



THE AUTOMOTIVE INDUSTRY: THE ACHILLES' HEEL OF GERMAN ECONOMY?

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Abstract

The global car market has been shrinking since 2018. This is a key economic sector for Germany whose producers belong to the Top 15 carmakers worldwide. Yet they are running the risk of being outclassed and eventually replaced, given emerging actors in the USA and China.

These new competitors benefit from the growing digitization of the mobility sector, disruptive economic models and the obsolescence of vehicles with an internal combustion engine. This form of propulsion is progressively being replaced by less-polluting alternatives, which are being endorsed by public authorities.

The Chinese-American rivalry is also impacting German carmakers, whose strategy greatly relies on the globalization of production chains. This has led to major successes in the past, but the threat of a technological decoupling between the USA and China limits German carmakers' activities in terms of production and exports. Access to the Chinese market, which accounts for nearly 20% of the global population, is indispensable for the German brands that intend to benefit from China's catch-up effects.

European industrial and political actors plan to invest in promising sectors whilst seeking to respect environmental and social objectives. Also, the European Union (EU), led by a German powerhouse, intends to prevent market distortions such as hurdles to market access, while supporting the emergence of technologies and the compliance with production standards. However, developments in the automotive sector are challenging the EU's capacity to act in a unified fashion, even if the EU is not seeking to impose its vision on the industry's private sector, in a top-down manner.

Résumé

Depuis 2018, le marché de l'automobile est en recul. Ce secteur emblématique pour l'Allemagne, dont les constructeurs figurent dans le top 15 au niveau mondial, risque un déclassement, puis un remplacement, à la faveur de l'émergence de nouveaux acteurs, notamment aux États-Unis et en Chine. Ces concurrents s'appuient sur la numérisation croissante de la mobilité, des modèles économiques disruptifs et sur l'obsolescence de la voiture à moteur thermique, au bénéfice d'alternatives moins polluantes, soutenues par les pouvoirs publics.

La rivalité sino-américaine impacte les constructeurs allemands, dont la stratégie repose largement sur l'internationalisation de leur chaîne de production. Si celle-ci a été porteuse de succès dans le passé, la crainte d'un découplage technologique entre les États-Unis et la Chine limiterait les activités des constructeurs allemands, tant pour la production que l'exportation. L'accès au marché chinois, comptant près de 20 % de la population mondiale, est indispensable pour les marques automobiles allemandes, soucieuses de bénéficier de l'effet de rattrapage de la Chine.

Les acteurs de l'industrie automobile et les dirigeants européens envisagent d'investir dans des secteurs porteurs tout en posant la question de la cohérence avec les objectifs environnementaux et sociaux. De plus en plus, l'Union européenne (UE), et à sa tête la « locomotive économique allemande » s'efforce de corriger les distorsions relatives à l'accès au marché, au développement de technologies d'avenir et au respect de standards de production, par rapport aux concurrents étrangers. Le secteur de l'automobile concentre donc un certain nombre d'enjeux qui mettent à l'épreuve la capacité de l'UE à agir de manière unifiée sans toutefois imposer de manière directive sa vision aux acteurs industriels privés européens.

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Introduction

2020 was the year three major challenges for the future of the German car industry became apparent. It was caught up by Tesla in terms of stock market capitalization, challenged by the new type of propulsion that is emerging – the electric vehicle – and threatened by being outclassed in the growing digitization of new vehicles.

As the jewel of German industry (*Appendix 1*), the automotive sector employs 12% of the country's manufacturing labor force,¹ producing 16 million cars per year.² Its iconic brands – Volkswagen (VW), Daimler and Bayerische Motoren Werke (BMW) – are among the top 15 car producers in the world.³ Yet this sector is now slowing, as shown by declining sales and registrations since 2018. If Germany's car manufacturers are holding the line, it is thanks especially to their outward reach, and presence in growth markets. For example, 75% of cars made in Germany are exported,⁴ while more than 70% of German-brand cars are built abroad.⁵ The United States and China are important markets, as the market shares of German manufacturers there are 8% and 24% respectively.⁶ Yet the US market is seeing serious competition for German manufacturers emerge from the GAFAM (Google, Amazon, Facebook, Apple, and Microsoft) as well as Tesla. The former are diversifying their businesses into mobility, while the latter is disrupting markets.

Meanwhile, Chinese manufacturers are impressive not only in terms of quantity, but increasingly also for the quality of the cars produced. Yet, dependence on the Chinese market by German producers is almost more insidious than it is for the US. The trade surplus of German manufacturers

1. "The Automobile Industry Pocket Guide 2020-2021", European Automobile Manufacturers Association (ACEA), July 30, 2020, available at: www.acea.be.

2. Production statistics for German manufacturers from 1957 to 2019, April 1, 2021, VDA, available at: www.vda.de.

3. Production statistics from 2016 to 2019, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

4. Registration Statistics, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

5. Production statistics for German manufacturers from 1957 to 2019, *op. cit.*

6. K. Popławski, "At a Crossroads: Crisis in the German Automotive Industry", *Point of View* 79, *Center for Eastern Studies*, May 2020, available at: www.osw.waw.pl.

with China was €15 billion in 2020,⁷ and €9 billion with the United States.⁸ So the Chinese market is larger than the American market, accounting for 33% of global registrations and sales in 2019, compared to 7% for the US.⁹ Access to the Chinese market has therefore become a key issue for German manufacturers.

Moreover, the continued existence of German carmakers in China may not be sustainable in the long run. Chinese manufacturers (such as Geely, Beijing Automotive Group – BAIC, SAIC or Great Wall) are currently unknown in the West. Yet, if they gain legitimacy and increasingly seek to conquer international markets, then the shift to electric vehicles could mark a profound turning point. Once Chinese players have mastered the technologies that support their ambitions, the risk is that they will eventually push Western players out of the Chinese market, and then export their vehicles to the world. Indeed, German manufacturers fear the loss of a market comprising nearly 20% of the world's population,¹⁰ coupled with a “Kodakization” of their flagship product: cars powered by the internal combustion engine.

In addition to these structural shifts in the automotive sector are the consequences of the Sino-American rivalry. This has trade implications, which are all the more important given the decoupling of technology between the US and China. This directly affects German manufacturers, whose economic model is based on an international mesh of production chains according to competitive advantages (see *Appendices 2 and 3*).¹¹

In 2010, German manufacturers embarked on a “golden decade” resulting from a subtle balance between the internationalization of production chains, on the one hand, and the maintenance of high value-added industrial activities in Germany drawing on the whole of the European single market on the other hand (see *Appendix 4*). With the COVID-19 pandemic, current debates on the relocation or regionalization of industry also risk disrupting the cohesion of the European Union (EU).

7. Statistics on data for trade in vehicles, Eurostat online data code: DS-018995 781- motor cars and other motor vehicles primarily designed for the transport of persons (other than motor vehicles for the transport of 10 or more persons), Eurostat, available at: www.eurostat.ec.europa.EU.

8. *Ibid.*

9. Registration statistics, OICA, *op. cit.*

10. *World Population Prospects 2019*, United Nations, August 2019, available at: www.population.un.org.

11. The automotive value chain can be broken down between: 1/components and systems, 2/vehicle construction and assembly, 3/ the automotive aftermarket (sales and service), and 4/mobility and services. See D. Drohse, E. Bode, A. Hanley *et al.*, *Analysis der industrierelevanten wirtschaftlichen Rahmenbedingungen in Deutschland im internationalen Vergleich*, Final Report 24/19 for the Bundesministerium für Wirtschaft und Energie (BMWi), Department I C 4, Kiel Institut für Weltwirtschaft, May 29, 2020, p. 333, available at: www.ifw-kiel.de.

This underscores the importance of defining European industrial and social policies, and adapting trade and competition policy to better respond to actors like China which skillfully handle market asymmetries; or American digital giants, that hold oligopolistic positions in their market.¹²

Given these developments, what are the risks which the German automobile industry, and with it the European automobile industry, is running, in the face of Chinese and US competition in a rapidly changing sector? And what are the means committed to counter them?

12. U. von der Leyen, *The von der Leyen Commission: For a Union That Strives for More*, Brussels, September 10, 2019, available at: www.ec.europa.eu.

The Automotive Industry and the Emergence of a New Type of Mobility

Consumers are today more aware of digital services and are demanding new products and services for mobility. At the same time, there is greater environmental awareness not only among governments but also among customers. Finally, companies themselves are offering new products and services, causing a structural shift in the industry and leading established manufacturers to fear being downgraded and ultimately replaced.

Manufacturers that are adapting to regulatory and market changes

New consumer expectations are driving organizational and production changes for car manufacturers. At the same time, the latter face an increasingly constraining regulatory environment, which is promoting innovation.

New expectations calling for organizational and production changes

Driver profiles are becoming more diverse, as cars are no longer indispensable possessions for city-dwellers who are well-served by public transport. For others, cars are still necessary on a daily basis for commuting between home and work, but only for practical reasons. For others still, cars continue to be a mark of social distinction. If manufacturers want to appeal to these potential consumers, they must embrace this new situation and diversify their products.

In addition, digital technology is becoming more important in mobility, especially with autonomous cars. Several types of services exist already, such as driving assistance or cruise control. The final stage is likely to comprise of driverless cars that are interconnected with transportation infrastructure, other drivers, traffic lights and parking services. This multiple connectivity will help to streamline traffic and so reduce greenhouse gas emissions.

The new mobility services provided by the car of the future will require car manufacturers to adapt. Usually, they are organized vertically and rigidly, but now manufacturers are opting for methodologies that allow future drivers' expectations to be anticipated. Henceforth, *hardware* is being overtaken by *software*. The product qualities at stake could be decisive for consumer choices between vehicles. Manufacturers thus face the challenge of adopting interoperability with operating systems, via the synchronization between cars and the drivers' mobile phones, or by developing their own software. Production processes are also changing. Cars are no longer made on production lines from the car body onwards, whose size defines the production cycles. Instead, they are fabricated in production cells piloted by software.¹³

Binding environmental regulation accelerating innovation

Future mobility is aiming to improve energy efficiency, and increasing the use of alternatives to the internal combustion engine. This also increasingly meets the environmental considerations of civil societies and territorial actors. It is a concern that affects road transport in particular, which is responsible for 20% of greenhouse gas emissions in Europe.¹⁴ This issue was widely publicized by the *Dieselpgate* scandal, which in 2015 revealed that Volkswagen (VW) cars included fraudulent software, so that cars appeared to produce less emissions than they actually did, thus abusing customer confidence. Herbert Diess, VW's present CEO has now embarked on a "green mobility shift" for the group. But, in addition to consumer-led changes that have led to adaptations by manufacturers, public actors also have a role to play.

Cars are also directly impacted by environmental policies, with the goal of reducing greenhouse gas emissions by 55% by 2030, and reaching carbon neutrality by 2050.¹⁵ Moreover, specific transport targets will also force manufacturers to pay penalties of several hundreds of millions of euros in the event of non-compliance.¹⁶ In order to comply with the standards imposed by the EU, it is estimated that the share of electric

13. M. Faire, "BMW will Tesla und Google mit neuem Betriebssystem Paroli bieten", *Handelsblatt*, December 17, 2020, available at: www.handelsblatt.com.

14. M.-A. Eyl-Mazzega, C. Mathieu and E. Couffon, "Le pari de la mobilité routière propre en Europe : état des lieux, stratégies et perspectives post COVID-19", *Études de l'Ifri*, Ifri, October 2020, available at: www.ifri.org.

15. "Les dirigeants de l'Union européenne s'accordent pour réduire d'au moins 55 % leurs émissions de CO2 d'ici à 2030", *Le Monde*, December 11, 2020, available at: www.lemonde.fr.

16. "Volkswagen prend le virage de la voiture électrique", *L'Opinion*, November 18, 2019, available at: www.lopinion.fr.

vehicles will have to account for a quarter of sales as of 2022 and a half by 2030.¹⁷ According to experts, this amounts to spending €225 billion on the electrification of product ranges by 2023.¹⁸

The COVID-19 pandemic is an additional factor pushing for change, notably through the European stimulus package which links aid to companies to greater environmental awareness. Germany, in particular, has implemented a “conversion bonus”. These measures have been successful, as the sale of hybrid or electric cars is “booming”, and is leading car manufacturers to accelerate their commitments to energy efficiency and the shift to new types of propulsion.¹⁹

Yet, German carmakers’ fear of having reached a certain state of obsolescence is heightened by the emergence of disruptive competitors.

The emergence of disruptive actors

Tesla embodies the disruption German car manufacturers seem to be facing today. But, more generally, mobility platforms are forcing German manufacturers to diversify their products.

The reinvention of the car by Tesla

Today, Tesla is being taken increasingly seriously as a competitor by established manufacturers. To be sure, with an output of 370,000 cars in 2019, the brand is well behind VW (11 million), Daimler and BMW (3 million each). But its rapid rise worries the German companies. Between 2016 to 2019, Tesla’s volume output grew by 64 percent, while that of its German counterparts was in single digits over the same period.²⁰ Moreover, these manufacturers have remained relatively passive in the face of two major changes in mobility: digitization and the shift to alternatives to the internal combustion engine, both of which Elon Musk excels in.

First, Tesla has established itself as the benchmark for digitization in the automotive industry. This company was “born on the web”. It is customer-oriented, and has a digital business culture with Cloud-hosted

17. W. Canzler, F. Dudenhöffer, N. Jannsen *et al.*, “Autopindustries – auf dem richtigen Weg?”, Zeitgespräch 99. Jahrgang, 2019 Heft 7, pp. 451–469, Wirtschaftsdienst, available at: www.wirtschaftsdienst.eu.

18. “Tous les constructeurs automobiles perdent de l’argent avec chaque voiture électrique vendue,” *Transitions Energies*, July 27, 2020, available at: www.transitionsenergies.com.

19. R. Tyborski, K. Witsch and F. Hubik, “Elektrocars boomen – doch deutsche Hersteller stehen nur in der zweiten Reihe”, *Handelsblatt*, August 6, 2020, available at: www.handelsblatt.com.

20. Production statistics from 2016 to 2019, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

automated processes. *Second*, founded in 2003, the firm's mission is to "accelerate the world's transition to sustainable energy".²¹ In 2008, Tesla released a 100% electric sedan – the Model S. It was at the cutting edge of modernity, and the best-selling, 100% electric car in 2015 and 2016. Other models followed (*Figure 1*), and Tesla is seeking to democratize its range by making its models more affordable. This is increasingly realistic as the price of batteries falls.²²

German manufacturers are also worried about the ambitions expressed by the Californian firm, which plans to boost annual sales to 20 million vehicles by 2030.²³ In order to increase its access to funding, the group has floated shares on the stock exchange, and the company's stock value now exceeds General Motors (GM), Ford, Fiat-Chrysler, Toyota, Honda and VW combined.²⁴ Tesla's staunchly forward-looking posture is also reflected in its initiatives of building *Gigafactories* (*Figure 2*), a condition for Tesla to vertically control the production line of its electric cars, because 40% of electric cars' value comes from their battery.²⁵ Mastering battery manufacture is therefore a key strategic issue, as this activity is presently dominated by Asian groups. Tesla's *Gigafactories* aim to acquire competences in this area of high value added. This is also a question of supply security that is guaranteed by internalizing these activities, which furthermore ensures maximum profit. These *Gigafactories* now exist in the United States and in the People's Republic of China in Shanghai. A *Gigafactory* is also being built in Germany in Brandenburg, in the very "home country" of the automobile, although far from Germany's existing automobile clusters.

21. "About Tesla", Tesla, available at: www.tesla.com.


22. D. Drohse, E. Bode, A. Hanley *et al.*, *Analyse der industrierelevanten wirtschaftlichen Rahmenbedingungen in Deutschland im internationalen Vergleich*, Final report 24/19 for the Bundesministerium für Wirtschaft und Energie (BMWi), Department I C 4, Kiel Institut für Weltwirtschaft, May 29, 2020, available at: www.ifw-kiel.de.

23. "Tesla a livré 499 550 voitures en 2020, 36 % de plus qu'en 2019," *Le Point*, January 5, 2021, available at: www.lepoint.fr.

24. "Le patron de Tesla, Elon Musk, devient officiellement l'homme le plus riche du monde", *France TV Info*, January 7, 2021, available at: www.francetvinfo.fr.




25. S. Menzel "Wandel zur E-Mobilität: Vor allem Batteriezellen bereiten der Branche noch Probleme", *Handelsblatt*, August 24, 2019, available at: www.handelsblatt.com.

Figure 1: Tesla's different car models

	MODEL	LAUNCH DATE	PRICE	AUTONOMY
	Roadster I (Sports car)	2008 (stopped in 2012)	€100,000	340 km (the final version of the Roadster 3.0 had a maximum autonomy of 640 km)
	Model S (upmarket family sedan)	2012	100 000 USD	Initially 375 to 502 km
	Model X (SUV)	2015	100 000 USD	420 à 560 km
	Model 3 (compact sedan)	2017	As of \$35,000 (excl. tax and subsidies for clean-car purchase) – to date this is the cheapest Tesla model	402 to 500 km
	Model Y (electric SUV)	2020	\$58,000	370 to 480 km
	Roadster II (sports car)	2021	\$200,000 (€172,000)	1,000 km
	Model 2	2023	€20,000	600 km

Compilation by the author, based on various articles in the specialized press: J. Jodry, "Tesla Model 2 (2023): une compacte à moins de 30 000 € ?", December 2, 2020, available at: www.auto-moto.com; M. K., "Tesla Roadster (2020): les tarifs français", November 22, 2017, available at: www.autoplus.fr.

Figure 2: Tesla's main Gigafactories

Gigafactory in Fremont, USA	Gigafactory in Shanghai, China	Gigafactory in Grünheide, Germany (as of 2021)
		
-Capacity: 500,000 cars per year -Focus on: Model S -Other activities: battery production	-Capacité : 500,000 cars per year -Focus on: Models 3 and Y especially -Other activities: battery production	-Capacité : 500,000 cars per year -Focus on: Models 3 and Y especially -Other activities: battery production

Compilation by the author, based on various articles: P. Papazian, "Gigafactory: L'ambition d'Elon Musk à la hauteur de ses usines colossales [Dossier]", January 25, 2021, tesla-mag.com, available at: www.tesla-mag.com; S. Kersting and D. Neuerer "Naturschützer wegen Rodungsstopp für Tesla in der Kritik," December 2020, Handelsblatt, available at: www.handelsblatt.com.

"Platformization" and intermodality are creating new types of mobility

Disruptive actors can endanger established automobile actors. This is also reflected in the platformization of mobility and the shift from an ownership to a sharing society, which is forcing German car manufacturers to diversify their products.

The shift from "cars as products" to "mobility services" is now occurring in two forms, the platformization and intermodality of transport, in a context of growing digital uses. The latter provides alternatives to car possession, which entails a number of responsibilities and costs (for purchase, maintenance, insurance, parking, taxes, tolls, etc.).

Platformization is interesting in terms of car-sharing, carpooling, short-term rentals, or the use of chauffeur-driven cars for transport. The linking of supply and demand via digital platforms promises efficiency gains for all participants, with fewer cars in circulation, fewer traffic jams, and less pollution, all as a positive externalities. The creation of digital

platforms also provides users with mobility according to their preferences. Such intermodality takes into account real-time disturbances, and can adapt to user needs.

These developments may have an impact on automobile manufacturers. Indeed, according to a study by the Berylls consultancy, the use of new forms of mobility could lead to the substitution of 23 million passenger cars by 2035.²⁶ Beyond this, the study warns manufacturers of the importance of the leverage that digital tools allow. For example, a company like Uber provides 2 million rides per day, and its market value was estimated at US\$62,5 billion in 2017.²⁷ Yet the company does not have a fleet of its own. Its *business model* allows it to use 450,000 chauffeurs in the United States for example, while only having 6,700 employees.

This situation is leading German manufacturers to diversify their mobility services to capture an urban population. Such is the case for BMW with *DriveNow* (its *Premium-Carsharing* service), or with BMW and Daimler and their *Carsharing share now* service (for short term rental). For its part, VW briefly participated in *Gett*, Uber's Israeli equivalent. While this type of mobility remains a niche market for now, increasingly diversified urban mobility possibilities make owning a personal car less necessary than in rural areas that are generally less well-served.

Yet, the success of German car manufacturers in new urban mobility services is limited. And they are hesitating to renew the strategies adopted over the last decade, which have been successful.

26. *The Revolution of Urban Mobility*, Berylls, June 2017, available at: www.berylls.com.

27. U. Winkelhake, *Die digitale transformation der Automobilindustrie. Treiber – Roadmap – Praxis*, Wiesbaden, Springer Vieweg, 2017, p. 36.

The Challenges of New Mobilities and their Geopolitical Consequences

Three strategies have been successful in the past for German builders. But they may well no longer prove to be so profitable in a context of growing Sino-American rivalry.

German manufacturers trapped in their industrial strategies?

The successful strategies for German carmakers have been based on the leverage of the European single market, globalization, and the protection of value-added creation in Germany. Together, these strategies have enabled German car manufacturers to generate profits in the last ten years, during what may be called “a golden decade”, following the 2008-2010 financial and economic crisis.²⁸

A strategy based on the European single market

German companies, for example, took advantage of the Central and East European countries when they entered the EU to relocate a certain number of low-value-added, low-cost activities there, such as assembly. This has been the case for the car industry, which relies on a value chain that is constantly adapted in view of potential efficiency gains. As car production is sequenced, with a particular time line, “just-in-time” production saves time and reduces inventories. As a result, many subcontractors and suppliers of the major automobile brands, which are hyper-specialized in niche areas, are integrated into car production chains, and are located in

28. This expression is taken from Thomas Puls, who has used the terms “globalization strategy” and “premium strategy”. See T. Puls and M. Fritsch, *Eine Branche unter Druck – Die Bedeutung der Autoindustrie für Deutschland*, IW-Report 43/2020, Institut der Deutschen Wirtschaft, September 7, 2020, available at: www.iwkoeln.de.

lower-cost countries, where some manufacturers have established production plants.²⁹

In addition to the production benefits of the European single market, its size allows German manufacturers to sell their goods. The 450 million inhabitants of this single market are almost a domestic target of German brands. In 2019, Germany exported 62% of its car production to Europe, including 55% of intra-Community deliveries to EU countries.³⁰

A global strategy that has kept high value-added assets in Germany

German car manufacturers have also benefited from the accessibility of foreign markets outside the EU. This has been especially true for the US, to which the EU and Germany export large numbers of cars; and for China, where more and more car manufacturers are established. This strategy can be called a “globalization strategy”.

In terms of exports, in 2019, the German automobile industry produced 16 million cars worldwide, of which 4.7 million were made in Germany, of which 75% were exported.

In terms of business relocation, German manufacturers produced 64% of cars in Germany, compared to 36% of cars abroad in 1999. In 2017 the situation was the reverse (*Figure 3*).

- For example, the US market is dominated by the sale of Sport Utility Vehicles (SUVs), pick-ups and vans, which account for approximately 70% of sales. BMW produces the entire range of its SUV there.
- Another example is the Chinese vehicle market, the world's largest today with 21.3 million cars registered in 2019, or 46% of global registrations. The share of German brand production there is already high, with China accounting for 16% of Daimler's car production, 14% for BMW and 38% for VW, in 2016.³¹ This is a development that has the potential to accelerate further with the expansion of electric vehicle purchases.

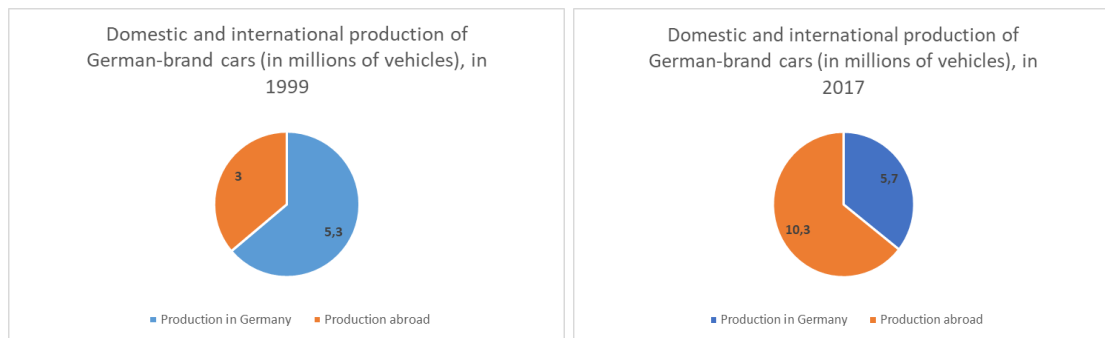
29. “In order to avoid any surplus, the *just-in-time* rule is that the time between the manufacture of a product and its sale is as short as possible, which implies tight-flow production supply chains. Zero stocks are a corollary: the management of spare parts and components is entrusted to [...] external subcontractors.” in: G. Pitron, *La guerre des métaux rares – La face cachée de la transition énergétique et numérique*, Paris: Les Liens qui Libèrent, 2018.

30. Statistics of the Verband der Automobilindustrie (VDA), available at: www.vda.de.

31. OICA, *op. cit.*

The presence of German manufacturers in the US and Chinese markets, respectively for SUVs and electric cars, is all the more important because it is precisely these two segments that seem particularly promising.³²

Figure 3: Domestic and international production of German car brands in 1999 and 2017



Graph by the author. K. Poplawski, "At a Crossroads. Crisis in the German Automotive Industry," op. cit.

In addition to the "globalization strategy", manufacturers have applied a "premium strategy", whereby German manufacturers have maintained most of their high-end car production in Germany. In 2019, 96% of the top-of-the-range German-branded models were produced there. Globally, therefore, according to the usual counting method, German car manufacturers produce between 70% and 85% of premium cars. Much of the demand is overseas and customers have to pay both the price of the car and import costs. Nevertheless, this model is viable, being based on an affluent clientele that is not very price sensitive, and is instead prone to value quality and brand reputation.³³

The dual strategy adopted by German manufacturers has therefore paid off. From 2009 to 2019, the global automotive market grew by only 3% in terms of sales. But at the same time, VW's output increased by 7%, and for BMW and Audi output rose by 8% over the same period, which must be understood in terms of the rising purchasing power of the Chinese middle class. The correlation seems relevant, as the Chinese market grew by 8% over the same period.³⁴

32. W. Canzler, F. Dudenhöffer, N. Jannsen *et al.*, "Autoproductions – auf dem richtigen Weg?," *op. cit.*; R. Irle, "Global Plug-in Vehicle Sales Reached over 3.2 Million in 2020," EV-volumes.com, available at: www.ev-volumes.com.

33. *Ibid.*

34. OICA, *op. cit.*

Yet, paradoxically, this dual strategy puts German builders at risk in the face of some of the car industry's vanguard and a geo-economic rivalry between the US and China.

The risks of automobile manufacturers becoming dependent on the United States

Dependence on the US is both technological and commercial. This highlights the lateness of European digital technology players, in a context in which digital technologies are becoming increasingly important in mobility on the one hand, while the impact of trade shocks is reinforcing the need for adaptation on the other hand.

Technological dependency

Software will play a dominant role in mobility in the future, as cars are become more connected and autonomous. Cars will increasingly be equipped with cameras and sensors and will communicate data *via* the 5G and the Internet of Things. Therefore, exchanging data will be paramount. Some companies, such as the GAFAM, have an advantage in data processing. They have made a difference in citizens' daily lives and are now diversifying their services. Google, for example, has launched "Google Automotive Services". With an advantage in data access and analysis, this facilitates the creation of powerful algorithms that GM, the world's largest mass-vehicle manufacturer, intends to use. BMW, VW and Bosch, for their part, prefer to develop their own alternatives in order to avoid depriving themselves of income. This challenge is essential for manufacturers and suppliers of high-end cars, whose customers are demanding and responsive to performance and innovation. Embedded software nowadays generates €20 billion in revenues, and experts expect this figure to triple within a decade.³⁵ As a result, German car manufacturers are under increasing pressure from new oligopolistic digital players in making their own way into mobility services.

35. M.-W. Buchenau and R. Tyborski, "Bosch will das Auto der Zukunft programmieren," *Handelsblatt*, July 21, 2020, available at: www.handelsblatt.com.

The risks of US trade retaliation

Decisions by President Donald Trump concerning international trade have also undermined the safety of value chains and their associated predictability for German car manufacturers.

His *America First* approach was initially directed against China, as he wanted to take steps to reduce America's trade deficit with the country. To try to restore balance, he thus introduced customs duties on certain products. These developments were followed by counter-measures by China on vehicles imported from the United States. Experts estimate that the US-China trade rivalry could reduce car sales by 35 million vehicles, resulting in revenue losses of €700 billion between 2018 to 2024.³⁶ These developments are affecting German manufacturers, as all three of them are in the world's top 15 in terms of sales.³⁷ They accounted for 19% of total cars exported in 2019, worth US\$142 billion.³⁸ Their deep involvement in both markets thus makes them collateral victims of Sino-American rivalries.

Indeed, half of the cars exported by the United States are made by German brands, and in 2017, China imported 150,000 German-brand cars from the US.³⁹ By implication, the tariff increases Trump announced would lead to higher car prices, this being the only way manufacturers can remain profitable.⁴⁰ Accordingly, the broker-dealer Bernstein has estimated that Trump's policies would lead to a 20% price increase, or an additional €20,000 for the purchase of German cars produced in the US and sold in China.⁴¹

In addition to taking steps on China, Donald Trump also focused on the EU, targeting the US trade deficit with Germany in particular. This was explained first by the important US role in defending Germany, which has been considered the Atlantic Alliance's "free-rider", and then by Germany's bilateral trade surplus at the expense of the US. The auto industry has been

36. F. Dudenhöffer, "Schaden von mehr als 700 Mrd. Euro durch Trump'schen Zollkriege für weltweite Autoindustrie", Universität Duisburg-Essen, CAR-Center Automotive Research, October 2019, available at: www.assets.republik.space.

37. "Global Sales of Car groups in 2019", Center of Automotive Management, available at: www.ecomento.de.

38. D. Workman, "Car exports by country", World's Top exports, available at: www.worldstopexports.com.

39. P. Houédé, "Commerce : les patrons de l'automobile allemande en opération déminage à Washington", *Les Échos*, December 4, 2018, available at: www.lesechos.fr.

40. This left these firms with two alternatives: first, they could increase their SUV production in China, or second, sell US-produced SUVs into China in the form of spare parts, thereby circumventing Trump's tariffs. In both cases, this would increase the output of German manufacturers in China, to the detriment of production in the US. So, the effects of Donald Trump's tariffs on European steel and aluminum was counter-intuitive; in C. Giesen and C. Hulverscheidt, "Handelskrieg zwischen USA und China bedroht deutsche Firmen", *Süddeutsche Zeitung*, April 6, 2018, available at: www.sueddeutsche.de.

41. *Ibid.*

the main sector contributing to this trade surplus. In terms of value in 2020, the United States exported €5 billion worth of cars to Germany, compared with €14 billion worth of car imports from Germany.⁴²

For the EU, the stakes are high, because the US is its second largest export car market (20% of EU car exports go to the US), and its third largest supplier of imports (15% of cars imported into the EU come from the US).⁴³ But, since June 2018,⁴⁴ the Trump administration's tariffs on aluminum and steel from the EU to the US have applied.⁴⁵ Beyond the additional costs of President Trump's policies, it is the complex, internationalized value chains, which are characteristic of German manufacturers, that are being called into question. The Trump administration did also threaten to establish tariffs on the German automobile industry, but these threats were not finally implemented following the Juncker-Trump agreement in July 2018, that facilitated US soybean access to the European market.⁴⁶ But the agreement has shown the risk of coercion European countries face in their exposure to additional tariffs in economically crucial sectors.

The risks of dependence of German manufacturers on China

Developments in China also require close examination, both because China enjoys a special status under international trade law that does not fully reflect its level of development, and because it fully assumes its ambition to make mobility one of its strategic priorities.

42. Eurostat, *op. cit.*

43. "Main EU-27 Partners for Exports and Imports of Motor Cars, 2019", Eurostat, available at: www.ec.europa.eu.

44. "US-Zölle auf Stahl und Aluminium – Bedeutung für Bayern und Deutschland," Ernst & Young EY Economic Advisory commissioned by the Vereinigung der Bayerischen Wirtschaft, December 2018, available at: www.vbw-bayern.de.

45. While new US President Joe Biden has decided to suspend tariffs between the US and the European Union in the Airbus-Boeing dispute, tariffs on aluminum and steel imports have been maintained. US, "EU to Suspend \$11.5B in Tariffs for four months", *The Hill*, May 3, 2021, available at: www.thehill.com.

46. "Rencontre Trump-Juncker: une trêve dans les tensions commerciales", *La Tribune*, July 26, 2018, available at: www.latribune.fr.

China's catch-up is a risk factor for German carmakers

China is a big market, owing to its demographic size and economic catch-up effects relative to the West (*Figure 4*).⁴⁷ The country is experiencing a significant development of its middle class, with 7 million graduates entering the labor market each year, who have much more purchasing power than their elders. This makes it an increasingly important market for German car manufacturers (*Figure 5*), which hold 24% market share.⁴⁸ Today, the Chinese market is larger in volumes terms than the US market for German manufacturers (*Figure 6*), as in 2019, 33% of the world's car sales and registrations were in China, compared to 7% in the US.⁴⁹ In 2019, VW sold 40% of its cars to China, while Daimler and BMW sold 28% and 25% respectively of their production to China.⁵⁰ And China's importance is growing even more with the coronavirus epidemic, thus saving German manufacturers from even worse results.⁵¹

It is reasonable to believe that changes in China's consumption patterns will influence strategic choices for the world car industry as a whole, given China's demographic weight, with nearly 20% of the world's population as of today. Indeed, with China committed to carbon neutrality by 2060, Goldman Sachs estimates that this will require a shift to 100% new-energy vehicles by 2060.⁵² These developments are likely to have ripple effects on car manufacturers around the world.

But now Chinese manufacturers have asserted themselves (*Figure 7*).⁵³ Their ambition in the future is to play a more important role internationally. For this, many favor cooperating with Western manufacturers in the form of joint ventures or equity interests. For example, the Chinese manufacturers Geely and BAIC have taken equity stakes in Daimler of 9.7% and 5% respectively. Joint ventures also exist, for example, between VW and First Automotive Works (FAW),⁵⁴ for BMW and Geely as well as with Brilliance Auto, or between Mercedes Benz and the

47. "Millionen E-Autos für das Milliardenvolk", Volkswagen AG, January 20, 2020, available at: www.volkswagenag.com.

48. K. Popławski, "Germany joins the Electromagnetic Race", *op. cit.*, p. 13.

49. OICA, *op. cit.*

50. D. Heide and F. Hubik, "April-Verkäufe fast wie im Vorjahr: China lässt deutsche Autobauer hoffen", *Handelsblatt*, Mai 11, 2020, available at: www.handelsblatt.com.

51. S. Menzel, "Zweistelliges Wachstum: Dailers Autoverkäufe in China Boomen", *Handelsblatt*, December 18, 2020, available at: www.handelsblatt.com.

52. "Carbonomics – China Net Zero: The clean Tech Revolution", Goldman Sachs, January 20, 2020, available at: www.goldmansachs.com.

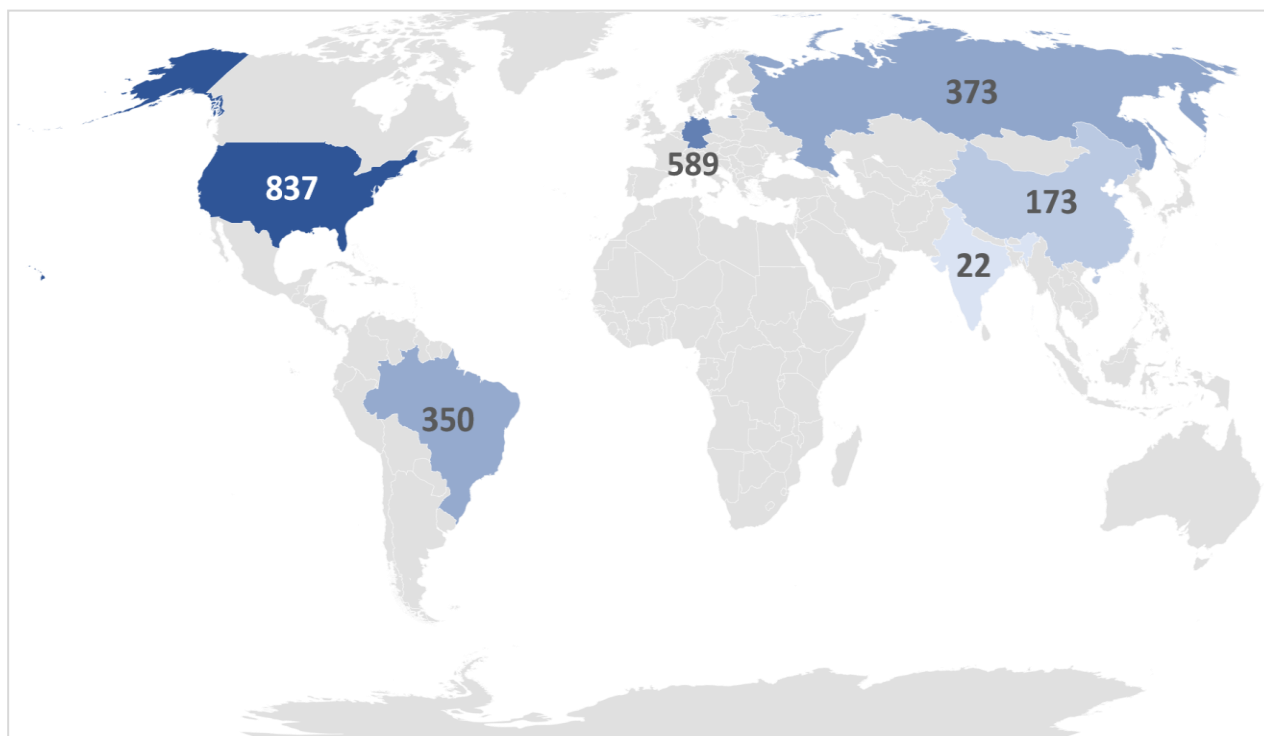
53. OICA, *op. cit.*

54. C. Giesen and C. Hulverscheidt, "Handelskrieg zwischen USA und China bedroht deutsche Firmen", *op. cit.*

Baic Group.⁵⁵ In this way, German car manufacturers are reinforcing the so-called “*Standort China*” by bringing their technology and know-how to it.

China has indeed experienced a dramatic increase in output over the past two decades. The global market share of cars produced in China was 9% in 2004, and reached 28% in 2019, which amounts to a five-fold increase in absolute figures (*Figure 8*).⁵⁶ But Chinese manufacturers are also highly successful in quality terms, because high-end Chinese cars are similar in quality to those produced in Europe, and they are cheaper. This is leading to fears of a replacement of German manufacturers, who could suffer from crowding out of the Chinese market once the technology sought by their Chinese counterparts has been fully mastered.

Figure 4: Number of vehicles per 1,000 inhabitants of a sample of countries

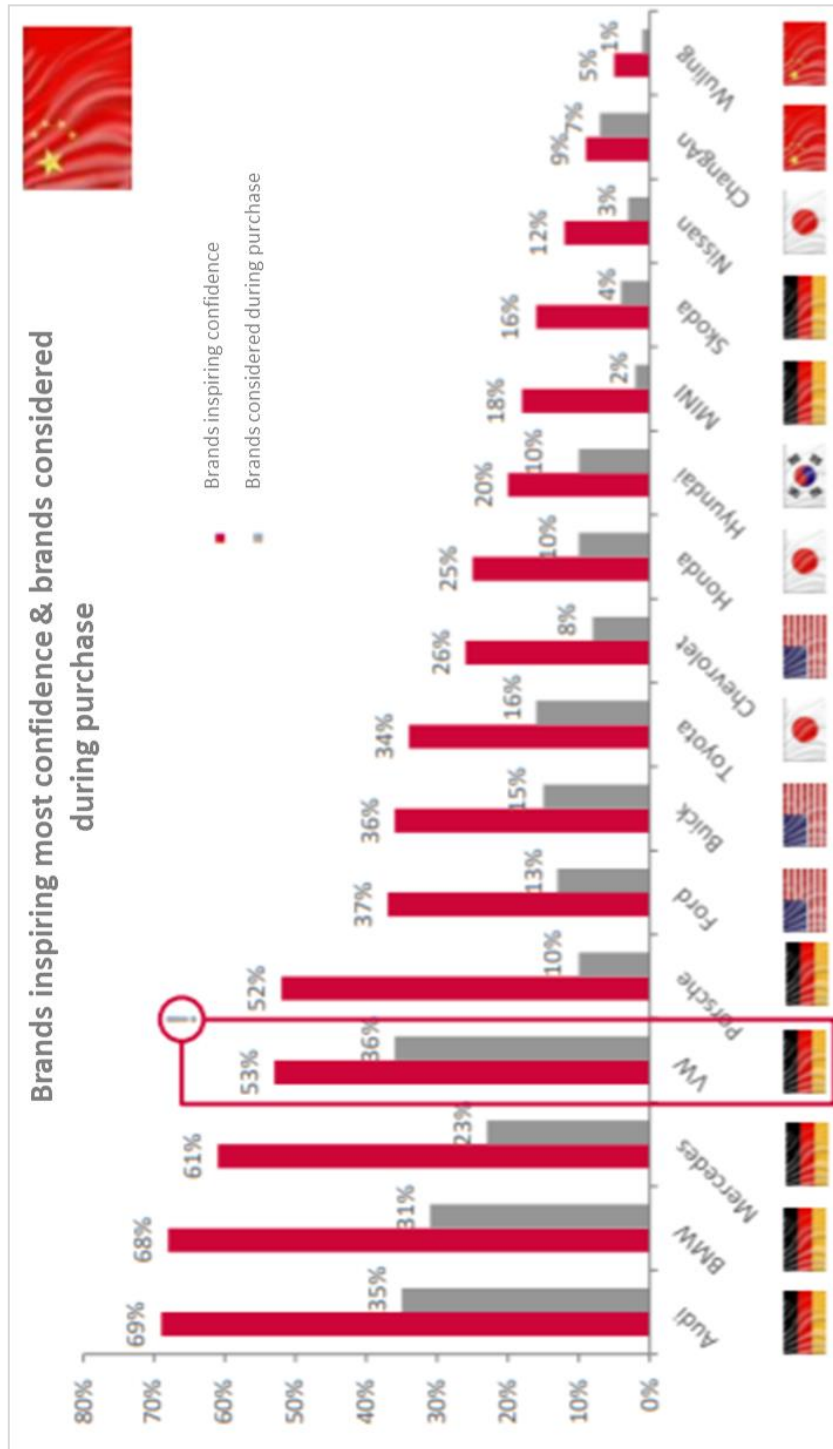


Source: Volkswagen AG “Millionen E-Autos für das Milliardenvolk,” January 20, 2020, Volkswagen AG, available at: www.volkswagenag.com.

55. N. Bourassi, “Mercedes : pourquoi les groupes chinois se bousculent dans le capital”, *La Tribune*, July 24, 2019, available at: www.latribune.fr.

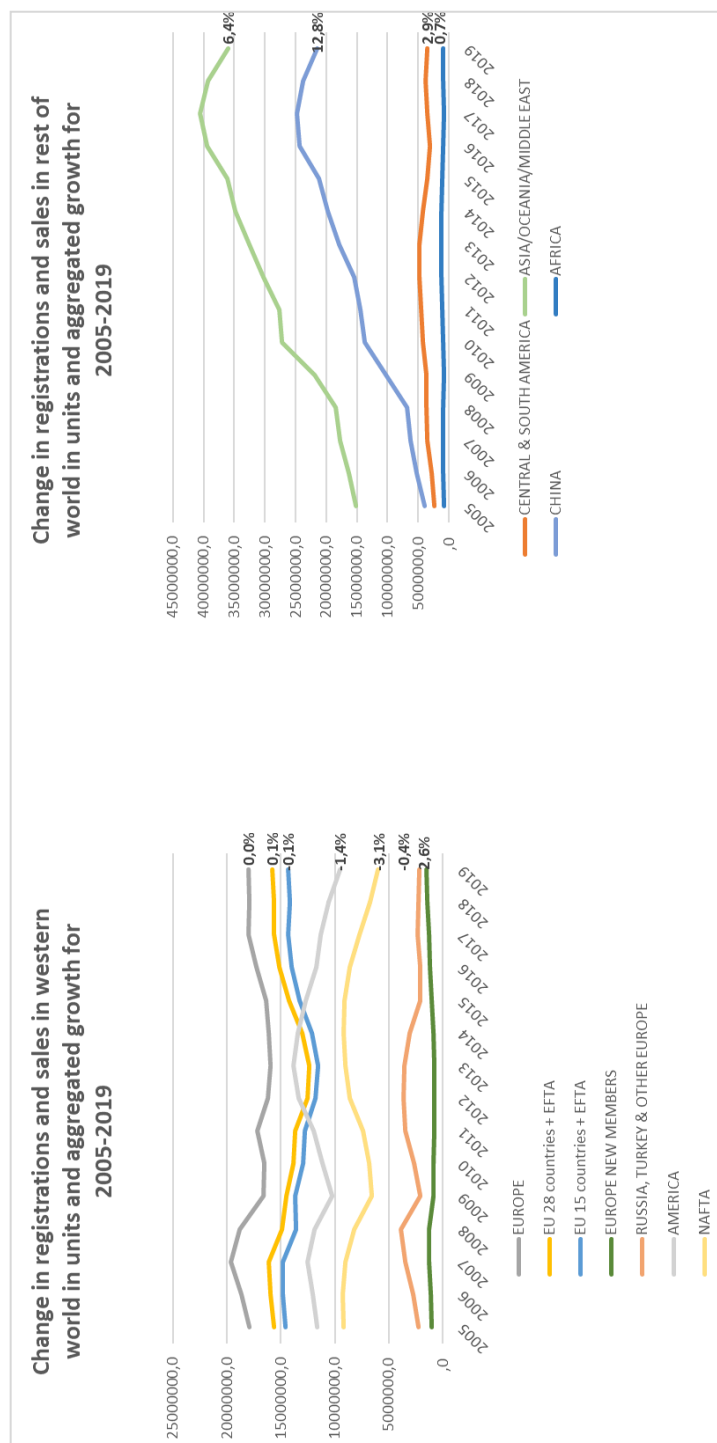
56. “The Automobile Industry Pocket Guide 2020-2021”, European Automobile Manufacturers Association (ACEA), July 30, 2020, available at: www.acea.be.

Figure 5: Most-trusted car brands in the people's Republic of China in 2015, after the *Dieselgate* scandal



Source: GlobeOne with the author's translations. Das Image deutscher Marken nach dem Volkswagen-Skandal – Wie Konsumenten in den USA, China und Deutschland "Made in Germany" wahrnehmen, GlobeOne, December 2015, available at: www.globe-one.com.

Figure 6: Registration and sales trends in the western world and in the rest of the world in units and aggregate growth over the period 2005 to 2019



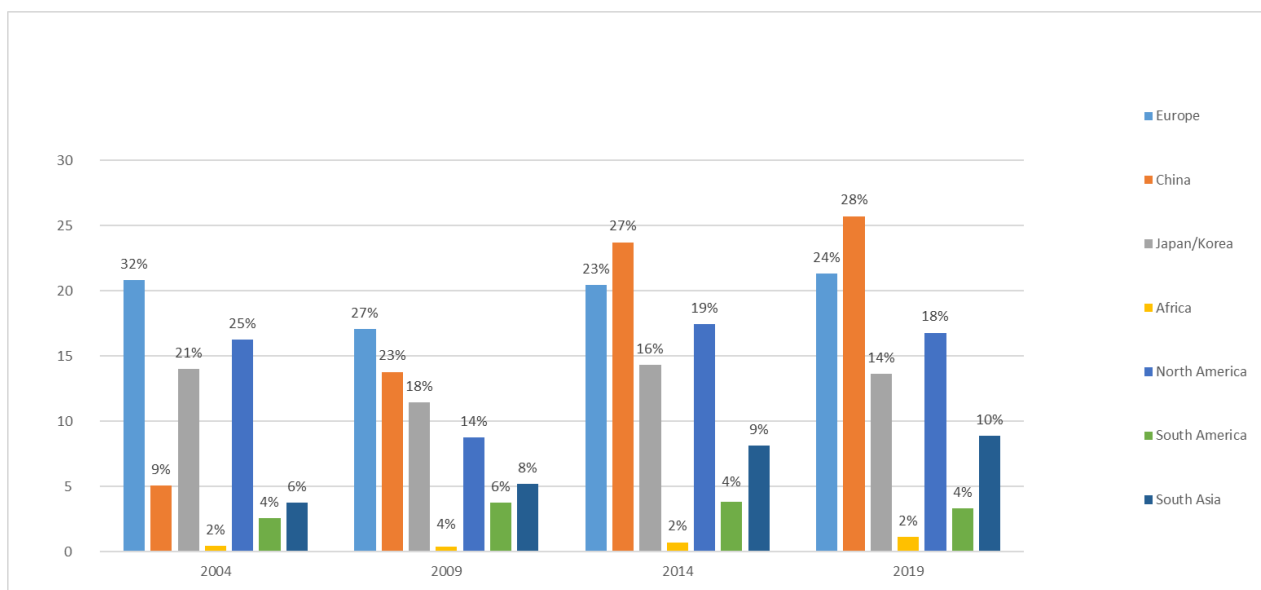
Graphics by the author. Registration Statistics, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

Figure 7: Number of cars produced by Chinese manufacturers in 2017

WORLD RANK	NAME	NUMBER OF VEHICLES PRODUCED IN 2017
12	Shanghai Automotive Industry Corporation (SAIC) 	2,866,913
15	Geely 	1,950,382
16	Changan 	1,616,457
18	Dongfeng Motor Corporation 	1,450,999
19	Beijing Automotive Industry Holding Co. (BAIC) 	1,254,483
22	Great Wall 	1,041,025
28	Chery 	605,331
29	FAW Group 	592,688
30	GAC 	513,870

Table by the author. Production statistics from 2016 to 2019, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

Figure 8: Trends in car production by regions of the world, in millions of units and market percentages (2014-2019)



Graph produced by the author. Association of European Automobile Manufacturers, op. cit.

For now, German builders are very popular in China, which is a growth market that is second to none, owing to its demographic abundance and catch-up effect. Chinese manufacturers, however, are emerging and producing in significant quantities. In 2017, Chinese manufacturers within the global top 30 built nearly 12 million cars, slightly more than the output of the world's second-largest manufacturer, Volkswagen (10 million cars built in 2017).

A strategic sector for China

The prospect of China conquering the automotive sector, thanks to electric cars, worries German manufacturers. In 2019, China's nine largest electric car manufacturers had a market share of 75% in sales of electric vehicles in their domestic market,⁵⁷ and BYD, BAIC and SAIC sold a total of 514,000 electric cars,⁵⁸ out of a global total market of 2,264,000 electric cars that year.⁵⁹

Aware of the consequences of increasing urbanization, such as pollution and excess mortality, China is incorporating ecological concerns into its five-year plans. The government intervenes with investments and subsidies (building of charging stations, incentives to buy). The results of these measures are already noticeable in China's domestic consumption of electric vehicles for which China is the leading world market, accounting for 75% of the world growth in electric vehicle sales from 2013 to 2017.⁶⁰

China takes a holistic view in its efforts to conquer the global electric vehicle market. It has therefore established a regulatory framework favorable to the production of electric vehicles, by punishing producers who do not devote a threshold of their fleet to electric cars.⁶¹ In terms of industrial policy, China has an arsenal that empowers it to achieve its ambitions by securing the supplies of metals that are essential to the

57. *China and the World – Inside the Dynamics of a Changing Relationship*, McKinsey Global Institute, July 2019, p. 73, available at: www.mckinsey.com.

58. According to an estimate by the Center of Automotive Management (CAM), the top 6 producers of electric cars in 2019 were: Tesla with 367,000 units produced, BYD with 219,000, BAIC with 160,000, SAIC with 135,000, BMW with 130,000, and VW with 100,000; in A. Grimm, "Tesla baut Spitzenposition unter den E-Auto-Bauern aus", KFZ Betrieb Vogel, February 6, 2020, available at: www.kfz-betrieb.vogel.de.

59. R. Irle, "Global Plug-in Vehicle Sales purchased over 3.2 million in 2020", EV-volumes.com, available at: www.ev-volumes.com.

60. *China and the world – Inside the Dynamics of a Changing Relationship*, McKinsey Global Institute, July 2019, p. 76, available at: www.mckinsey.com.

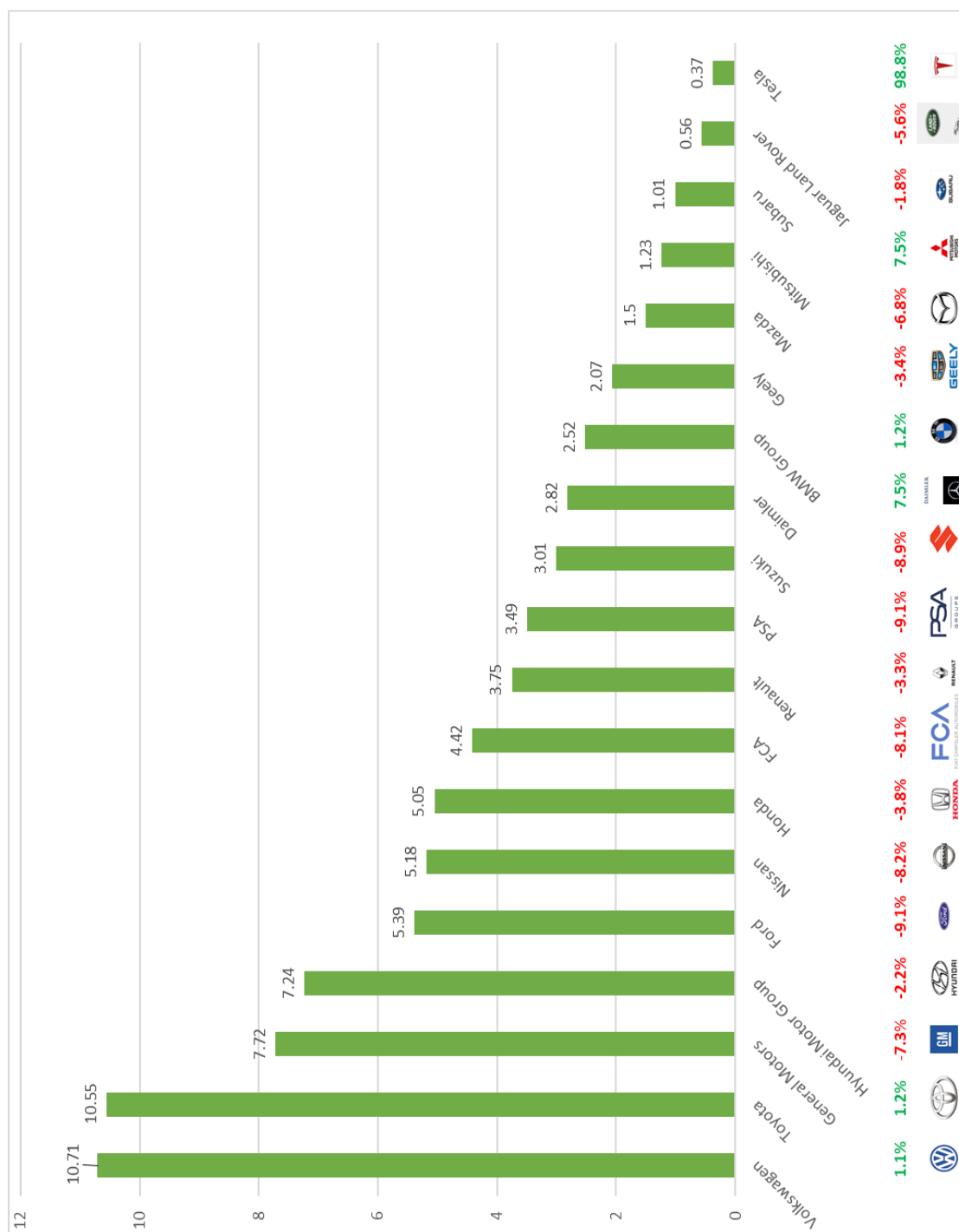
61. D. Heide, "Deutsche Hersteller nehmen den Kampf um den E-Automarkt in China auf," *Handelsblatt*, September 28, 2020, available at: www.handelsblatt.com.

manufacture of electric vehicles. This ensures China 65% of the world's production of lithium-ion batteries.⁶²

China is using protectionism to control competition. For example, electric-vehicle production is excluded from the Regional Comprehensive Economic Partnership (RCEP) China signed with the Association of Southeast Asian Nations (ASEAN) member states and four Southeast Asian countries representing 30% of global GDP, and 30% of the world's population, even as the imports of components, of which China is a customer, are free of tariffs.

In the face of US and Chinese competition, German car manufacturers face the challenge of reviewing the strategies they implemented during the “golden decade”. The systemic risk of decline the German automotive sector faces must now be addressed in order to consider the industrial-policy and competition tools that the EU can deploy to preserve the competitiveness of the German automobile industry (*Figure 9*).

62. “La guerre des batteries a commencé”, *Transitions Energies*, June 2, 2020, available at: www.transitionsenergies.com.

Figure 9: Global car sales in millions, in 2019⁶³

Source: Production statistics from 2016 to 2019, International Organization of Motor Vehicle Manufacturers (OICA), available at: www.oica.net.

63. "Global Sales of Car groups in 2019", available at: www.ecomento.de.

The Challenge for “*Standort Deutschland*” Is to Maintain its International Position

The systemic risk to economic and social prosperity in Germany and Europe

In terms of sales achieved in 2019, German manufacturers are included in the top 5 German companies (VW with sales of €253 billion, Daimler with €173 billion, and BMW with €104 billion).⁶⁴ As a result, the economic and social repercussions of a potential decline in Germany’s automotive sector pose a systemic risk not only to Germany, but also at the European level, owing to its close ties with automobile clusters in other EU member states.

Cars are a key sector

The automobile industry is the embodiment of Germany’s industrial power (21% of industrial turnover). In terms of value added produced, the German automotive industry’s share of German GDP was 4.7% in 2017,⁶⁵ with production of 5.6 million vehicles in Germany.⁶⁶

Cars are also crucial for German trade, and have thus contributed to the fact that Germany has long been “*Exportweltmeister*”, the world’s export champion. Indeed, in 2019, 16.8% of German exports came from the automotive industry.⁶⁷ Within the EU, the industry is also important because of the many subcontractors of German manufacturers scattered throughout the European single market (*Figure 10*). The car industry

64. Statistics for VW, M., Statista, February 4, 2021, available at: www.statista.com; statistics for BMW, M. Kords Statista, January 4, 2021, available at: www.statista.com; statistics for Daimler, M. Kords, Statista, February 4, 2021, available at: www.statista.com.

65. T. Puls and M. Fritsch, *Eine Branche unter Druck – Die Bedeutung der Autoindustrie für Deutschland*, op. cit.

66. Production statistics for German manufacturers from 1957 to 2019, April 1, 2021, VDA, available at: www.vda.de.

67. *Fakten zum deutschen Außenhandel*, Bundesministerium für Wirtschaft und Energie (BMWi), September 2020, available at: www.bmwi.de.

overall accounts for 7% of the EU's total value added,⁶⁸ producing some 18.5 million cars in 2019 (20% of world production).⁶⁹

The automotive industry is moreover important to other economic sectors, with its ripple effects. First, it is a very dynamic industry in which research and development (R&D) contributes to innovation and constant renewal. By spending €25.7 billion on R&D, Germany's automotive sector is in an exceptional position, accounting for one-third of all R&D spending in the automotive sector worldwide.⁷⁰ Germany's position as one of the world's champions of patents is largely due to the automobile industry.

The dynamism of the automotive sector spills over into other industries intrinsically related to it (steel, chemistry, textiles, information and communication technologies and mobility services). If the auto sector does well, then these industries tend to benefit via its multiplier effect, while if the sector fares poorly, they risk being negatively impacted. Moreover, the social importance of the sector must also be emphasized.

Social aspects and territorial cohesion

In Germany, 2.2% of jobs (800,000 in absolute terms) are directly related to the automotive industry. Furthermore, it may be noted that pay in the German automobile sector is high (monthly salaries are €5,000 to €5,500), providing a standard of living which is not negligible.⁷¹

However, electric vehicles are made up of fewer components than traditional cars, and their labor intensity is lower: 30% less labor is required in building electric vehicles.⁷² With the transition from the internal combustion engine to electric vehicles, the number of jobs could be reduced by several hundred thousand (*Figure 11*), which would not be offset by the 25,000 jobs created by electric mobility.⁷³ Yet it is not only the transition to electric power that represents a real challenge but also digitization. Germany increasingly recognizes the need to invest in

68. "Automotive industry", European Commission, available at: www.ec.europa.eu.

69. Association of European Automobile Manufacturers, *op. cit.*

70. *Analyse der industrierelevanten wirtschaftlichen Rahmenbedingungen in Deutschland im internationalen Vergleich*, BMWi, *op. cit.* p. 335.

71. T. Puls and M. Fritsch, *Eine Branche unter Druck – Die Bedeutung der Autoindustrie für Deutschland*, *op. cit.*, p. 13.

72. K. Popławski, "Germany joins the Electromagnetic Race", *op. cit.*

73. The *Institut für Arbeitsmarkt und Berufsforschung* (IAB) estimates job losses of 114,000 by 2035. In "Elektromobilität 2035", IAB, 8/2018, available at: www.doku.iab.de. The *Nationalen Plattform Zukunft der Mobilität* (NPM) has forecast the destruction of 400,000 jobs by 2030; in "VW, der Weltmarkt und die E-Autos," *Deutsche Welle*, January 13, 2020, available at: www.dw.com. For the *Leibniz-Institut für Wirtschaftsforschung an der Universität München* job losses are estimated to be fully 620,000 by 2030; in "Auto-industry: Transformation oder Untergang", *Deutsche Welle*, March 30, 2019, available at: dw.com.

“Industry 4.0”, in order to maintain the competitiveness of its automobile industry.⁷⁴

Figure 10: The automotive industry in the Central and East European countries

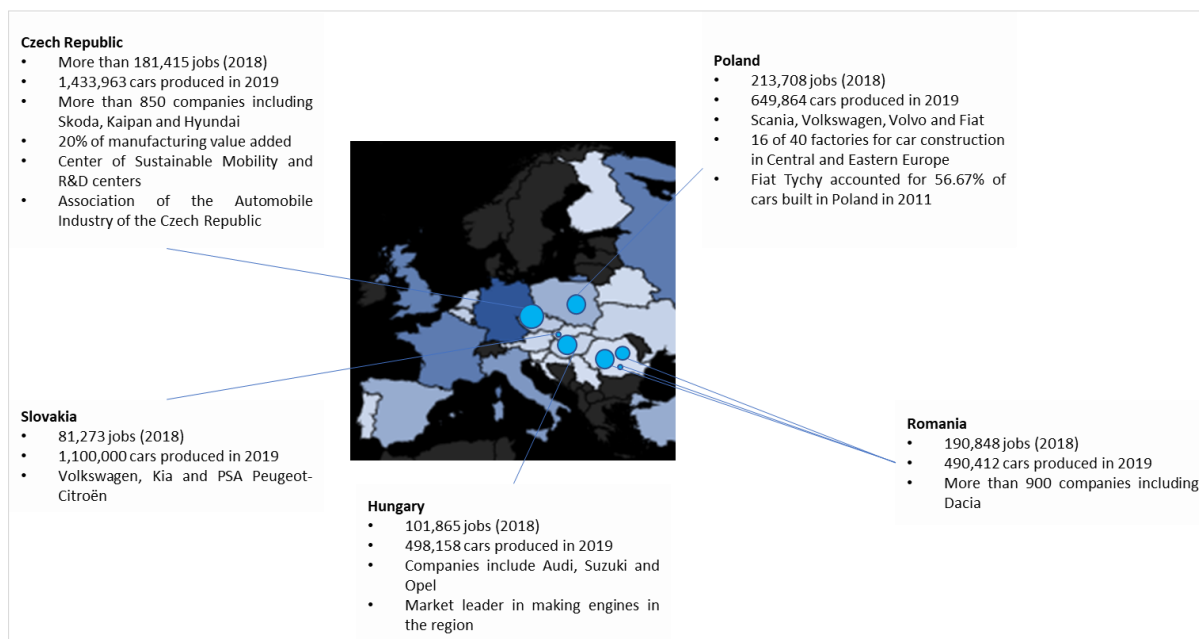


Figure by the author. Association of European Automobile Manufacturers, *op. cit.*; *A New Dawn: Reigniting Growth in Central and Eastern Europe*, The McKinsey Global Institute, December 2013, available at: www.mckinsey.com and updates by the author on the basis of ACEA and OICA data, *op. cit.*

Though affected by these changes, the large established manufacturers do seem to be more resilient to the twofold challenges of new propulsion and digitization. By contrast, their suppliers at the end of the value chain, especially when they are small and hyper-specialized in the combustion engine cars, are insufficiently diversified and overly dependent on contracts with major manufacturers.

This is a particular issue of rural areas, and reinforces the dependence on contracts with car manufacturers on which such firms' economic activity is concentrated. For example, both VW and Continental (respectively the world's largest car manufacturer and parts supplier in 2019) have their headquarters in Lower Saxony. In addition, 700 small and medium-sized enterprises work closely with VW and Continental. Given that the region is predominantly rural, opportunities for activity are limited, which gives these actors great weight: 120,000 jobs depend on

74. “Industry 4.0” includes growing automation and skills in information systems, artificial intelligence, the Internet of Things, cyber-security, in *Big Data Analytics*, and *Cloud Computing*, networking techniques, and production cycle management.

them directly, and 250,000 indirectly.⁷⁵ With manufacturers offshoring to emerging countries and the increasing use of digital technology, many of these jobs seem at risk. The shift to electric vehicles thus requires adequate means – skills in digital technologies, programming, renewable energy, mathematics, engineering, natural sciences and technology (Figure 11).⁷⁶

Figure 11: Layoff announcements from German manufacturers and suppliers





Announced job losses		
Carmaker	Audi 	9,500
Carmaker	BMW 	6,000
Carmaker	Daimler 	20,000
Carmaker	VW 	30,000
Parts supplier	Hella 	1,200
Parts supplier	ZF 	15,000
Parts supplier	Leoni 	2,000
Parts supplier	Schaeffler 	1,900
Parts supplier	Bosch 	2,600
Parts supplier	Continental 	20,000
	TOTAL	108,200

Table by the author. T. Puls and M. Fritsch, Eine Branche unter Druck – Die Bedeutung der Autoindustrie für Deutschland, op. cit. completed by data from the German press; "Volkswagen will bis zu 7,000 Arbeitsplätze in der Verwaltung streichen," Neues Deutschland, March 13, 2019, available at: www.neues-deutschland.de; M.-W. Buchenau and R. Tyborski, "Bosch-Manager bereitet Belegschaft auf weiteren Stellenabbau vor", Handelsblatt, November 24, 2019, available at: www.handelsblatt.com.

75. "Weltspitze – die Automobilwirtschaft", Invest Niedersachsen, available at: www.nds.de; "Die Bedeutung der Automobilindustrie für Niedersachsen," Niedersächsisches Ministerium für Wirtschaft, Arbeit, Verkehr und Digitalisierung, Basse-Saxe, available at: www.mw.niedersachsen.de.

76. Arbeitsmarkt der Zukunft – Ein Regionalprofil für Niedersachsen, Institut der deutschen Wirtschaft Köln Consult commissioned by Niedersachsen Metall, Cologne, October 5, 2020, available at: www.iwkoeln.de.

The challenges for the EU

Given the intertwining of value chains in the automotive sector in Europe and the sector's strong social impact, as well as developments in the market, the question of social cohesion within the EU cannot be avoided. Moreover, Europe's stated aim of achieving "sovereignty" in key sectors, while pursuing environmental goals, means the EU faces a certain number of conflicting interests.

Impact on social cohesion in Europe

In Germany, the Federal Ministry of Labor and Social Affairs predicts that by the end of 2035, some 7 million jobs will be operating under radically different circumstances from today, in all sectors.⁷⁷ The EU is also aware of the twin challenges of the green and digital transformation. Given skills obsolescence, it is providing *reskilling* programs to ensure that employees can train throughout their lives and adapt to the demands of a constantly changing world of work that is increasingly integrating digital tools.⁷⁸ The automotive sector is particularly targeted by these European programs with an emphasis on challenges in terms of digital development and green technologies, including the need for capacity in battery production, car electrification and alternative fuels.

Similarly, the transformation of the automotive sector also raises the question of the division of labor within the European single market.

Indeed, the COVID-19 pandemic has accelerated issues concerning the *reshoring* of a number of activities. This is particularly so in view of the fact that COVID-19 initially led to a supply shock.⁷⁹ As borders closed at times and economic activity was restricted, the crisis highlighted the risk of cross-border activities, even where these occur within the European single market.

In the longer term, social tensions could increase in an automotive sector under pressure, in a context marked by transformation and possible relocations. This shift threatens suppliers in Poland specializing in internal combustion engines and their components. Similarly, some of Germany's

77. BMAS-Prognose „Digitalisierte Arbeitswelt“, IAB-Forschungsbericht 5|2019 Bundesministerium für Arbeit und Soziales (BMAS), IAB, June 11, available at: www.doku.iab.de.

78. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions – European Skills Agenda for sustainable competitiveness, social fairness and resilience. COM/2020/274 final, European Parliament, July 1, 2020, available at: www.eur-lex.europa.eu.

79. Association of European Automobile Manufacturers, *op. cit.*

neighboring countries are dependent on the automotive sector for exports (20% of exports by the Czech Republic, 16% by Hungary and 30% by Slovakia). If parts of the value chain are relocated back to Germany, this would be at the expense of these countries, and would likely challenge their relations with Germany and their industrial choices.

The job destruction that experts are warning of could sharpen territorial inequalities, foster popular frustration, and encourage populist narratives. The example of France's yellow vests (*gilets jaunes*) or economic and political polarization in the US *rust belt*, as indeed developments in some Central and Eastern European countries, are fueling debates about values and the rule of law in the EU, revealing fragilities that could worsen, if the transformation of the automotive sector is too brutal.

Combining environmental and industrial ambitions

In line with its social ambitions, the EU has developed industrial projects to accompany the European automotive industry in its transformation to new types of propulsion, by providing it with the means to control the production chain and supply components such as batteries. This is particularly so with the European Battery Alliance founded in 2017 or the so-called “Airbus of Batteries” (the “Automotive Cell Company”) set up in 2020. In this context, a factory is planned for France in 2023 and Germany in 2024. The European Commission has promised aid of €3 billion, while Berlin is expected to invest €1 billion and France €960 million.⁸⁰

These initiatives reflect the growing awareness of dependence on Chinese, South Korean, and Japanese know-how in extracting and refining cobalt and rare metals, and testify to the EU's aspirations of working towards mineral sovereignty. Moreover, these projects anticipate the importance of R&D in batteries to increase density, enhance autonomy, and improve recycling, for both industrial and environmental concerns.

Other alternatives to the conventional cars exist, including hybrid cars, hydrogen cars and alternative fuels. The diversity of solutions reveals the multiplicity of energy visions among different EU member states, which may confuse messaging. For example, some Central and East European countries are working on alternative fuels. France is betting on electric cars, and Germany is advocating *Technologieoffenheit*, i.e., not opposing any of the alternatives, which all have advantages and

80. Commission approved €3.2 billion public support by seven Member States for a pan-European research and innovation project in all segments of the battery value chain, December 9, 2019, available at: www.ec.europa.eu.

disadvantages. A convergence in choices over the future technology to promote might be desirable in pooling factors of production, create synergies and economies of scale, and avoid over-investment.

In addition to questions of coherence in EU Member States' choices for future mobility technology, coherence with the *European Green deal* and industrial policy is also at stake. For example, EU Commissioner Thierry Breton's focus on mineral sovereignty calls for the reshoring of extractive activities to Europe. But, this is not always received positively by local populations the negative externalities of such activities (pollution, health issues, and the destruction of nature). Yet these externalities are the price of security of supply. The issue thus shows the need of finding trade-offs between environmental and industrial objectives that necessarily follow from policy choices based on informed decisions.

Challenges for the EU in its external relations

The focus on coherence is not just internal. It must also exist in external relations, to strengthen Europe's industrial sector during its conversion, and to attract foreign investment while enforcing competition law.

A more assertive industrial and competition policy

Today, German car manufacturers import all of their lithium-ion battery cells for their electric vehicles. Two Chinese firms Contemporary Amperex Technology Co. (CATL) and BYD, two Korean firms (LG Chem and Samsung) and Japan's Panasonic form a market-sharing oligopoly in supplies, with Europe's share of global production being only 1% today.

In particular, CATL's current offensive in Europe may be noted, as the company supplies the German manufacturers BMW, Daimler and VW, and has also concluded a cooperation agreement with Daimler for the design of electric trucks.⁸¹ In addition, CATL is building a production plant with an annual battery output of 14-gigawatt (GW) in Erfurt (Germany), which Chinese analysts interpret as a desire to maintain its oligopoly status in a market that is likely to become increasingly competitive by 2025, given that estimated annual sales will be around €83 billion.⁸²

81. E. Béziat, "Le véritable coût de la voiture électrique", *Le Monde*, February 11, 2019, available at: www.lemonde.fr.

82. H. Bork and J. Scheiner, "CATL nutzt die Krise für aggressive Expansion," *Automobilindustrie Vogel*, China Market Insider, April 22, 2020 available at: www.automobil-industrie.vogel.de.

Similarly, LG Chem, Samsung SDI and SK Innovation are now present on the European market in Wrocław, Poland for the former and in Hungary for the latter two. Added to this is Tesla's *Gigafactory* under construction in Brandenburg.

Battery projects are, of course, value-creating in Europe, but they also serve the interests of foreign companies to maintain their market dominance. The passivity of Europe's car industry in acting early to acquire skills in this field, means that it is lagging today. While German manufacturers now purchase battery cells from diversified sources, the German government hopes that one-third of European-made cars will be equipped with European batteries by 2025.⁸³ However, Benchmark Mineral Intelligence estimates that by 2028 China will have 46 battery production plants with a production capacity of 1,000 gigawatt hours (GWh), while Europe will have only 9 production plants with a production capacity of 248 GWh.⁸⁴ So China seems to be starting with a clear advantage.

In addition to industrial policy, the EU can also defend its competitiveness by ensuring fair competition in accordance with the rules of international law and the fight against market asymmetries.

Efforts have recently been made with China under the EU-China Comprehensive Agreement on Investment. The agreement aims to re-balance the trading relationship between the two parties by establishing clear rules for intellectual property enforcement, technology transfers, and subsidies to Chinese state-owned enterprises. Moreover, China has conceded that European automakers are no longer obliged to cooperate with Chinese companies to be given market access. This is normally a pre-condition for investing in China and had led to reluctance by German manufacturers to do so, though they eventually yielded because of the potential of the Chinese market.

While Germany was particularly keen to conclude the agreement with China, owing to its close trading relations (in 2019, it exported €96 billion to China, and imported €116 billion worth of goods), the controversy over the agreement demonstrates the need for vigilance over what will follow up.⁸⁵ With Germany being vulnerable to China in a vital industry, Chinese interests cannot be ignored, as shown by the threats made by China's

83. "EU-Gigafactory – der zweite Batteriezellen-Verbund steht", *Manager Magazin*, September 6, 2019, available at: www.manager-magazin.de.

84. K. Popławski, "Germany Joins the Electromobility Race", Centre for Eastern Studies, November 20, 2019, available at: www.osw.waw.pl.

85. *Außenhandel, Ranking of Germany's trading partners in foreign trade, 2020*, Destatis, February 18, 2021, available at: www.destatis.de.

ambassador to the German authorities if they decided to ban Huawei from participating in the 5G deployment in Germany.⁸⁶

The danger of abandoning R&D and production activities

While new players have mobilized resources for the electric transition, the German automobile industry has remained relatively passive. In fact, “*Standort China*” has been strengthened, thereby undermining the attractiveness of Europe’s industrial base and thus Europe’s economy and employment. This can be seen in particular through the relocation of European electric vehicle production to China.

Similarly with another type of propulsion, namely hydrogen, for which Germany plans to obtain supplies in particular from West and Southern Africa, with better weather conditions especially in terms of sunlight. This is part of its strategy to make Germany the “world champion of hydrogen”⁸⁷. These two examples raise questions about the value added created in Germany itself, given that finished products and primary resources are made abroad and will have to be imported.

Indeed, if the high-value-added activities in the value chain of car construction are concentrated abroad, and German industry is limited to assembly, imports and sales, then this would greatly reduce the margins of German automakers and suppliers which had hitherto been pioneers in their field and at the cutting edge of innovation. This could cause the dynamism of German manufacturers to slow, making future catch-up difficult. But if the auto sector remains strategic to European eyes, then R&D investment remains crucial, in support of an ambitious industrial policy that accepts the need of tackling competitive disadvantages.

The shifts in the value chain in automobile production, and uncertainties about the roles Germany and Europe will play, also raise broader questions about freedom of enterprise and sovereignty. The loss of self-sufficiency in sectors as crucial to daily life as mobility, and the growing acquisition of equity in European automobile companies by actors which are tightly or loosely linked to foreign powers (as with Geely’s stake in Daimler) are a geo-economic risk for Europe. The failure of having a credible European alternative in the face of market-dominated actors who

86. T. Wieder, “En Allemagne, la grande coalition divisée sur le cas Huawei,” *Le Monde*, January 29, 2020, available at: www.lemonde.fr.

87. *Die Nationale Wasserstoffstrategie*, June 2020, Bundesministerium für Wirtschaft und Energie (BMWi), available at: www.bmwi.de and “Deutschland will Wasserstoff-Land Nummer eins werden,” *Deutsche Welle*, June 10, 2020, available at: www.dw.com.

want to control vertical integration even further, such as Tesla and the GAFAM, or Chinese actors under the authority of the Chinese Communist Party, is a source of vulnerability for the EU.

The EU is not yet seen as a full-fledged geopolitical and geo-economic player. But the growing dependence of German manufacturers, especially towards China, risks further reducing Europeans' room for maneuver in Sino-European relations, as has been the case with the US and the Juncker-Trump agreement. Indeed, who could reasonably argue that, in the future, an EU that is more dependent on raw materials or Chinese consumption would respond more forcefully to China's human-rights violations in Xinjiang or in Hong Kong? The EU is already very timid in comparison with its American and British counterparts.

Conclusion

The German automotive sector is a powerful example reflecting the need for innovation and transformation, and raises questions about the sustainability of value added produced by “*Standort Deutschland*.” Moreover, the internationalization and resulting geo-economic interdependencies of Germany are exposing it to possible coercion.

If the German and European car industries are to continue to play a dominant role internationally, then it will be necessary to:

- Integrate them into an industrial policy that has set priorities based on existing competitive advantages in Europe, but also on possible future developments, including: strategic sectors, future technologies, and the anticipation of vulnerabilities.
- Build on a competition policy that protects European automobile players from asymmetries in international trade. One tool to do this, for example, is the instrument for controlling investment set up by the European Commission. But respect for international trade law and special trade agreements may also be mentioned, as these ensure greater predictability in a context of Sino-American rivalry that could intensify the collateral damage that has hit German automobile operators.
- Build on a coherent European social and regional policy, while also investing in infrastructure to combat the territorial inequalities that impede European convergence. The financial and economic crisis of 2008 and 2009 provides us with precedents of Chinese influence in Greece and Italy that were weakened at the time. If the EU fails to meet the challenge of maintaining employment and creating added value, especially through cohesion policy, investors from other countries could pour into this void, and make it an instrument of influence.

Economic efficiency is not enough in itself to guide decision-makers' choices, because geopolitical and geo-strategic considerations are also needed. For this, it must be asked whether mobility is an area in which the EU wants to play a role in the future or if it wants to yield to other powers. Indeed, the EU could argue that other actors are better at mobility than the Union, and that this sector is not strategic for the future.

On the other hand, the EU may feel that it is important to continue to play a role in the production of the cars of tomorrow, even if other parts of the world appear to be better endowed in terms of factors of production, and have indeed gained a competitive advantage over the EU. This seems all the more important as mobility in the future will be a service embedded in a connected infrastructure and thus linked to different dimensions of people's lives. The EU's ability to master the technologies of the future, linked to mobility solutions, will give it legitimacy to participate in the regulation and the setting of standards ensuring the security of mobility, but also more broadly, for the infrastructures connected to it. These different issues explain the need for awareness of the (inter)dependencies generated by the question of mobility, and the need for actions aimed at adapting to these new realities.

Appendices

Appendix 1: The importance of the German automotive sector

































THE IMPORTANCE OF THE GERMAN CAR INDUSTRY					
Share of direct employment in the car industry in manufacturing jobs in Germany (2018)				12%	
Share of cars produced in Germany within the world total					5%
Share of car exports in total German exports in 2020					15%
Share of the production of German-brand cars with the world total (2019)					17%
Share of cars produced in Germany destined for export (2019)					75%
Share of German car exports within world car exports (2019)					19%
Share of the car industry in total German GDP (2019)					5%
Number of cars produced in Germany in millions (2019)					5
Number of cars produced by German companies in millions (2019)					16

Table by the author. "The Automobile Industry Pocket Guide 2020-2021", European Association of European Automobile Manufacturers (ACEA), July 30, 2020, available at: www.acea.be; "Exporte und Importe (Spezialhandel) nach Güterabteilungen des Güterverzeichnis für Produktionsstatistiken", Destatis, February 18, 2021, available at: www.destatis.de; Statistics relative to the export of cars produced in Germany, VDA, April 6, 2020, available at: www.vda.de; Statistics on the annual production of cars, VDA, April 1, 2020, available at: www.vda.de; D. Workman, "Car Exports by Country", Worlds Top Exports, available at: www.worldstopexports.com.

Appendix 2: Germany's trade balance 2020 (in € billions)























  GERMANY'S TRADE BALANCE IN 2020 (IN € BILLIONS)			
Exports			1,205
Imports			1,026
Trade surplus			179
Exports to China			96
Imports from China			116
German trade balance with China in 2020			- 20
Exports to the USA			104
Imports from the USA			68
German trade balance with the USA in 2020			36
Trade surplus in cars			77

Table by the author. "Exporte und Importe (Spezialhandel) nach Güterabteilungen des Güterverzeichnisses für Produktionsstatistiken," Destatis, op. cit., Außenhandel, Ranking of Germany's trading partners in foreign trade, 2020, Destatis, op. cit.

Cars are Germany's main export product. In 2020, Germany's trade surplus in car trade amounted to €77 billion, compared to an overall trade surplus of €179 billion.

Appendix 3: US-Germany and China-Germany relations




































    US-GERMAN RELATIONS AND CHINESE-GERMAN RELATIONS			
Car exports to the USA in 2020 (€ billions)			 14
Car imports from the USA in 2020 (€ billions)			 5
German trade balance in cars, with the USA in 2020 (€ billions)			 9
Car exports to China in 2020 (€ billions)			 15
Car imports from China in 2020 (€ billions)			 0
German trade balance in cars, with China in 2020 (€ billions)			15
Production			
Production of German cars exported to the USA in 2019			12%
Production of German cars exported to China in 2019			8%
Sales			
Market share of German carmakers in the USA (2017)			8%
Market share of German carmakers in China (2019)			24%
Share of the US market for sales and registrations in the global car market (2019)			7%
Share of the Chinese market for sales and registrations in the global car market (2019)			33%

Table by the author. Statistics on data for trade in vehicles, Eurostat online data code: DS-018995 781- motor cars and other motor vehicles principally designed for the transport of persons (other than motor vehicles for the transport of ten or more persons), Eurostat, available at: www.eurostat.ec.europa.eu.

Appendix 4: The importance of Germany in the European automotive industry












 THE IMPORTANCE OF GERMANY IN THE EUROPEAN CAR INDUSTRY		
Share of German car production in the EU (2019)		29%
Share of German exports in total EU car exports (2019)	  	60%
Share of jobs in German car manufacturing in total EU jobs in car manufacturing (2018)		33%
Share of EU assembly lines and production located in Germany		19%
Share of intra-EU deliveries in car exports from Germany	  	55%

Table by the author. Eurostat op. cit., "The Automobile Industry Pocket Guide 2020-2021," European Automobile Manufacturers (ACEA), op. cit., Statistics on the export of cars produced in Germany, VDA, op. cit.

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