The German Automotive Industry under Geo-Economic Pressure: From Hegemony to Structural Vulnerability

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Abstract: While the automotive industry has historically been at the core of Germany's economic strength and acted as a major driver of the country's export performance, it now reveals some of the most significant challenges facing the national growth model. Against this backdrop, the article examines how the traditional advantages of Germany's automotive industry have gradually turned into structural vulnerabilities, arguing that its current difficulties cannot be reduced to a cyclical downturn or to a delayed transition to electromobility and digitalisation. Instead, this evolution reflects a more profound transformation in the factors that have long sustained German manufacturing performance. Conventional sources of industrial advantage, such as engineering specialisation, export orientation, extensive integration into global value chains, and reliance on dynamic foreign markets, have become channels of exposure amid the recent intensification of geo-economic rivalry, China's rise in the electric vehicle sector, the resurgence of U.S. industrial policy, and the reconfiguration of global technology chains. Drawing on evidence related to gross value added, employment, foreign trade, vehicle production, and the shift towards electromobility, the paper highlights the progressive weakening of the long-standing pattern of German automotive performance. The analysis concludes that the German automotive industry is not merely undergoing a phase of sectoral adjustment, but has entered a broader process of strategic recalibration, whose outcome will shape Germany's ability to preserve its position as a major manufacturing power in an increasingly fragmented world economic order.

Keywords: German automotive industry; geo-economic rivalry; structural vulnerability; electromobility; global value chains; industrial policy; strategic recalibration
JEL Classification: L62; L52; O33; F14

1. Introduction

In the early years following the Second World War, the automotive industry established itself as one of the emblems of the broad process of reconstruction and economic reconfiguration initiated in West Germany, becoming a genuine anchor of the country's renewed identity and of the later achievement of the "economic miracle" (Koehler, 2010). The sector underwent rapid development, fuelled by sustained technological modernisation, the consolidation of industrial capacities and the refinement of a productive ecosystem grounded in engineering excellence, quality and rigour. These factors decisively positioned Germany as a benchmark of European and international manufacturing competitiveness at the time. In the subsequent decades, German-made automobiles came to be regarded as symbols of technical reliability and industrial performance, while the automotive sector evolved into one of the primary drivers of export-oriented growth, thereby consolidating the German economy as a major actor in the architecture of global trade (Tolliday, 1995).

This historical position was not, however, the result of a simple accumulation of productive capacity, but rather the expression of a complex industrial model, founded on technological specialisation, integration into increasingly extensive value chains and the consolidation of competitive advantages associated with high value-added segments. Thus, beginning in the 1980s[1] and, especially, following German reunification, the automotive

[1] In the 1980s, the expansion of West German automotive industrial networks was directed primarily towards Southern Europe, especially Spain and Portugal, following their accession to the European Economic Community (EEC). At the same time, the previously established partnership with Italy was consolidated during this period, particularly in the automotive components segment.

industry entered a phase of progressive internationalisation, marked, in a first stage, by the externalisation of certain production segments and the regionalisation of industrial chains within Europe (Spatz & Nunnenkamp, 2004). Thereafter, as German producers expanded their presence in the dynamic markets of the global economy, productive activities were gradually integrated into more complex transnational networks, while the technological core and strategic command functions were maintained in Germany. In this way, Germany assumed a pivotal role in orchestrating continental value chains within the automotive sector (Sturgeon, Van Biesebroeck, & Gereffi, 2008).

However, in recent years, this historically consolidated architecture has entered a phase of structural vulnerability. The technological transformations associated with electromobility and digitalisation, China's rise as a major automotive competitor, the revival of U.S. industrial policy and the reconfiguration of global value chains have modified the conditions that had sustained the performance of the German automotive industry for decades. In an economic order marked by mounting geo-economic rivalry, global interdependence no longer functions exclusively as a source of efficiency and expansion; rather, it is becoming a source of systemic vulnerability. Under the impact of these shifts, engineering specialisation, export orientation, deep integration into international production networks and dependence on dynamic foreign markets, which were previously the cornerstones of sectoral strength, have gradually turned into vectors of fragility.

Against this backdrop, the present article analyses the causes that have led to the transformation of the traditional advantages of the German automotive industry into structural vulnerabilities, based on the hypothesis that the sector's current difficulties cannot be interpreted as a cyclical downturn or as a simple delay in the transition towards electromobility and digitalisation. Instead, they signify a more profound transformation of the German manufacturing paradigm, in which the long-standing mechanisms of industrial performance require recalibration in relation to the new conditions of global competition. From this standpoint, the automotive industry no longer represents merely a strategic sector of the federal economy, but a critical test of Germany's capacity to reconfigure its productive base, preserve its technological advantages and maintain its position as a major manufacturing power in an increasingly fragmented international economic order.

The analysis is based on the examination of several indicators relevant for capturing the recent transformations of the sector: the evolution of gross value added (GVA), employment dynamics, foreign trade performance, vehicle production and the transition towards electromobility. This approach allows for a simultaneous assessment of the continuities and ruptures that define the current stage of transformation of the German automotive industry. The article is structured around two main directions: first, the assessment of the contemporary economic relevance of the German automotive industry and of the structural vulnerabilities that have come to the fore in recent years; second, the analysis of the mechanisms through which its traditional advantages have become channels of exposure, thereby imposing the need for a broad strategic recalibration.

2. Literature review

The existing literature on the German automotive industry has traditionally emphasised its pivotal role in the consolidation of Germany's post-war industrial model, export-oriented growth and manufacturing competitiveness. Historical and business-history analyses show that the sector's rise was not merely the result of accumulated productive capacity, but reflected a broader industrial architecture based on engineering excellence, technological specialisation, quality and close coordination between firms, suppliers and international markets (Tolliday, 1995; Koehler, 2010). At the same time, studies on global value chains have highlighted the internationalisation of German automotive production and the capacity of German manufacturers to coordinate transnational production networks while maintaining high-value strategic functions within Germany (Spatz & Nunnenkamp, 2004; Sturgeon, Van Biesebroeck, & Gereffi, 2008). More recent contributions, however, point to the growing fragility of this model under conditions of geo-economic rivalry, technological disruption and the transition towards electromobility. Openness, export dependence and deep integration into global value chains, formerly regarded as sources of efficiency and expansion, increasingly appear as channels of exposure and vulnerability (Krpata, 2021; RSM Ebner Stolz, 2025; Puls, 2024). This diagnosis is also supported by recent institutional analyses, which show that German automotive production and exports have fallen in volume terms, while higher prices, better-equipped vehicles and the shift towards high-value activities have only partially compensated for weaker sales volumes and declining domestic production (Heymann, 2026). At the same time, research on the "dual transformation" of the automotive industry emphasises the redistribution of value added

towards batteries, electronics, software, data services and connected mobility systems, as well as the consequences for employment, skills and industrial policy (Brown et al., 2021; Boewe & Schulten, 2023; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022; Expert Group Transformation of the Automotive Industry, 2024; Nettekoven, 2023). Building on these contributions, the present article develops an interpretative framework that understands the current difficulties of the German automotive industry not as a cyclical downturn, but as part of a broader process in which historical competitive advantages are being transformed into structural vulnerabilities.

3. Methodology

The article employs a qualitative and data-driven analytical approach, integrating structural interpretation with the examination of sectoral indicators relevant to the transformation of the German automotive industry. The empirical analysis is supported by a range of official statistical and institutional sources, including Eurostat, the Federal Statistical Office of Germany (Destatis), the German Association of the Automotive Industry (VDA), the International Organization of Motor Vehicle Manufacturers (OICA), the European Automobile Manufacturers' Association (ACEA), the International Energy Agency (IEA) and specialised policy reports. The period under review extends from 2010 to 2025, depending on data availability. The selected indicators capture several dimensions of sectoral performance and vulnerability, including gross value added, employment dynamics, foreign trade performance, domestic and international vehicle production, and the transition towards electromobility. Rather than treating these variables as isolated statistical series, the analysis interprets them as interconnected expressions of a broader transformation of the German productive model. This approach makes it possible to identify both continuities, such as the persistent economic relevance and export strength of the sector, and ruptures, such as the weakening of the domestic production base, the restructuring of employment, the trans-nationalisation of value creation and the growing dependence on software, digital infrastructures and electric mobility ecosystems.

4. The German automotive industry: strategic relevance and structural vulnerability

Although the automotive industry still retains its multifaceted strategic relevance within Germany's productive system, having been regarded for decades as a true "backbone" of national industrialism (Puls & Fritsch, Eine Branche unter Druck: Die Bedeutung der Autoindustrie für Deutschland, 2020), precisely this density of competences and interdependencies has rendered it an epicentre of systemic vulnerabilities. The recent erosion of globalisation, the reconfiguration of world demand in the premium segment[2] and the shift in performance criteria towards technology, efficiency, digitalisation and speed of innovation have profoundly altered the traditional coordinates of German automotive competitiveness (Puls, 2024).

Consequently, although the automotive sector maintains its position as a defining component of the federal economy and as a reference point of German industrial identity, the technological and geo-economic transformations of the last decade have significantly changed its relationship with the overall economy. Beyond its historical role in generating value added, employment and exports, the automotive value chain is currently undergoing a broad process of structural transformation, in which performance no longer derives exclusively from high-end engineering quality and integration into global production chains, but increasingly from the capacity to adapt to the new paradigms of mobility, digitalisation and sustainability. This transition does not entail a quantitative decline in the economic importance of the automotive industry, but rather a qualitative transformation of the internal balance of the German productive model. The primary factors driving this transformation are the increasingly complex European regulatory agenda, combining objectives of

[2] In the automotive industry, the premium segment refers to vehicles with high embedded value added, advanced technological content, superior quality and strong brand positioning (Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022; Puls, 2024). While this segment has long supported the competitive strength of German car manufacturers, its sustainability is increasingly challenged by electric mobility, software integration, faster innovation cycles and the rise of Chinese manufacturers (RSM Ebner Stolz, 2025).

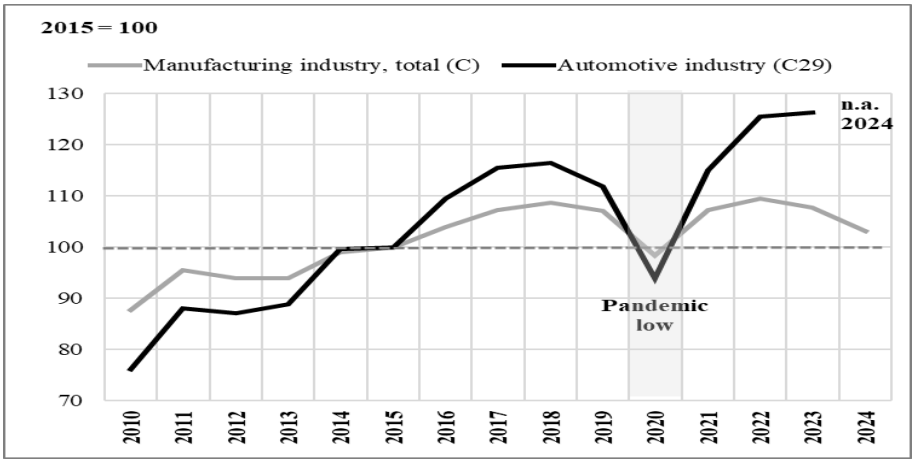
decarbonisation, digitalisation and industrial standardisation, and the intensification of global competition for technological dominance. Taken together, these developments have reshaped the sector's value-added equation, both internally and externally.

A close examination of developments over the 2010–2024 period reveals the complexity of the evolving role of the automotive industry within the German economy. Beyond cyclical fluctuations and conjunctural tensions, the sector remains one of the key pillars of the federal productive architecture, exerting, through an extensive network of producers and suppliers, a strong spillover effect on value added, employment and exports. However, recent dynamics point to increasingly visible signs of fragility in the traditional performance model, reflected in the decline of domestic production from the late 2010s, the gradual relocation of manufacturing capacities to China, and the deepening dependence on this market. It is precisely at this intersection between continuity and vulnerability that the meaning and direction of the strategic recalibration of the German automotive industry are ultimately defined.

To assess the scale and nature of these transformations, the analysis focuses on three core dimensions of the automotive industry: its contribution to GVA, employment dynamics and foreign trade performance. This methodological approach facilitates the identification of the qualitative changes that have occurred within the structure of the German industrial model, whilst also providing the empirical basis required to evaluate the sector's contemporary strategic significance.

The examination of gross value added, a relevant indicator of the automotive industry's real contribution to domestic production and to the consolidation of the national industrial base, reaffirms its central role in Germany's economic dynamics. From 2010 to 2023 (the latest year for which C29[3] data are available), the GVA trajectory reveals not a linear decline, but an alternation of expansion, shock-induced contraction and subsequent recovery, reflecting both the regenerative capacity and the degree of vulnerability of the German productive model (see Figure 1).

Figure 1: Real gross value added in the automotive industry and total manufacturing industry in Germany, 2010–2024[1),2)]



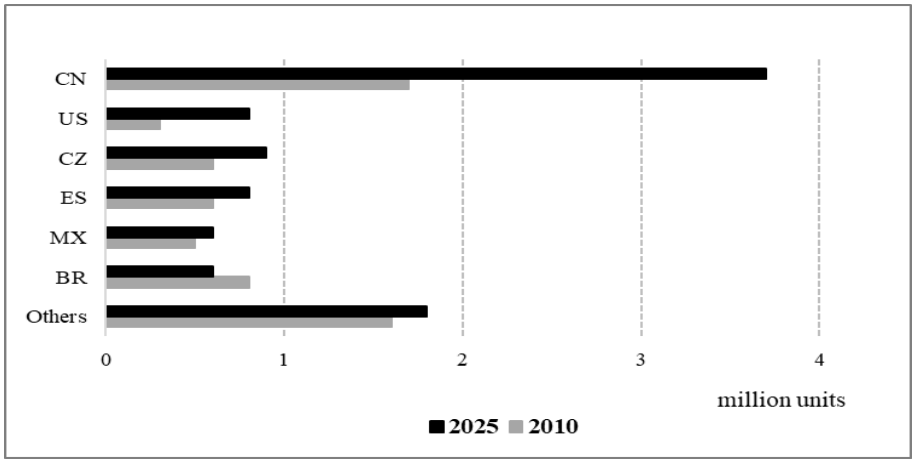
Source: Author's representation based on Eurostat data (2026), code: *nama_10_a64 – Gross value added and income by detailed industry (NACE Rev. 2)*;
Notes: [1)] Chain-linked volumes, 2015 = 100; [2)] Data for the German automotive industry (C29) are not available for 2024, the latest available observation refers to 2023.

In the early years of the period under review, the automotive industry remained below the performance of total manufacturing[4], a development that may be associated with the lingering effects of the sovereign debt crisis, which affected European demand for motor vehicles and delayed the recovery of exports. As the euro area gradually stabilised after 2013, the automotive industry closed the earlier gap, reaching the 2015 benchmark,

[3] C29 refers to the NACE Rev. 2 division "Manufacture of motor vehicles, trailers and semi-trailers", used here as the statistical approximation of the automotive industry.
[4] The faster recovery of total manufacturing was supported by other industrial branches, especially those serving the domestic market and/or segments with more stable demand, such as chemicals and electrical equipment.

after which it entered a phase of pronounced expansion and emerged as a major vector of industrial growth, thus reaffirming its role as a pivotal sector of the German economy.
The pronounced expansion recorded between 2015 and 2018, fuelled by external demand and the development of high value-added segments, confirmed, in value-added terms, the prominent position of the automotive industry within the national industrial architecture. However, this period also marked a subtle but decisive change in the paradigm of industrial performance. The focus shifted from volume and manufacturing integration to the structural refinement of production through technological upgrading, innovation and the consolidation of export-oriented premium segments (Falck, Ebnet, Koenen, & Dieler, 2017; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022). At the same time, the redirection of investment towards Asian markets, notably China, initiated a new form of external dependence, whereby the source of expansion gradually shifted from the domestic base towards foreign production networks. This shift is reflected in the fact that passenger car production abroad by German manufacturers has more than doubled in China since 2010, making it by far their most important foreign production location by 2025 (Heymann, 2026) [See Figure 2].

Figure 2: Passenger car production abroad by German manufacturers, 2010 and 2025 (million units)



Source: Author's representation based on data published by German Association of the Automotive Industry (VDA, 2026); International Organization of Motor Vehicle Manufacturer (OICA, 2026); CEIC Database (2026).

This externalisation of production does not contradict the strong GVA performance observed in Germany during the pre-pandemic expansion phase (2015–2018), but rather, it points to the increasingly transnational configuration through which German automotive value creation was sustained.
The economic downturn in 2020, triggered by the pandemic, resulted in a substantial decline in GVA. This contraction also exposed the automotive industry's strong interdependence with the Chinese market, which had deepened during the pre-pandemic expansion phase of German carmakers, particularly in the second half of the 2010s. Nevertheless, the post-pandemic recovery recorded between 2021 and 2023, supported by the rebound in exports and the acceleration of the transition towards electromobility, confirmed the sector's structural resilience and strategic role. Even in a context of compressed profitability and heightened dependence on global supply chains, the automotive industry continued to act as an essential pillar of Germany's industrial economy.
Following the examination of the trajectory of real gross value added a complementary perspective is provided by the relative weight of the automotive industry within total manufacturing and GDP. These indicators make it possible to assess not only the sector's own dynamics, but also its degree of concentration within the German economic structure, thereby showing the extent to which automotive performance continues to shape the national manufacturing base and the wider economic structure (Box 1).

Box 1: The German automotive industry's weight in manufacturing and GDP, 2010–2024[1), 2)] (%)

Figure 3: Automotive GVA as share of total manufacturing GVA, 2010–2024 (%)

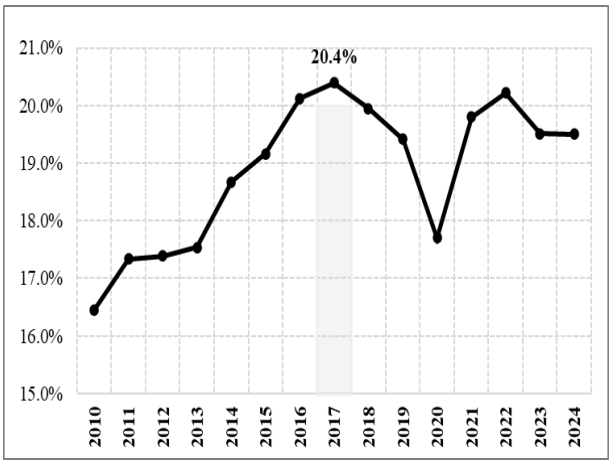
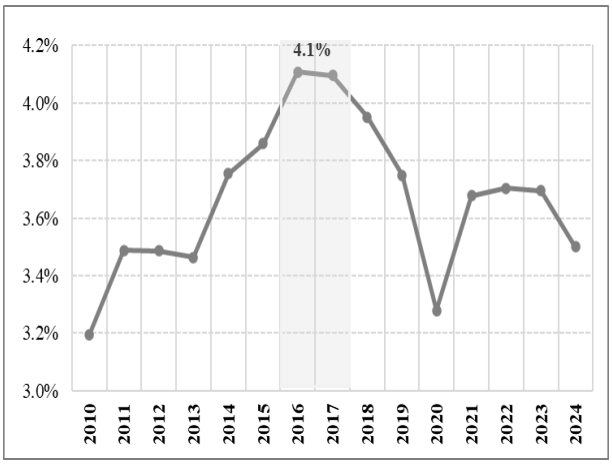


Figure 4: Automotive GVA as a share of GDP, 2010–2024 (%)



Source: Author's calculations and representation based on Eurostat data (2026), codes: *nama_10_a64 – Gross value added and income by detailed industry (NACE Rev. 2)* and *nama_10_gdp – Gross domestic product (GDP) and main components*;
Notes:[1)] Shares are calculated as the gross value added of the automotive industry relative to total manufacturing gross value added and to GDP, respectively; [2)] Latest available data at the time of writing, 2026.

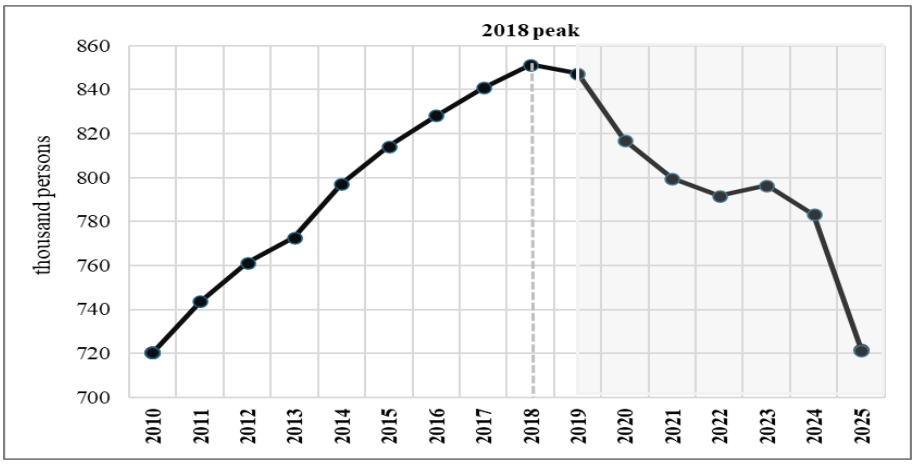
The developments summarised in Box 1 show that, despite significant fluctuations, the automotive industry has preserved substantial structural importance in the German economy. Its share in total manufacturing GVA increased from 16.5% in 2010 to more than 20% in 2017, while its contribution to GDP rose from 3.2% to 4.1% over the same period. These values illustrate not only the sector's role as a key pillar of the German productive architecture, but also the systemic risk associated with such a high degree of concentration, since any sectoral decline can rapidly propagate across the national economy.

However, the post-2017 decline points to the gradual weakening of this traditional configuration. Under the combined impact of high energy costs, productivity stagnation, the accelerated transition towards electromobility, the relocation of production capacities and China's growing competitive pressure, the German automotive industry has entered a phase of profound structural transformation (Boewe & Schulten, 2023; Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022). Thus, the relative weight of the sector confirms both the persistence of its economic significance and the fragility generated by its concentration within the German growth model.

At the same time, China's rise in the automotive and electric mobility sectors, Sino-American trade tensions and the successive shocks generated by the pandemic and the energy crisis associated with the war in Ukraine have intensified competitive pressures and further exposed the fragility of the German industrial model. Although the sector recovered relatively swiftly after the pandemic-induced contraction, its share in GDP did not return to the peak levels recorded in 2016–2017. Nevertheless, the automotive industry remains a key reference point of German industrial performance, capable of concentrating resources, innovation and skilled labour, even in a context marked by volatility and structural adjustment.

Recent developments in employment provide insight into the profound changes that have reshaped the German automotive industry, revealing not only the intensity of technological change, but also the reconfiguration of the relationship between industry, labour and competitiveness. Following a period of sustained growth, typical of the peak years of exports and brand-oriented production, the sector entered a phase of structural adjustment driven by the "dual transformation", namely the simultaneous acceleration of decarbonisation and digitalisation processes, as well as by the relocation of a significant share of production capacities to Central, Eastern and South-Eastern European (CESEE) countries and Asia, especially China (Krzywdzinski, Lechowski, Ferdinand, & Schneiß, 2022) [see Figure 5].

Figure 5: Employment in the German automotive industry, 2010–2025 (thousand persons)



Source: Author's representation based on Destatis data (2026), cod: 42271-0002 – *Persons employed and turnover of local units in manufacturing* [WZ2008].

A close examination of the employment data reveals a change in trend, structured into three distinct phases. The number of employees increased steadily between 2010 and 2018, in line with the expansion of production and exports, reaching a peak of more than 850 thousand persons in 2018. After this point, a marked inflection in the trend became evident, associated with a prolonged phase of structural adjustment. Between 2019 and 2025, the decline in labour demand became persistent, accentuated by the effects of the pandemic, supply chain disruptions and growing pressures on production costs. By 2025, employment in the German automotive industry had returned close to its 2010 level, suggesting not merely a cyclical correction, but the substantial erosion of the employment base accumulated during the expansionary phase.

Beyond the simple arithmetic of job losses, this reorientation of employment dynamics does not simply reflect a cyclical contraction, but rather a deeper redefinition of labour demand. This transition is characterised by the gradual replacement of conventional roles in assembly and mechanical production with positions requiring more advanced digital and technological skills, particularly in electrical engineering, electronics and industrial software. The decline in employment therefore corresponds to a qualitative restructuring of the workforce, partly offset by demographic decline and by the expansion of related fields, such as battery production, charging networks and digital mobility services (Expert Group Transformation of the Automotive Industry (ETA), 2024). Overall, the employment trend indicates a transition from extensive growth to a skills- and innovation-driven pattern, in which sectoral competitiveness increasingly depends on human capital and innovative capacity.

After examining the automotive industry's contribution to value added and employment dynamics at the domestic level, particular relevance is attached to the external dimension of industrial performance, which reflects the sector's capacity to transform national productive potential into a durable trade advantage. The evolution of foreign trade reveals not only the strength of the German automotive industry's integration into international exchange, but also its role as a linking mechanism between the internal dynamics of growth and the outward projection of the national economy.

The automotive industry continued to play a structurally significant role in the external performance of the German economy, as reflected in the persistently high share of automotive exports in total exports throughout the 2010–2025 period (see Box2 / Figure 6). Following a gradual increase in the initial phase of the period under review, the share of automotive exports in Germany's total exports reached its peak in 2016, pointing to the consolidation of the industry's international specialisation in high value-added segments (German Association of the Automotive Industry (VDA), 2025).

Box 2: Foreign trade performance of the German automotive industry, 2010–2025 [1), 2), 3)]

Figure 6: Share of automotive exports and imports in Germany's total exports and imports (%)

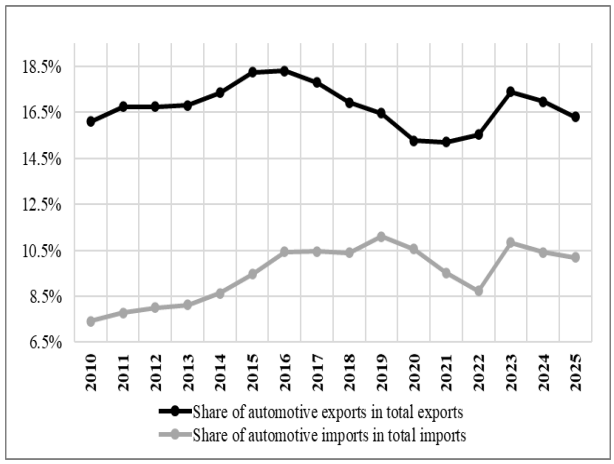
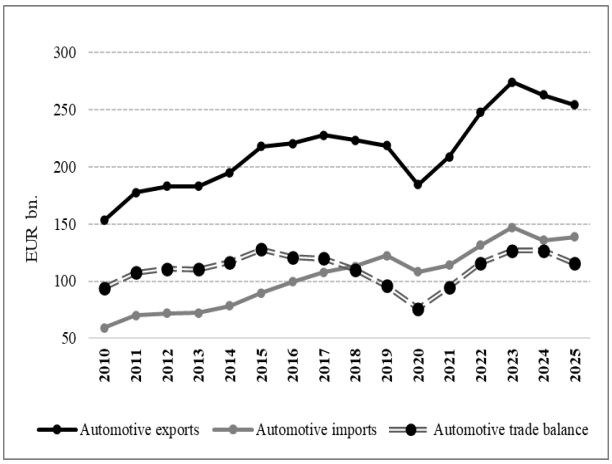


Figure 7: Automotive exports, imports and trade balance (EUR bn)



Source: Author's calculations and representations based on data published by Destatis (2026), codes *51000-0001 and 51000-0005*: Exports and imports (foreign trade): Germany, years; Exports and imports (foreign trade); Germany, years, classifications of trading goods, Foreign Trade Statistics, 2-digit code, WA87 – Vehicles other than railway or tramway rolling stock;
Notes: [1)] Shares are calculated as the value of automotive exports and imports relative to Germany's total exports and imports, respectively; [2)] Values are expressed in current prices; [3)] Data for 2025 are provisional.

The subsequent decline, particularly between 2019 and 2022, reflected the cumulative impact of major exogenous factors, such as the deterioration of U.S.-China trade relations, the acceleration of technological transition, the pandemic shock and the outbreak of the war in Ukraine. Nevertheless, the visible recovery recorded in 2023 brought the indicator back towards its historical average, confirming the structural resilience and adaptive capacity of German manufacturers, even though the values recorded in 2024–2025 suggest a stabilisation below the peak levels of the 2015–2017 period (Puls, 2024).

In parallel, the share of automotive imports in Germany's total imports followed a long-term upward trajectory, reaching a peak of approximately 11% in 2019 and returning to elevated levels after the decline recorded in 2022. This development signals, on the one hand, the sector's deeper integration into international production chains, reflected in a stronger dependence on imports of components, subassemblies and vehicles originating from external networks, and, on the other hand, the intensification of competition on the domestic market, driven by the increase in imports of finished vehicles. Consequently, the external performance of the German automotive industry remains robust, but it is supported by an increasingly trans-nationalised production architecture, in which the export advantage coexists with greater exposure to value-chain fragmentation and international competition.

Data on exports, imports and the trade balance confirm the same structural ambivalence (See Box 2 / Figure 7). Automotive exports remained high in nominal terms, while the industry's trade surplus stayed substantial throughout the period under review, exceeding EUR 120 billion in 2023 and 2024, before declining to approximately EUR 116 billion in 2025. This evolution confirms the sector's role in supporting the external position of the German economy. Nevertheless, the increase in imports and the volatility of the trade balance after 2019 show that external performance can no longer be interpreted exclusively as the expression of uncontested industrial superiority, but rather as the outcome of a complex insertion into a global production system increasingly exposed to technological reconfiguration, trade fragmentation and geo-economic competition.

The synthesis of developments observed across the three defining pillars – gross value added, employment dynamics and external performance – provides a complex picture of the German automotive industry, marked by an increasingly pronounced structural dissonance. Although the indicators continue to

confirm its central role within the national industrial architecture, post-2018 trends reveal a gradual weakening of the traditional performance model. The apparent resilience of the sector conceals a deeper reconfiguration of the growth paradigm, driven by technological disruption, recurrent economic shocks and mounting geopolitical pressures, which have transformed the sector's historical competitive advantage into a source of systemic vulnerability. Consequently, to capture the broader implications of this transformation, the following section examines the causal mechanisms and structural effects that define the fracturing of the German export-oriented growth model.

5. From competitive advantage to systemic vulnerability

Viewed against the backdrop of the processes examined above, the evolution of the German automotive industry reveals a fundamental paradox of industrial modernity. The very mechanisms that, for decades, underpinned its performance, stability and rise, namely technological specialisation, global integration and a pronounced export orientation, are gradually transforming into sources of systemic vulnerability. Behind the apparent balance between value added, employment and external performance, a dynamic of structural tension is taking shape, driven simultaneously by the intensification of external pressures, the erosion of the domestic production base and the acceleration of technological transformation.

This metamorphosis of competitive advantage does not point to a cyclical crisis, but to the progressive fracturing of the industrial paradigm that established Germany as the leader of European automotive production. The relocation of production centres, the decline of domestic volumes and the reconfiguration of value chains under the impact of electromobility and digitalisation indicate the end of a historical cycle. In place of the old expansion model, which was based on volume, engineering excellence and manufacturing integration, an economy of adaptation is taking shape. In this new economy, performance increasingly depends on the capacity for strategic reconstruction.

5.1 From global integration to geo-economic exposure

A first manifestation of the structural vulnerability of the German automotive industry lies in the erosion of the global architecture that served, for several decades, as both its frame of reference and a driver of performance. The German export model, built on the principles of economic liberalisation, the optimisation of value chains, the reduction of trade barriers and the maximisation of productive efficiency, is currently facing a profound reversal of the very logic that ensured its success. Liberalisation, once a guarantee of expansion, has become a source of exposure, while global interdependence, formerly an advantage, has turned into a systemic risk.

This structural shift marks the transition from the open economy of classical liberalism to the strategic economy of geo-economics, "in which economic development worldwide is not driven by market liberalisation and the globalisation of supply chains, but rather by the pursuit of economic superiority and political dominance" (RSM Ebner Stolz, 2025, p. 3). In the context of contemporary geopolitical dynamics, in which states increasingly use economic instruments to achieve geopolitical objectives, the German export model, founded on openness, interdependence and access to dynamic markets, has become increasingly vulnerable. As Krpata (2021) observed, its traditional role as a driver of European industrial hegemony is transformed into the "Achilles' heel of the national economy".

This change in the global economic regime has concrete effects on the material base of the automotive industry. The decline in production volumes within Germany (see Table 1 and Figure 8) signals a shift in the centre of gravity from manufacturing production towards design, coordination and R&D functions. This reorientation is driven on the one hand by the deterioration of structural competitiveness factors, the rise of global protectionism, high energy costs and excessive domestic bureaucracy, and on the other by the imperative of proximity to dynamic markets and easier access to resources (Expert Group Transformation of the Automotive Industry (ETA), 2024; Puls, 2024).

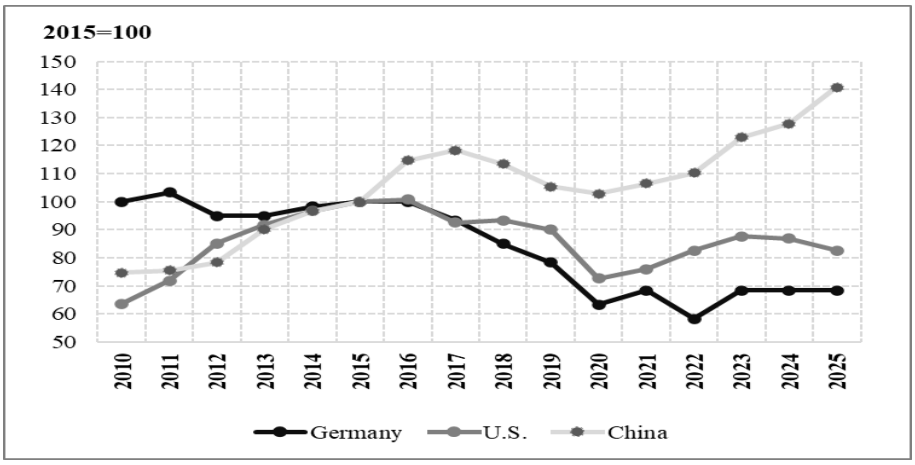
Table 1: Domestic motor vehicle production in Germany, the United States and China, 2010–2025[1), 2)]
(million units)

	Germany	United States	China
2010	6.0	7.7	18.3
2011	6.2	8.7	18.5

	Germany	United States	China
2012	5.7	10.3	19.2
2013	5.7	11.1	22.1
2014	5.9	11.7	23.7
2015	6.0	12.1	24.5
2016	6.0	12.2	28.1
2017	5.6	11.2	29.0
2018	5.1	11.3	27.8
2019	4.7	10.9	25.8
2020	3.8	8.8	25.2
2021	4.1	9.2	26.1
2022	3.5	10.0	27.0
2023	4.1	10.6	30.1
2024	4.1	10.5	31.3
2025	4.1	10.0	34.5

Source: Author's compilation based on data published by the International Organization of Motor Vehicle Manufacturers (OICA, 2026), the European Automobile Manufacturers' Association (ACEA, 2026) and the German Association of the Automotive Industry (VDA, 2026);
Notes: [1)] Values refer to domestic motor vehicle production (including passenger cars and commercial vehicles), expressed in million units; [2)] Figures are rounded to one decimal place.

Figure 8: Diverging trajectories of motor vehicle production in Germany, the United States and China, 2010–2025 (2015 = 100)[1)]



Source: Author's representation and calculation based on data published by the International Organization of Motor Vehicle Manufacturers (OICA, 2026), the European Automobile Manufacturers' Association (ACEA, 2026) and the German Association of the Automotive Industry (VDA, 2026);
Note: [1)] Values are volume indices (2015 = 100), calculated based on domestic motor vehicle production, including passenger cars and commercial vehicles, expressed in million units.

The available data on motor vehicle production confirm the gradual weakening of Germany's role within the global production architecture. Following a period of relative stability between 2010 and 2017, the German automotive industry entered a phase of persistent contraction, followed by only a partial recovery after the pandemic shock. The stabilisation of production on a plateau below the pre-2018 level suggests that this break in trend cannot be interpreted as a simple cyclical fluctuation, but rather as an erosion of the domestic production base, associated with rising energy costs, shortages of highly skilled labour and the relocation of facilities to other production centres (Puls, 2024).

In contrast, China has continued a process of large-scale industrial expansion, demonstrating its systemic capacity for the vertical integration of value chains, control over intermediate production and the internalisation of segments with high embedded technological content (Germany Trade & Invest (GTAI), 2025). This evolution marked the shift of the centre of gravity of the global automotive industry towards Asia, where volume growth has been combined with direct political support and strategic control over critical resources, particularly in

batteries and critical raw materials. The United States followed a different trajectory, seeking to mitigate the limits of its production capacity by directing investment towards high-value-added sectors, including microelectronics, software and electric mobility.

Taken together, these developments describe a profoundly reconfigured industrial world: Germany, once synonymous with engineering excellence, is increasingly moving towards an economy of coordination and design; the United States increasingly resembles an economy of selection and specialisation; while China has evolved into an economy of scale and integration. Consequently, the production indicator reflects a structural reconfiguration of the global competitiveness model, in which manufacturing strength no longer derives solely from efficiency, but from strategic control over the entire productive ecosystem (RSM Ebner Stolz, 2025).

5.2 From mechanical excellence to electric and digital mobility

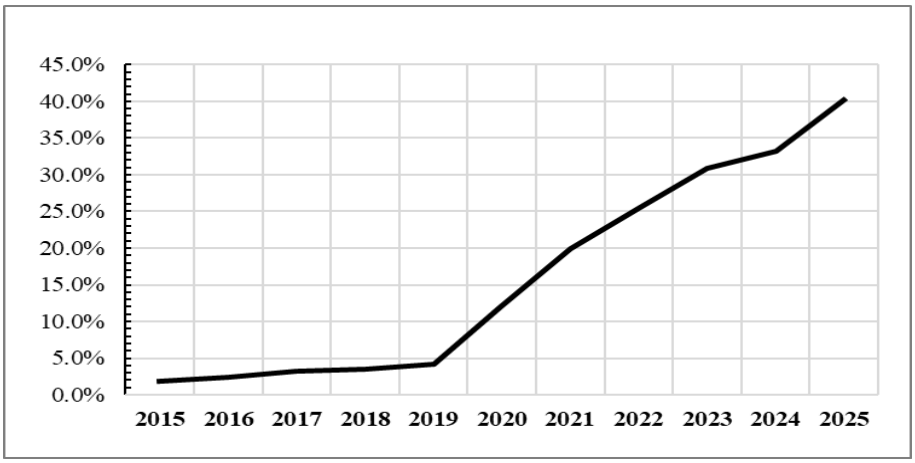
The second dimension of the weakening of the German model is internal and results from the profound transformation of the structure of value added. Over the last decade, the centre of gravity of industrial performance has shifted from traditional mechanical engineering towards integrated electronic systems, software and data management technologies, generating a structural mutation in the business model of automotive manufacturers (Boewe & Schulten, 2023).

This change does not represent merely a transitional stage of modernisation, but a fundamental reconstruction of the automotive product itself. For decades, Germany's competitiveness rested on the engineering excellence of the internal combustion engine and on the superiority of manufacturing processes. In the contemporary technological landscape, however, value added is increasingly generated in the domains of software, integrated electronics, connectivity and digital services, progressively reducing the relevance of conventional mechanical components.

This shift of value towards the digital domain modifies the balance of power within the global value chain. The expansion of connected vehicles and automated driving systems is transferring a growing share of control over innovation processes and data flows towards global technology actors, particularly those based in the United States and China. The absence of a sufficiently developed European and German information technology sector accentuates the structural dependence of automotive manufacturers on extra-EU suppliers, which already hold dominant positions in software infrastructure, digital mapping, data analytics, battery production and electronic components.

Germany's transition towards electromobility accelerated significantly after 2020, following a prolonged period of stagnation between 2015 and 2019 (see Figure 9). However, this increase, although remarkable as a share of total passenger car production, reveals a structural lag when measured against the pace of transformation imposed by the global market and by intense competition from Asia. The scale of this asymmetry becomes particularly visible when Germany is placed against the global production landscape: in 2024, China produced 12.4 million electric cars, compared with approximately 1.4 million in Germany, and accounted for more than 70% of global electric car production, confirming its position as the main manufacturing hub of electric mobility (International Energy Agency (IEA), 2025). Against this background, Germany's progress remains insufficient to compensate for the decline in traditional production and to secure a superior competitive position in a context in which China and the United States have already consolidated industrial ecosystems dedicated to electric mobility.

Figure 9: Share of electric vehicles in total passenger car production in Germany, 2015–2025 [1), 2)] (%)



Source: Author's representation and calculations based on monthly data published by the German Association of the Automotive Industry (VDA, 2026);
Notes: [1)] For the years prior to 2015, electric vehicle production was statistically insignificant, accounting for less than 1% of total passenger car production; [2)] The category "electric vehicles" (EVs) includes battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

This structural discrepancy highlights the difficulty of aligning the German automotive hub with the dynamics of global transformation, turning the transition effort from a potential source of competitive advantage into an additional factor of short-term vulnerability. In this sense, the digitalisation of the automotive industry is not merely a technological test per se, but also an institutional one, which will determine whether the transition can be converted into a new competitive advantage or whether, on the contrary, it will deepen existing structural dependencies (Brown, et al., 2021).

However, the efforts to develop domestic software capabilities are constrained by a structural shortage of qualified human resources, as the share of the workforce with advanced digital skills remains below the EU average. This incongruity between the industry's strategic objective of closing gaps "in all key areas of value creation" and the effective capacity to develop human capital accentuates the digital capability gap and limits the speed of industrial adaptation (Expert Group Transformation of the Automotive Industry, 2024, p. 10).

Overall, the internal reconfiguration of industrial performance marks the transition from a mechanically driven production model to a digital-systemic one, in which competitiveness depends on the capacity to integrate hardware, software and data-based services into a unified, scalable and updatable product. This transition is not merely a technological process, but rather a shift in the economic paradigm through which the German automotive industry is redefining its position within the global value chain. In the absence of strategic coordination between public policy, industrial strategies and vocational training programmes, Germany risks preserving its engineering performance while losing control over the core of value added in the automotive industry.

6. Strategic reconstruction and the imperatives of industrial resilience

In the contemporary context, the German automotive industry is confronted with a triad of challenges: the erosion of the domestic manufacturing base, the intensification of global competitive pressures and the acceleration of technological transition. In such circumstances, the strategic imperative can no longer be framed in terms of preserving the old performance model, but rather in terms of its recalibration. The transformations examined above, namely the decline in domestic production volumes, the weakening of engineering-based advantages, the widening gap in digital skills and the shift of value added towards software, electronics and data services, all point to the same conclusion: industrial resilience can no longer derive from the inertia of historical competitiveness, but from the capacity for structural reorganisation, the re-anchoring of value added and the redefinition of the relationship between industrial policy, innovation and the material foundations of production. In this new context, the automotive industry becomes the arena in which the limits of the established paradigm are tested, and the premises of a new industrial model begin to take shape. The previous model can no longer be sustained through successive adjustments or through the mere prolongation of historical advantages. Instead, it

requires the consolidation of technological autonomy, securing critical segments of the value chain and reconstructing endogenous innovation capacity. Without a strategic repositioning of key industries, Germany risks not only an episodic weakening of its industrial position, but also the loss of control over the core of value added. This risk becomes particularly acute at a time when geo-economic competition is transforming the automotive industry into a strategic domain of economic power (IPE Institut für Politikevaluation GmbH, Institut für Kraftfahrzeuge, RWTH Aachen University & Roland Berger GmbH, 2020; RSM Ebner Stolz, 2025).

The reconstruction agenda must be built around two interdependent components. The first concerns the restoration of the internal capacity for value creation, through the recovery of control over the decisive technological segments that define the vehicle of the future: microelectronics, advanced electronics, software, digital infrastructures and energy systems associated with electromobility. In these areas, dependence on extra-European actors, high imports of specialised components and the concentration of key capacities in Asia have reduced Germany's ability to retain full control over the technological core of the automobile of the future. The reconstruction of this pillar requires not only investment in research, prototyping and testing, but also the formation of a coherent ecosystem in which European and federal initiatives, competence centres, suppliers, universities and automotive manufacturers operate within a common architecture of innovation (Nettekoven, 2023; Boewe & Schulten, 2023; Puls, 2024).

The second component concerns the institutional, financial and organisational stabilisation of the new industrial model. Technological reconstruction, however necessary, remains incomplete without an institutional framework capable of sustaining the pace, coherence and depth of transformation. This requires mechanisms of strategic financing, the simplification of administrative procedures, a fiscal framework more favourable to productive investment, targeted support for suppliers undergoing technological conversion and the modernisation of digital, energy and logistics infrastructures. In the absence of these conditions, the German automotive industry risks remaining trapped between insufficient investment, administrative bottlenecks and the vertical fragmentation of the supplier ecosystem.

A third pivotal element of this reconstruction is human capital. The digital and electric transformation of the automotive industry requires new skills in software engineering, data analytics, electronic control systems, artificial intelligence and advanced production technologies. Without a coherent reform of vocational training, technical education and university partnerships, industrial reconfiguration remains incomplete, while the gap between the strategic objective of recovering technological value and the effective capacity to develop human resources may become a long-term structural constraint.

Overall, the industrial reconstruction of the German automotive sector cannot be reduced to a simple process of technological adaptation. It implies a systemic recalibration of the productive model, in which competitive advantage must be rebuilt through technological control, institutional coordination and the re-anchoring of value added within the national and European industrial ecosystem. Germany is not condemned to industrial decline, but neither can it preserve its position through the inertia of engineering excellence alone. The future of the German automotive industry will depend on its capacity to transform current pressures into a new competitive advantage, built on software, digital infrastructures, technological autonomy, human capital and institutional resilience.

7. Conclusion

Reconstructing the trajectory of the German automotive industry over the last decade and a half reveals a profound transformation of one of the core components of the federal industrial model. The historical competitive advantage, built on engineering excellence, manufacturing integration, specialisation in high value-added segments and export performance, is being reshaped in a context marked by intensifying global competition, the fragmentation of value chains, China's rise in electric mobility and the simultaneous pressure of digitalisation and the green transition. The weakening of Germany's position in global production, the progressive relocation of productive capacities, the compression of the employment base and the transfer of value towards software, electronics and data-based services do not point to a linear decline of the German automotive industry, but to the structural mutation of an economic model compelled to redefine the foundations of its competitiveness.

The analysis of gross value added, employment and foreign trade performance shows that the automotive industry continues to retain major structural relevance within the German economy. However, this position no

longer functions exclusively as a source of strength, but also as a mechanism of systemic exposure. Although the sector remains a benchmark of industrial performance, and the automotive trade surplus continues to support Germany's external position, post-2018 developments reveal the gradual weakening of the traditional performance model, through the contraction of domestic production, the intensification of dependence on external networks, the rise in imports and the widening technological gaps relative to new global competitors.

In this context, industrial resilience can no longer derive from the inertia of historical competitiveness, but from the capacity for institutional reorganisation, technological reconstruction and the re-anchoring of value added within the national and European industrial ecosystem. German industrial policy is therefore becoming an increasingly important instrument of strategic survival, aimed at rebuilding the link between innovation, financing, productive autonomy and human capital. The success of this recalibration depends on the synchronisation of the technological, institutional and social dimensions of transformation: the capacity to generate domestic technologies, to stabilise mechanisms of financing and coordination, to support suppliers and to ensure a sustainable transition for the workforce.

Consequently, the German automotive industry is not simply approaching the end of a cycle, but the reconfiguration of a new industrial paradigm, in which performance will no longer be assessed exclusively through volume, exports or mechanical excellence, but through the degree of control over the core of value added and the ability to transform technological transition into systemic advantage. The revalidation of this sector as a pivot of European competitiveness will depend on Germany's capacity to convert its current fragility into a new form of economic power, based on technological autonomy, strategic digitalisation, human capital and industrial cohesion.

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