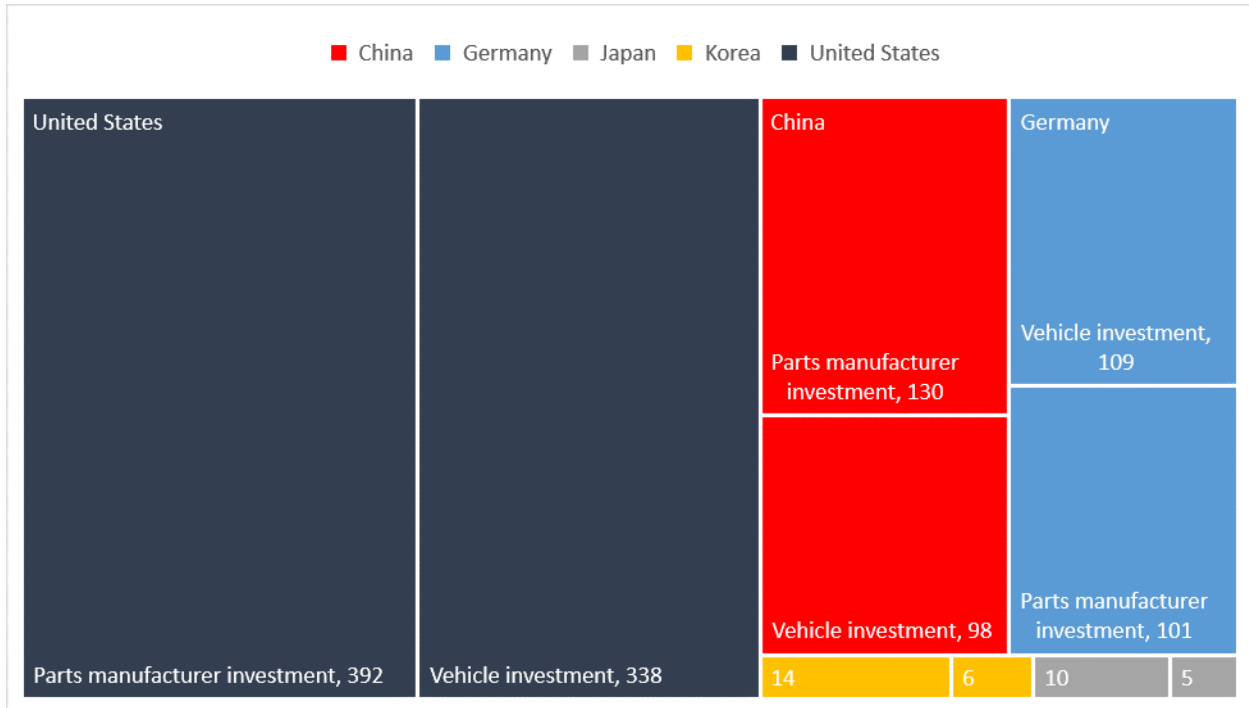
Investment

Research and development (R&D) spending and investment can also be seen as elements of competitiveness, with multinational companies investing in areas with competitive automotive environments. The United States is by far the largest destination of greenfield automotive investment, reflecting an open environment for foreign investment, a strong domestic automotive supply chain and domestic R&D.

The United States is a leading destination for greenfield investment, as companies seek to participate in the U.S. market and U.S. automotive supply chain. According to data from FDImarkets’ project level data, the United States is the leading destination for foreign greenfield vehicle and parts investment (figure 16). This data shows Japan and Korea receiving significantly lower numbers of greenfield investments than other major vehicle manufacturing countries. Historically they have been less open to foreign investment, and have developed vertically integrated supply chains managed by large conglomerates.²⁴

²⁴ See discussions of Korean “chaebol” or Japanese “zaibatsu.”

Figure 16 Motor vehicle and parts investments by country, 2018–22
In number of investments



Source: FDI Markets, Database, accessed October 1, 2023.

Note: Groupings from database were project level investments by automotive component manufacturers and by automotive OEMs.

The United States appears to be in the middle of the pack when it comes to number of automotive firms with significant R&D expenditures, and in total R&D spending. Figure 17 shows research and development (R&D) spending by the country where the “Global 2500” company is headquartered.²⁵ While many companies conduct R&D outside of their home country, most R&D tends to occur in their home market. U.S. headquartered companies had the third highest R&D spending levels among motor vehicle and parts manufacturers in 2021. They also were also the second most numerous, with 28 U.S. motor vehicle and parts manufacturers in the Global 2500. China was the only country with more automotive firms in the Global 2500 (45).²⁶

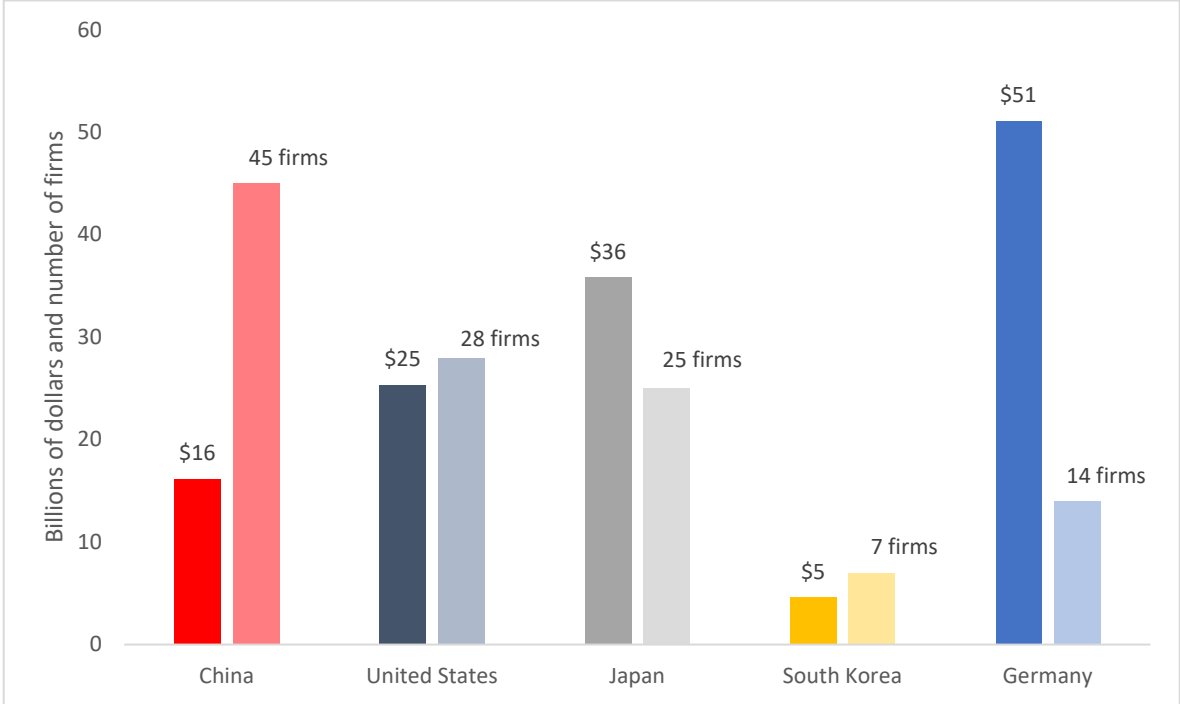
²⁵ The Global 2500 is the 2,500 companies in all sectors that invested the most in R&D.

²⁶ Grassano et al., “The 2022 EU Industrial R&D Investment Scoreboard | IRI,” December 13, 2022.

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Figure 17 R&D spending by HQ country of company in major vehicle producing countries, 2021

In billions of dollars and number of firms



Source: Grassano et al., "The 2022 EU Industrial R&D Investment Scoreboard," December 13, 2022.

Note: Only includes R&D by the Global 2500. R&D investments by companies outside of the Global 2500 not included, thus undercounting total R&D spending.

Conclusion

Overall, the United States appears to be competitive in both vehicle and parts production, although its ranking compared to the other major automotive producers depends on which competitiveness metric one uses. U.S. production focuses, first and foremost, on its large domestic market. This focus leads to the United States being less export-oriented than some other major vehicle manufacturing countries. Despite this domestic focus, the United States produces and exports significant amounts of vehicles and parts. U.S. export competitiveness is particularly strong in engines, and appears to also be relatively strong in downstream automotive parts.

As the automotive industry transitions to electric and alternative-fueled vehicles, the U.S. industry will also need to transition to avoid over-reliance on foreign parts or vehicles. Electric vehicles will require significantly fewer parts. Further, electric vehicle manufacturers in the United States often rely on foreign manufacturers for battery cells and, particularly components of batteries further upstream (e.g., cathodes, anodes, etc.). U.S. investment in battery cells and components has been significant in recent years, and appears to be ramping up to prepare for this transition.²⁷

²⁷ Forthcoming JICE Article on EVs.

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Appendix: Automotive Parts

There is no accepted global list of HS subheadings for automotive parts. While many automotive parts are in the same chapter as motor vehicles (chapter 87), key parts including the engine, battery, and seats are located in other chapters. This working paper uses two automotive parts list: “broad” and “narrow.”

Broad Automotive Parts List

The broad list includes all HS subheadings that contain statistical codes under the United States Harmonized Tariff System that are included in the Department of Commerce’s automotive parts list (table appendix.1).²⁸ This list includes upstream components, such as rubber hoses and ball bearings that could be used for multiple purposes as well as more downstream inputs that are specific for motor vehicles. This list likely encompasses a greater share of the total automotive supply chain, while including trade in goods that are not necessarily automotive.

Table Appendix.1 Broad List of Automotive Parts and their descriptions

HS-6	Description
381900	Hydraulic Brake Fluids And Prepared Liquids For Hydraulic Transmission, With Less Than 70% (If Any) By Weight Of Petroleum Or Bituminous Mineral Oils
382000	Antifreezing Preparations And Prepared Deicing Fluids
400912	Tubes, Pipe, And Hoses, Of Vulcanized Rubber, Exc Hard Rubber, Not Reinforced Or Otherwise Combined With Other Materials, With Fittings
400922	Tubes, Pipes, Hoses Of Vulcanized Rubber, Exc Hard Rubber, Reinforced Or Otherwise Combined With Metal, With Fittings
400932	Tubes, Pipes And Hoses Of Vulcanized Rubber, Exc Hard Rubber, Reinforced Or Otherwise Combined Only With Textile Materials, With Fittings
400942	Tubes, Pipes And Hoses Of Vulcanized Rubber, Exc Hard Rubber, Reinforced/Otherwise Combined With Other Materials, With Fittings
401110	New Pneumatic Tires, Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars)
401120	New Pneumatic Tires, Of Rubber, Of A Kind Used On Buses Or Trucks
401211	Retreaded Tires Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars)
401212	Retreaded Tires Of Rubber, Of A Kind Used On Buses Or Trucks
401220	Used Pneumatic Tires, Of Rubber
401310	Inner Tubes, Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars), Buses Or Trucks
401693	Gaskets, Washers And Other Seals, Of Vulcanized Rubber Other Than Hard Rubber
401699	Articles Of Vulcanized Rubber Other Than Hard Rubber, Nesoi
681320	Friction Material And Articles Thereof, Unmounted, With A Basis Of Asbestos
681381	Brake Linings And Pads Not Of Asbestos, Other Mineral Substances Or Cellulose
681389	Friction Material And Articles Thereof (Except Brake Linings Or Pads), Unmounted, Not Containing Asbestos, Other Mineralsubstances Or Of Cellulose,Nes
700711	Toughened (Tempered) Safety Glass, Of Size And Shape Suitable For Incorporation In Vehicles, Aircraft, Spacecraft Or Vessels

²⁸ U.S. Department of Commerce, “Automotive Parts Tariff Codes,” 2023.

HS-6	Description
700721	Laminated Safety Glass, Of Size And Shape Suitable For Incorporation In Vehicles, Aircraft, Spacecraft Or Vessels
700910	Rear-View Mirrors For Vehicles
731511	Roller Chain Of Iron Or Steel
731816	Nuts, Threaded, Of Iron Or Steel
732010	Leaf Springs And Leaves Therefor, Of Iron Or Steel
732020	Helical Springs Of Iron Or Steel
830120	Locks Of A Kind Used On Motor Vehicles, Of Base Metal
830210	Hinges, And Parts Thereof, Of Base Metal
830230	Mountings, Fittings And Similar Articles Nesoi (Except Hinges), And Parts Thereof, Suitable For Motor Vehicles, Of Base Metal
840734	Spark-Ignition Reciprocating Piston Engines For Propulsion Of Vehicles Except Railway Or Tramway Stock, Over 1,000 Cc Cylinder Capacity
840820	Compression-Ignition Internal Combustion Piston Engines (Diesel Or Semi-Diesel), For The Propulsion Of Vehicles Except Railway Or Tramway Stock
840991	Parts For Use With Spark-Ignition Internal Combustion Piston Engines (Including Rotary Engines), Nesoi
840999	Parts For Use With Compression-Ignition Internal Combustion Piston Engines, Nesoi
841330	Fuel, Lubricating Or Cooling Medium Pumps For Internal Combustion Piston Engines
841391	Parts Of Pumps For Liquids
841430	Compressors Used In Refrigerating Equipment (Including Air Conditioning)
841459	Fans, Nesoi
841480	Air Pumps And Air Or Other Gas Compressors, Nesoi; Ventilating Or Recycling Hoods Incorporating A Fan, Nesoi
841520	Automotive Air Conditioners
841590	Parts, Nesoi, Of Air Conditioning Machines
842123	Oil Or Fuel Filters For Internal Combustion Engines
842131	Intake Air Filters For Internal Combustion Engines
842139	Filtering Or Purifying Machinery And Apparatus For Gases, Nesoi
842549	Jacks, Nesoi; Hoists Of A Kind Used For Raising Vehicles, Nesoi
842691	Lifting Or Handling Machinery Designed For Mounting On Road Vehicles
843110	Parts For Pulley Tackle And Hoists (Other Than Skip Hoists), Winches, Capstans And Jacks
848210	Ball Bearings
848220	Tapered Roller Bearings, Including Cone And Tapered Roller Assemblies
848240	Needle Roller Bearings, Including Cage And Needle Roller Assemblies
848250	Cylindrical Roller Bearings, Including Cage And Roller Assemblies, Nesoi
848310	Transmission Shafts (Including Camshafts And Crankshafts) And Cranks
850132	Dc Motors Nesoi And Generators Of An Output Exceeding 750 W But Not Exceeding 75 Kw
850710	Lead-Acid Storage Batteries Of A Kind Used For Starting Piston Engines
850730	Nickel-Cadmium Storage Batteries
850760	Lithium Ion Batteries
850790	Parts Of Electric Storage Batteries, Including Separators Therefor
851110	Internal Combustion Engine Spark Plugs
851120	Internal Combustion Engine Ignition Magnetos, Magneto-Dynamos And Magnetic Flywheels
851130	Internal Combustion Engine Distributors And Ignition Coils
851140	Internal Combustion Engine Starter Motors And Dual Purpose Starter-Generators
851150	Internal Combustion Engine Generators, Nesoi
851180	Electrical Ignition Or Starting Equipment Used For Internal Combustion Engines, Nesoi, And Equipment Used In Conjunction With Such Engines, Nesoi
851190	Parts For Electrical Ignition Or Starting Equipment Used For Internal Combustion Engines; Parts For Generators And Cut-Outs Used With Such Equipment

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HS-6	Description
851220	Electrical Lighting Or Visual Signaling Equipment, For Use On Cycles Or Motor Vehicles, Except For Use On Bicycles
851230	Electrical Sound Signaling Equipment Used For Cycles Or Motor Vehicles
851240	Electrical Windshield Wipers, Defrosters And Demisters Used For Cycles Or Motor Vehicles
851290	Parts Of Electrical Lighting Or Signaling Equipment, Windshield Wipers, Defrosters And Demisters, Used For Cycles Or Motor Vehicles
851712	Telephones For Cellular Networks Or For Other Wireless Networks
851714	Cellular Phones And Other Telephones For Wireless Networks, Nesoi
851981	Sound Recording Or Reproducing Apparatus, Using Magnetic, Optical Or Semiconductor Media, Nesoi
852560	Transmission Apparatus Incorporating Reception Apparatus, For Radio-Broadcasting Or Television
852721	Radiobroadcast Receivers For Motor Vehicles, Combined With Sound Recording Or Reproducing Apparatus, Not Capable Of Operating Without Outside Power
852729	Radiobroadcast Receivers For Motor Vehicles, Not Capable Of Operating Without Outside Power, Nesoi
853180	Electric Sound Or Visual Signaling Apparatus (For Example, Bells, Sirens, Indicator Panels), Nesoi
853641	Relays For A Voltage Not Exceeding 60 V
853690	Electrical Apparatus For Switching, Protecting Or Making Connections To Or In Electrical Circuits, For A Voltage Not Exceeding 1,000 V, Nesoi
853910	Sealed Beam Electric Lamp Units
853921	Tungsten Halogen Electric Filament Lamps
854430	Insulated Ignition Wiring Sets And Other Wiring Sets For Vehicles, Aircraft And Ships
870710	Bodies (Including Cabs) For Motor Cars And Other Vehicles Principally Designed For Transport Of Persons (Except Public-Transport Of Passengers)
870790	Bodies (Including Cabs) For Road Tractors For Semi-Trailers, Motor Vehicles For Public-Transport Of Passengers, Goods Transport And Special Purpose
870810	Bumpers And Parts Thereof For Motor Vehicles
870821	Safety Seat Belts For Motor Vehicles
870829	Parts And Accessories Of Bodies (Including Cabs) For Motor Vehicles, Nesoi
870830	Brakes And Servo-Brakes; Parts Thereof
870840	Gear Boxes For Motor Vehicles
870850	Drive Axles With Differential For Motor Vehicles
870870	Road Wheels And Parts And Accessories Thereof For Motor Vehicles
870880	Suspension Shock Absorbers For Motor Vehicles
870891	Radiators For Motor Vehicles
870892	Mufflers And Exhaust Pipes For Motor Vehicles
870893	Clutches And Parts Thereof For Motor Vehicles
870894	Steering Wheels, Steering Columns And Steering Boxes For Motor Vehicles
870895	Safety Airbags With Inflator System; Parts Thereof
870899	Parts And Accessories For Motor Vehicles, Nesoi
871690	Parts Of Trailers, Semi-Trailers And Other Vehicles, Not Mechanically Propelled
902910	Revolution Counters, Production Counters, Taximeters, Odometers, Pedometers And The Like
902920	Speedometers And Tachometers; Stroboscopes
902990	Parts And Accessories For Revolution Counters, Production Counters, Taximeters, Odometers, Pedometers Etc., Speedometers, Tachometers And Stroboscopes
910400	Instrument Panel Clocks And Clocks Of A Similar Type For Vehicles, Aircraft, Spacecraft Or Vessels
940120	Seats Of A Kind Used For Motor Vehicles
940190	Parts Of Seats (Except Parts Of Medical, Dentist', Barbers' And Similar Seats), Nesoi

Source: S&P Global, Global Trade Atlas, accessed September 6, 2023.

Narrow Automotive Parts List

The “narrow” list of automotive parts (table appendix.2) only uses HS subheadings that are automotive-specific (often designated with “for motor vehicles” in the description). These parts tend to be farther downstream, and are either direct inputs into vehicles or direct inputs into major systems for motor vehicles. Unfortunately, some key automotive components (such as EV batteries and electric motors) do not have automotive-specific subheadings, and are thus not included in this list.

Table Appendix.2 Narrow List of Automotive Parts and their descriptions

Hs Code	Description
870850	Drive Axles With Differential For Motor Vehicles
870860	Non-Driving Axles And Parts For Motor Vehicles
841520	Automotive Air Conditioners
852721	Radiobroadcast Receivers For Motor Vehicles, Combined With Sound Recording Or Reproducing Apparatus, Not Capable Of Operating Without Outside Power
870870	Road Wheels And Parts And Accessories Thereof For Motor Vehicles
852729	Radiobroadcast Receivers For Motor Vehicles, Not Capable Of Operating Without Outside Power, Nesoi
870880	Suspension Shock Absorbers For Motor Vehicles
870891	Radiators For Motor Vehicles
700910	Rear-View Mirrors For Vehicles
870892	Mufflers And Exhaust Pipes For Motor Vehicles
870893	Clutches And Parts Thereof For Motor Vehicles
870894	Steering Wheels, Steering Columns And Steering Boxes For Motor Vehicles
401110	New Pneumatic Tires, Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars)
870895	Safety Airbags With Inflator System; Parts Thereof
401120	New Pneumatic Tires, Of Rubber, Of A Kind Used On Buses Or Trucks
842549	Jacks, Nesoi; Hoists Of A Kind Used For Raising Vehicles, Nesoi
870899	Parts And Accessories For Motor Vehicles, Nesoi
830120	Locks Of A Kind Used On Motor Vehicles, Of Base Metal
842691	Lifting Or Handling Machinery Designed For Mounting On Road Vehicles
870710	Bodies (Including Cabs) For Motor Cars And Other Vehicles Principally Designed For Transport Of Persons (Except Public-Transport Of Passengers)
871690	Parts Of Trailers, Semi-Trailers And Other Vehicles, Not Mechanically Propelled
401211	Retreaded Tires Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars)
843110	Parts For Pulley Tackle And Hoists (Other Than Skip Hoists), Winches, Capstans And Jacks
851220	Electrical Lighting Or Visual Signaling Equipment, For Use On Cycles Or Motor Vehicles, Except For Use On Bicycles
870790	Bodies (Including Cabs) For Road Tractors For Semi-Trailers, Motor Vehicles For Public-Transport Of Passengers, Goods Transport And Special Purpose
401212	Retreaded Tires Of Rubber, Of A Kind Used On Buses Or Trucks
830230	Mountings, Fittings And Similar Articles Nesoi (Except Hinges), And Parts Thereof, Suitable For Motor Vehicles, Of Base Metal
851230	Electrical Sound Signaling Equipment Used For Cycles Or Motor Vehicles
870810	Bumpers And Parts Thereof For Motor Vehicles
840734	Spark-Ignition Reciprocating Piston Engines For Propulsion Of Vehicles Except Railway Or Tramway Stock, Over 1,000 Cc Cylinder Capacity
851240	Electrical Windshield Wipers, Defrosters And Demisters Used For Cycles Or Motor Vehicles
870821	Safety Seat Belts For Motor Vehicles
840820	Compression-Ignition Internal Combustion Piston Engines (Diesel Or Semi-Diesel), For The Propulsion Of Vehicles Except Railway Or Tramway Stock
848240	Needle Roller Bearings, Including Cage And Needle Roller Assemblies
851290	Parts Of Electrical Lighting Or Signaling Equipment, Windshield Wipers, Defrosters And Demisters, Used For Cycles Or Motor Vehicles
870822	Front Windscreens (Windshields), Rear Windows And Other Windows Specified In Chapter 87 Subheading Note 1
401310	Inner Tubes, Of Rubber, Of A Kind Used On Motor Cars (Including Station Wagons And Racing Cars), Buses Or Trucks

Hs Code	Description
870829	Parts And Accessories Of Bodies (Including Cabs) For Motor Vehicles, Nesoi
940120	Seats Of A Kind Used For Motor Vehicles
870830	Brakes And Servo-Brakes; Parts Thereof
870831	Mounted Brake Linings Fr Motor Vehicles
870839	Brake System Parts Nes For Motor Vehicles
870840	Gear Boxes For Motor Vehicles

Source: S&P Global, Global Trade Atlas, accessed September 6,

