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German Industrial Policy and the Twin Transition: Pre- and post-Covid Trajectories in the Automotive and IT Services Sectors*

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Abstract
The European Union (EU) and Germany were already being confronted with rapidly changing dynamics on the economic, ecological, and technological terrains prior to the Covid-19 crisis. The pandemic however has fully exposed critical global value chain (GVC) dependencies, jeopardising European industries. Yet, while the automotive industry was directly hit and worsened by the GVC distortions, the information technology (IT) services sector increased in value. By employing a historical-institutional and a pre-and post- Covid-19 industrial policy analysis, this article finds that in spite of previous attempts, it was during the height of the pandemic that the implementation of green and digital industrial policy gained significant political support in Germany and the EU. In this context, there is an increased relevance of vertical industrial policy, which is geared towards the 'twin transition', partly altering the primarily horizontal industrial policy framework manifested in the post-Maastricht period.

Key words: Vertical Industrial Policy, Automotive industry, IT services industry, Covid-19, Geopoliticized Competition, Twin Transition

JEL classification: L5, L62, O38

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Introduction

Technological innovations had a critical role in generating Germany's economic growth and robustness in the post-WWII period. Structural transformations made available by innovative know-how and products often materialized because of strategic industrial policies. Among other institutional changes brought about by the post-Fordist era in Germany and the EU, the relevance of vertical industrial policy[1] declined. Instead, more attention was given to broad and horizontal policymaking. Currently, new challenges are on the horizon. On the one hand, ecological threats brought by climate change demand new techniques for cleaner energy production and the transformation of the country's most important industrial sector – the automotive industry. The increasing relevance of artificial intelligence (AI) and digitalization requires a vigorous policy approach and their embeddedness into industrial production. On the other hand, massive shortages and economic disarray created by the Covid-19 pandemic put over-reliance on global supply chains under scrutiny. Furthermore, frontrunners in the IT sector such as the USA and strong players in East Asia seriously challenge not only Germany's but the EU's international competitiveness.

In the aftermath of the current events, initiatives such as the so-called 'twin transition' (digital and green transition) are gaining momentum both in Germany and the EU. The Covid-19 programs not only entail immediate economic relief, but they aim to realize long-term goals such as achieving more sustainable ways of production and reducing external dependencies in key technological and industrial areas. In this context, the revival of targeted and interventionist industrial policies can be observed in the European and German policymaking. In turn, Germany's industrial policy is being conditioned and impacted by the EU guidelines and rules. Importantly, there is an on-going paradigm shift in Germany which is driven by deeper structural conflicts predating the Covid-19 reality. For a better comprehension of the existing dynamics, a closer sectoral and institutional analysis is needed.

Against this backdrop, the paper is organized as follows: Chapter 1 reviews the existing academic literature on industrial policy. Chapter 2 analyzes the impact of new dynamics in industrial policy at the EU level for the studied industries at the member state level. This is followed by (Chapter 3) the analysis of the structure and the political economy of the German postwar model and its relevance for the automotive and IT service sectors. Chapter 4 explores new and existing challenges for the respective industries. The aim of Chapter 5 is to reveal the roots of the policy re-orientation in Germany as well as to scrutinize industrial policies introduced during the pandemic. This is followed by concluding remarks.

[1] Weiss (2016:138-139) defines vertical industrial policy as a governmental policy intervention with targeted and sector-specific infrastructure investment, skills training, selective import protection, selective credit guarantees. Whereas horizontal industrial policy refers to broad regulatory reforms or investments covering wide range of sectors, general educational or research and development (R&D) funding.

1. Relevance of Industrial Policy

An increasingly fragmented production gathered across GVCs and organized by transnational companies (TNCs) has restructured international trade drastically in the last forty years. Within these new constellations - dictated by large, multinational firms - some developing countries have managed to achieve economic and social upgrading, and many have failed to do so. The dominant view has offered an explanation by highlighting a positive role of GVCs for economic upgrading. The argument is that the lead firms can provide market access, share new technologies and develop learning mechanisms for the suppliers. Sampath and Vallejo (2018: 482) however note that: "the full range of effects that GVCs can have on countries at different levels of development are yet to be understood". Integration in supply chains may lock countries into low value-added activities "where they depend on low labour and production costs as their key competitive advantage with limited prospects for learning and spillover effects" (Bernhardt/ Pollak 2015: 2). Chang and Andreoni (2020) find that TNCs can limit learning prospects as they do not produce substantial backward and forward linkages, or they can even cause downgrading of local firms. Dünhaupt et al. (2022: 507) question the mainstream assumptions and state: "upgrading also depends on a country's capacity to shape the national competitive and labour market situation through a series of political measures such as labour regulation, industrial policy and others". Lema et al. (2019) emphasize the necessity for national innovation policies that encourage sustainable economic growth.

A view that underlines a connotation of deliberate state policies has experienced a contemporary resurgence. The 2008 global financial crisis and its subsequent economic downturns, and China's impressive utilization of a state-managed policy, have induced a significant comeback of industrial policy. Ferrannini et al. (2020) list two additional factors for a sharp industrial policy revamp: 1. Industrialization processes are essential for the transformation of the economy and structural changes cannot be achieved without industrial policy; 2. In the context of unfettered globalization and GVCs, capturing national economic gains or accomplishing disruptive technological changes cannot be realized by the markets.

Otsubo and Otchia (2021: 9) describe industrial policy as: "a large set of strategic and proactive government interventions to address market failures that prevail in the economy and to promote/develop new industrial capabilities and institutional capacities to accelerate the structural transformation necessary for growth and sustainable development". The description of industrial policy by Stiglitz (2017: 24) goes beyond promoting industrialization and "embraces any policy affecting the sectoral composition of the economy or the choice of technology". Chang and Andreoni (2020: 329-330) highlight that the goal of industrial policy should be "the continuous development of collective capabilities through learning" as a process of development and production increase.

Literature on industrial policy has identified horizontal or 'functional' and vertical or 'selective' policy interventions (Weiss 2016; Otsubo/ Otchia 2021), classifying vertical incentives as strategically more important. Weiss (2016: 135) considers two key strands: historical tradition "where in the nineteenth century 'infant industry' protection was used effectively to create new industries in 'latecomer' or follower countries, such as the USA and Germany"; and the twentieth century examples of strategic state interventions conducted by the "Asian Miracle" countries. In the latter case, the state-led economic policies were

deliberately directed at enhancing industrialization for boosting production and economic growth. Vertical policies were crucial for embedding foreign capital and technologies in specific industries on the one hand and developing domestic skills and research & development (R&D) on the other. "Asian Tigers" managed to protect infant industries, diversify manufacturing, and utilize export-led models, eventually leading to 'catch-up' industrialization.

Currently, developmental policies are required to be aware of the broader environmental, social, and macroeconomic domains. Investing in strategic industries is no longer sustainable without considering planetary boundaries and social costs. Growing ecological threats demand a shrewd approach to renewable energy production as well as the transformation of polluting sectors such as the automotive industry. The global race for disruptive technological solutions and digital innovations requires tactical policies that go beyond functional / horizontal interventions. Drawing on Henry Ergas (1987), Kattel and Mazzucato (2018) suggest that mission-oriented (emphasis on inducing radical technologies breakthroughs / disruptive technologies) rather than diffusion-oriented (emphasis on delivering technology-related public goods, education and research) industrial and innovation policies have a capacity to achieve greater societal goals. Herr (2019) points out that to obtain political support for such industrial policy, 'losers' of industrial change should be compensated. Chang and Andreoni (2016) argue that conflict management should be part of such policy to limit social disarray. Moreover, in the ideal case, economic and social upgrading should be linked, which in turn will increase productivity (Herr 2019). Additionally, many authors (Pianta et al. 2016; Eder et al. 2018; Eder/ Schneider 2018) argue that a good industrial policy should strive to materialize a more just and equal society. Given the context, a modern industrial policy should be responsive to novel technological, geopolitical, and macroeconomic challenges while embedding social and environmental questions.

2. European Framework for Germany's Industrial Policy

Industrial policy has a long yet changing tradition at the EU-level impacting and limiting policies and initiatives at the member state level, as it is a *shared* competence (Landesmann/ Stöllinger 2020: 4). This section puts industrial policy in the German Automotive and IT services sector into the European context. To evaluate changes during the Covid-19 pandemic, section 2.1. outlines the development of EU's industrial policy from the 1990s until the outbreak of the pandemic with a focus on the impact of neoliberal policies as the prevailing economic policy paradigm, and section 2.2. describes the new dynamics of industrial policy during the pandemic.

2.1 Development of Industrial Policy at the EU-level

Since the 1970s, there has been a shift away from interventionist policies towards more regulatory modes of economic governance which Majone (1997: 123) identified as the beginning of the "regulatory state as external or market regulator, and as internal regulator of decentralized administration." In the following years, the policy space for industrial policy and

government involvement decreased. There was a new consensus that the state should refrain from taking on the role as a 'producer' with 'selective policies' in support of specific sectors or firms. Instead, a new consensus assigned the role as the more efficient producer to the market (Pianta et al. 2020: 780).

This consensus was anchored in new or transformed European policies and institutions such as the Maastricht Treaty, which formed the basis for the European Monetary Union in 1992, and the European Single Market in 1993 (Pianta et al. 2020: 780). As stipulated in Article 173 of the Treaty on the Functioning of the European Union (TFEU)[2], *horizontal* industrial policy became the dominant industrial policy form (Polluveer 2022). Cohesion policy mainly in the form of European Structural and Investment Funds (ESIF), became a key pillar of EU industrial policy (Landesmann/ Stöllinger 2020: 2). However, this is highly intertwined with several other policy fields such as innovation, investment, and competition policy, and remains subordinate to other policy objectives such as strict compliance to EU fiscal rules. Thereby, competition policy assumes a key role as it prescribes a limitation of state aid for firms and sectors in the EU. Following a general principle in EU legislation, the state and state funds must not selectively support a specific firm or sector to avoid an 'unfair' competitive advantage (Pianta et al. 2020: 781; Pichler et al. 2021: 143).

Yet, Landesmann and Stöllinger (2020: 1) conceptualize the tradition of EU industrial policy to have followed a '*mixed approach*' which includes both horizontal and vertical policies. Exceptions to the prevailing 'horizontal' industrial policy encompass initiatives linked to Industry 4.0 such as 'Digitizing European Industry' and 'European Digital Innovation Hubs' (Pianta et al. 2020: 782). However, vertical industrial policy represented a significantly lower share (3% of total industrial policy spending for space, aircraft and electronics at the EU level and 7% of total industrial policy spending for bailouts aid and restructuring at national levels) between 2014 and 2017 (Landesmann/ Stöllinger 2020: 6).

According to Pianta et al. (2020: 780), the loss of policy control through more vertical industrial policy resulted in a huge divergence of industrial production and investment with diverging and polarized balance of powers of industrial production between the center, among others Germany, and the periphery in the EU, further aggravated by varying industrial performances after the 2007-2008 Global Financial Crisis (GFC). The GFC indeed triggered a series of reviving debates on the necessity of industrial policy as a policy instrument. The crisis paved the way for the '*return of industrial policy*' (Wade 2012) in Western capitalist centers. Next to deindustrialization and increasing polarization of industrial production, increasing geopolitical competition with the Chinese and the American economy in core segments of the economy, and the pressure for a 'twin transition' further contributed to this return (Gräf/ Schmalz 2023).

With this return, new concepts emerged such as the 'smart specialization program, which links industrial and cohesion policy with a focus on innovative Industry 4.0 technologies (Wigger 2023). While this program contributed to technological upgrading, it remains

[2] The Treaty of Rome (1957) laid out exemptions and limitations to state aid (Article 81-89) which were revised by the Lisbon Treaty in 2008 (Article 101-109). Article 107 establishes the general rule that any form of direct state aid is per se prohibited, yet allows for certain exceptions as laid down in the General Block Exception Regulations (GBER). Hence, the GBER declares certain state aid categories to be compatible with TFEU Article 107 and 108 (see Pianta et al. 2020: 787).

unsuccessful in "narrowing the gap between advanced high-tech regions and rapidly de-industrializing regions, or regions locked into labor-intensive, low value-added and less knowledge-intensive production"(ibid.: 20).

Whereas the more far-reaching concept of 'mission-oriented' innovation and industrial policy – systemic public policies targeting frontier knowledge and societal cross-sectoral missions instead of promoting individual sectors (Mazzucato 2018) - remains controversial, '*green industrial policy*' (GIP) (Rodrik 2014) increasingly gained political support in the last decade. In broad terms, this policy aims at reshaping production structures and hence economic activities towards ecological sustainability and clean and green production (Pianta et al. 2020: 781). Considering the shared competence of industrial policy, we should distinguish between industrial policy spending stemming from the supranational EU-level (via the central EU budget or the ESIF) and state aid spent by member states in accordance with EU competition regulation. At the supranational level, the thematic focus of industrial policy lies on, first, research, development, and innovation (RDI) and technology, and second, regional industrial policy. In contrast, spending on GIP prevails among member states with Germany having contributed the highest share due to the *Energiewende* ('energy transition') (Landesmann/ Stöllinger 2020: 5-6). It shows that recurring priorities such as supporting small and medium-sized enterprises (SMEs) and innovation, which are key to EU programs such as Horizon2020, were expanded by green policies. This is exemplified by the 2020 Energy and Climate Package, the European Commission (EC)'s Investment Plan for Europe ('Juncker Plan') from 2015), and in particular the European Green Deal (EGD) with its main investment pillar 'European Green Deal Investment Plan (EGDIP)' and a 'Just Transition Mechanism'.

The new European Commission (EC) in 2019 (the von der Leyen Commission) was a key actor in driving the green agenda forward, focusing on the EGD (Belitz et al. 2021: 10). Financial resources are channeled into climate-friendly policies (Pianta et al. 2020: 783), with the European Investment Bank (EIB) assuming a key role in distributing various sources of funding, similar to the German KfW Development Bank ('Kreditanstalt für Wiederaufbau') at the national level (ibid.: 785). The EIB's focus has simultaneously changed over the years. After starting with regional development projects in economically weaker areas in the 1950s and 1960s and promoting energy independence in the 1970s, the EIB supported liberalization and privatization policies by investing in cross-border infrastructure projects in the 1980s (Clifton et al. 2018). For the coming decade, the EC intends to transform the EIB into a 'climate bank' (Pianta et al. 2020: 783). Furthermore, new actors such as the European Innovation Council (initiated in 2015 and launched in 2021) tasked with identifying next generation technologies and their commercial dissemination (see Belitz et al. 2021: 10), reflect an increasing engagement by policymakers in the development and commercialization of high-risk technologies. Thereby, the notion of filling gaps of private funding and hence market failures due to high uncertainty or large-scale investments emerge (Pianta et al. 2020: 785).

Simultaneously to the rise of GIP, the return of industrial policy included an 'industrial revival' by digitizing the European Industry due to the "new industrial revolution, driven by new generations of digital technologies" (European Commission 2016). This provided leeway for *digital industrial policy* (DIP) as Europe's digital sector was relatively small, fragmented and lagging behind in competition. Arguing that some issues such as standardization and volume of investment can only be dealt with at the EU-level, the EC reclaimed regulatory

competence and aimed at scaling up national or regional initiatives such as 'Industrie 4.0' in Germany, the 'Smart Specialisation' approach or bottom-up inter-regional initiatives (European Commission 2016; Gruber 2018).

Thus far, the focus of the EC was on supporting strategic (digital) infrastructure by means of subsidies from regional development funds or the Connecting Europe Facility. Yet, the nature of the digital industry calls such traditional industrial policy into question. First, the change towards intangible goods, services, and knowledge requires the focus of DIP to shift to the intangible asset base of digital GVCs and support until first industrial deployment. Second, digital markets competition tends to result in monopolistic structures and poses challenges to traditional competition policy including merger control and state aid[3] (Gruber 2018).

As a result, DIP gained political support with an increased focus on digital services. This led to several industrial policy programs and initiatives for the digital economy, most prominently the 2016 EC Communication 'Digitising European Industry' to be realized by the Digital Single Market (DSM) strategy and accompanied by the Communication on the European Cloud Initiative, the Communication on Priorities for ICT Standardisation and the E-Government action plan. The DSM aimed at establishing a coherent policy framework building on initiatives like the Investment Plan for Europe, the Energy Union, and the Single Market Strategy (European Commission 2016; Gruber 2018:2).

Prior to the pandemic, EU industrial policy was characterized by a supply-side focus, fragmented programs, and a lack of applying additional (public financial) resources to industrial policy programs whose focus has centered on cohesion funds and regional levels. Overall, industrial policy still "remains too narrow in scope" as exemplified by the conceptual basis of most EU programs (Pianta et al. 2020: 781-782). Joint and large-scale supranational industrial policy projects to support the development of European champions have been lacking.[4] With regard to the automotive industry in the EU, Pichler et al. (2021: 149) criticize a "reliance on innovation rather than exnovation policy" and an "ecological modernization through efficiency and low-emission technologies" instead of transformative industrial policies[5]. Digital industry policy on the other hand would require a broader strategy reiterating its focus on IT services and targeting wide-reaching upgrading of digital capabilities and the dissemination of Web-based activities, ICT production and knowledge while also addressing associated social and employment risks (Pianta et al. 2020: 790). Nevertheless, there is an "emergence of new global norms in favor of a more developmental role of the state" (Wade 2012) and hence a more active-interventionist role of the state allowing vertical industrial policy. For example, Staab and Piétron (2020) identify the emergence of a decentralized development state conditioned by national path dependencies in the field of AI in the USA, China and in Germany.

[3] For example, in 2022, the EU introduced the Digital Markets Act (DMA) and the Digital Services Act (DSA) to regulate the power of dominant online platforms (`gatekeepers´) complementing competition policy.
[4] Airbus is probably the only exception (Pichler et al. 2021: 143).
[5] Transition refers to an ecological modernisation reflecting a simple switch to e-mobility whereas a transformation includes more profound changes such as changed mobility concepts.

Following the blocked Alstom-Siemens[6] merger by the EC in 2019, the former Minister for Economic Affairs Peter Altmaier, together with his French counterpart, demanded reforms of EU industrial and competition policy as stated in the "Franco-German Manifesto for a European industrial policy fit for the 21st Century"[7]. This turn of the traditionally ordoliberal German government was enabled by a fraction within the German 'power bloc' reflecting "growing divisions within German capital over how to react to increasing geopolitical rivalries and technological decoupling between the USA and China" (Schneider 2023:242). According to Schneider (2023: 250-252), an ordoliberal-defensive group[8] opposed such reforms. In contrast, a world market-oriented-strategic group (the Federation of German Industries (BDI) and other business associations such as Deutsche Telekom or Siemens) remains biased yet supports these while the social democratic-interventionist group (main trade union organizations, think tanks and the German Social-Democratic Party) strongly supports these (ibid.). This turn by the German government was an important pre-condition for triggering a paradigm shift of the predominantly horizontal and 'technology-neutral' paradigm leaning towards more vertical industrial policy at the EU-level (Gräf/ Schmalz 2023).

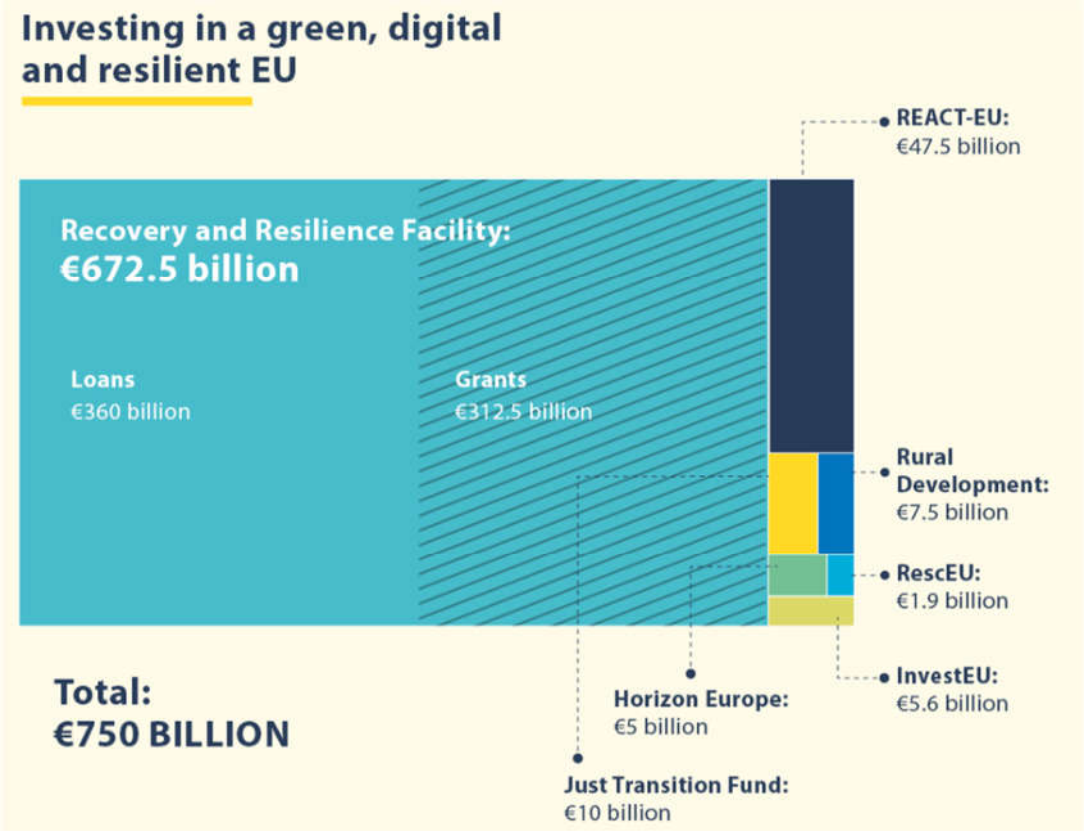
2.2 Changes to industrial policy due to the Covid-19 pandemic

The EU allowed massive state intervention into economic processes and coordination of the market as part of its crisis management (Meunier/ Mickus 2020: 1077). The EU's recovery instrument 'New Generation EU (NGEU)'[9] (see Figure 1) totaling EUR 750 billion (2021-2026) in addition to the regular 2021-2027 budget of the EU's Multiannual Financial Framework (MFF), pushes for a 'green transition' (environmentally friendly technologies, vehicles, and public transport) and a 'digital transformation' (5G, AI and digital identity). Following the approval of Germany's Recovery and Resilience Facility (RRF) plan by the Council of the European Union in July 2021 and of the updated plan in February 2023, thus far RRF grants worth EUR 2.25 billion were disbursed to Germany from which 47% were channeled to green transition and 53% to digital transformation (European Commission 2023a) - putting the automobile and IT services industry as beneficiaries into focus. In addition, the original InvestEU[10] (2021-2027) proposal, the successor program to the EFSI of the Juncker EC, was expanded in spring 2020 to better respond to the Covid-19 crisis (see Figure 1). This included doubling the funding for the policy area 'Sustainable Infrastructure" up to EUR 20

[6] The EC blocked a merger of the two leading European railroad technology providers, Siemens (Germany) and Alstom (France), due to competition concerns and distortive effects within the EU market. The aim was to create a European champion in the rail transport sector, which is able to compete with global competitors.
[7] See: https://www.gouvernement.fr/sites/default/files/locale/piece-jointe/2019/02/1043_-_a_franco-german_manifesto_for_a_european_industrial_policy_fit_for_the_21st_century.pdf
[8] This groups comprises "business associations [representing] the Mittelstand, such as the Federal Association of Mittelstand-Businesses (BVMW) or the association of family enterprises (Die Familienunternehmer), the mechanical engineering association (VDMA, at least to some extent), the (neo-)liberal party FDP, parts of the conservative parties (CDU/CSU), the majority of state-affiliated economic think tanks (such as the Munich-based ifo, the Kiel-based IfW or the Council of Economic Experts in its majority position) as well as the American Chamber of Commerce in Germany" (Schneider 2023:259).
[9] The NGEU is the second rescue package following the first package that encompassed credit assistance in the amount of EUR 540 billion next to European Stability Mechanism credits for health costs, the national short-term work programs SURE by ECOFIN, and the EU guaranty fond by the EIB.
[10] The InvestEU fund is backed through an EU budget guarantee by the EIB and further financial partners.

billion and adding the new policy area ‘Strategic European Investment" with a budget worth EUR 31 billion (both programs together are 0.38 of total EU27 GDP in 2020) aimed at the promotion and securing of the newly proclaimed goal of “open strategic autonomy” in key sectors (Belitz et al. 2021: 10).

Figure 1: Allocation of Next Generation EU funds



Source: Council of the EU and the European Council (2022a)

These increasing *active-interventionist* measures were complemented by *sector-specific* regulatory approaches before and during the pandemic reiterating the focus on sustainability and the digital decade. Directly targeting the automotive sector, the EC pushed for partly transformative policies by allowing member states to use NGEU funds to support the automotive industry according to own national preferences under the condition that these are compatible with the decarbonization goals set out by the EGD. This utilization adds to pro-environmental policies set by the EC in support of already ongoing sectoral transformation processes within the automotive industry, accelerating the transition to electro mobility. The increasingly strict vehicle emission standards concern the ‘Euro’ tailpipe-emission norms (since 1992) and the CO_2 fleet-wide emission targets (since 1998) which were at first voluntary and later mandatory (Lechowski et al. 2021). As part of the ‘Fit for 55’ package - a set of legislative proposals to reduce the EU’s greenhouse gas emissions by at least 55% by 2030, the European Parliament (EP) and the Council of the EU agreed on stricter CO_2 emission targets for new cars and light commercial vehicles upon an EC proposal in 2022. New cars have to

reduce their CO_2 emissions by 55% by 2030, and new vans by 50%. By 2035, reduction targets are 100% compared to 2021. This is a de facto ban of the conventional internal combustion engines (ICE)[11] (Council of the EU and the European Council 2022b).

Similar to the EGD, the EC has started to embrace 'Europe's Digital Decade' in the wake of the pandemic targeting a 'post-pandemic' world. The 2021 EC Communication 'Path to the Digital Decade' (which builds on the EC's 2020 Digital Strategy and is expanded by the 2022 EC's internal Digital Strategy 'Next Generation Digital Commission') sets out digital targets for 2030. Multi-country projects will be implemented in areas with strategic dependencies and lacking capacities such as 5G communication, secure quantum communication, blockchain, low-power processors, high-performance computing and digital skills. This reflects increasing political support for the IT services industry. Investments shall not only stem from the private sector, but also from member states and the EU budget. In addition, each member state must contribute 20% of its RRF funds to the digital transition (European Commission 2023b). EUR 250 billion of the NGEU shall be channeled to the area of digitization. Furthermore, the new funding program Digital Europe Programme (DIGITAL) was introduced with a budget worth EUR 7.5 billion (as part of the MFF 2021-2027), a main work program worth EUR 909.5 million for data, AI, cloud, advanced digital skills (2023 – 2024) and a work program on cybersecurity with a budget of EUR 375 (2023 and 2024) (European Commission 2023c).

Apart from specific crisis programs, the EC issued a new Industrial Strategy in 2020, which collided with the outbreak of the Covid-19 pandemic. In May 2021, the EC presented an updated version, which incorporated learnings from the pandemic. This was preceded by demands by members of the EP to design industrial policy in support of the recovery. In line with the recovery programs, the updated strategy centers on three dimensions reflecting the 'twin transition': ecological change, which refers to the modernization and decarbonization of energy-intensive industries, and digital transformation and leadership. The third and additional component 'global competitiveness' entails the lesson learned from the pandemic to create less dependent GVCs in future markets and strengthening Europe's 'strategic autonomy' for critical infrastructure and future technologies (see Belitz et al. 2021: 9-10).

This 2020 Industrial Strategy marks a new phase in industrial policy. It continues to support new industrial alliances (see Appendix A.1.) in areas in which innovations by the market have failed to materialize such as the Alliance on Processors and Semiconductor Technologies, the Alliance for Industrial Data, Edge and Cloud, and Zero Emission Aviation, but has changed to an ecosystem-based monitoring approach of 14 industrial ecosystems, among others 'digital', 'mobility-transport-automotive', 'energy intensive industries' and 'energy-renewable' (European Commission 2021a). As part of the crisis management, there were novel changes to competition policy such as the temporary suspension of state aid controls and the adoption of the 'State aid Temporary Framework'. This allowed member states to issue, among others, massive state aids in forms of direct grants, selective tax advantages, and guarantees on loans (Meunier/ Mickus 2020: 1077-1080). In addition, competition rules are subject to a major review (European Commission 2021a) with major implications for industrial policy beyond the Covid-19 crisis.

[11] Close to the resolution, the German minister for Transport Volker Wissinger from the Liberal Free Democratic Party (FDP) initiated a debate to allow e-fuels of combustion engines.

Nonetheless, current EU competition policy allows for Important Projects of Common European Interest (IPCEI). IPCEIs, partly building on industrial alliances, are cross-country industrial policy projects carried out and co-financed by national governments and participating firms in accordance with EU state aid law. The focus lies on investments in disruptive research and developing new technologies up to first industrial deployment.[12] Thereby, IPCEIs make maximum use of and bypass limiting EU state aid regulation to horizontal industrial policy while addressing competition policy concerns[13] (Gräf/ Schmalz 2023). IPCEIs became the key strategic instruments for the implementation of the new and updated European Industrial Strategy.[14] With innovation projects of this kind, the EC and participating states set technological priorities targeting important market failures or societal challenges. This reflects more coordination of the market at the (supra-) national level initiated by policymakers (Belitz et al. 2021: 9-10).

In contrast to temporarily limited crisis management programs, IPCEIs run beyond the Covid-19 pandemic. Reflecting the EU's in-depth review of strategic dependencies (European Commission 2021b) in the areas of raw materials, batteries, pharmaceutical ingredients, hydrogen, semiconductors, and cloud and edge technologies, six IPCEIs have been implemented relevant to the automotive and IT (services) industries (see Table 1).

Table 1: Overview of IPCEIs

IPCEI	**Start**	**Public Funding from member states** (approx. numbers)
Microelectronics I (Semiconductors)	2018	EUR 1.75 billion (GER, FRA, ITA, UK) + EUR 146.5 million (AUT)
IPCEI on Batteries (I)	2019	EUR 3,2 billion (BEL, GER, FIN, FRA, ITA, POL, SWE)
IPCEI European Battery Innovation (EuBatIn) (II)	2021	EUR 2,9 billion (from 12 member states including GER)
Next Generation Cloud Infrastructure and Services (IPCEI-CIS)	2021	EUR 0.75 billion (GER)
Hydrogen (IPCEI Hy2Tech)	2021	EUR 3 billion (GER)
Microelectronics II (Semiconductors)		(planned) EUR 3 billion (GER) also receives funding from RRF

Source: Author's own depiction.

Similar to the GFC, the Covid-19 pandemic has once again fueled industrial policy dynamics at the EU-level. A continuation of the 'mixed approach' (Landesmann/Stöllinger

[12] This refers to upscaling pilot facilities following the pilot line and R&D phase before mass production or commercial activities.

[13] To qualify as an IPCEI in accordance with Article 107(3)(b) TFEU, projects must contribute to the strategic objectives of the EU, receive private funding by the beneficiaries, contribute to positive spillover effects throughout the EU, be highly ambitious in terms of research and innovation, limit potential distortions of competition, channel back major parts of additional profits of the participating companies to the state through a claw-back mechanism, and disseminate results to the European scientific community and non-involved companies (see Belitz et al. 2021:9-10). IPCEIs must further involve several member states. The EC Communication (COM/2014/C 188/02) which established the eligibility criteria for IPCEIs, was revised to align the criteria with the goals of the 'twin transition' and expanded the minimum of involved member states from two to four in 2021.

[14] IPCEIs were first introduced before the Covid-19 pandemic and build on industrial alliances such as the European Battery Alliance (EBA).

2020:1) can be observed with an increase of the vertical dimension. Hence, there is a trend of reshaping the horizontal post Maastricht Treaty providing member states, such as Germany, more room for green and digital (industrial policy) support for the automotive and IT (services) industry covered by the 'twin transition'. State intervention in the forms of (massive) financial resources, a relaxation of state aid rules and selective industry support has increased which may last to some extent beyond the crisis. This is reflected in the direct response to the offensive US industrial policy 'Inflation Reduction Act'. In 2023, the EC presented a 'Green Deal Industrial Plan' (GDIP) including the Net-Zero Industry Act that addresses, among others, battery production. This GIP foresees a simplified regulatory framework by means of, for example, an amended 'Temporary State aid Crisis and Transition Framework' and increasing the notification thresholds of the General Block Exemption Regulation (European Commission 2023d).

3. Peculiarities of the German Economic Model: Brief Contours

The automotive and IT services industry have held a variegated position within the German economy. While the automotive industry has been highly competitive for decades, the IT sector gained relatively recent institutional connotation. Naturally, the two industries did not develop separately from the broader German institutional, economic, and historical framework. Therefore, a thorough examination of the industry-specific dynamics or state-targeted polices requires an understanding of the German economic model and its institutional ecosystem.

An export oriented economic model and high-skilled, high value-added manufacturing were distinctive characteristics of 'German Capitalism'[15] in the post-WWII period. Exports continue to occupy a central pillar of the German GDP, reaching 47.3 % in 2018 (Schneider 2023). This allowed Germany to maintain its international competitiveness for decades, but it did not occur automatically. In fact, the model only materialized because of carefully chosen industrial policies. Chang et al. (2013:25) argue that "the German model (*Modell Deutschland*), as Helmut Schmidt called it in the 1970s, was developed during the first two decades after the WWII thanks to an articulated package of industrial policies operating both at the national and regional (Länder and municipalities) levels". Kattel et al. (2020) note that the main challenge in the postwar Germany was to rebuild previously competitive manufacturing industries, with innovation and industrial policies predominantly focused on this goal.

With a historically grounded approach to the comparative political economy literature, (Streeck 2009) argues that Modell Deutschland has been disintegrating in the wake of neoliberal globalization. Concomitantly, the nature of industrial policy has been changing over time, following manifold institutional, ideological, political and geo-economic dynamics. Nevertheless, it is important to identify those central features that generated Germany's postwar economic success.

On one hand, the state supported heavy investments targeted towards key industries and technological innovations. On the other hand, a combination of multiple factors – such as cheap

[15] Streeck (1995). Also referred to as 'Rhenish capitalism' (Albert, 1993), or ordoliberalism (in Hassel 2015).

and long-term financing, a dual vocational training system, effective work councils and trade unions, as well as the participation of research institutions in the decentralized cluster creation – have led to the economic robustness. Additionally, institutions such as the German development bank -KfW - played a crucial role in shaping the country's industrial policy (Dünhaupt/Herr 2020). Since its establishment in 1948 the state-owned bank has supported fostering of German exports and provided continuous assistance to SMEs, or Mittelstand[16]. It played a key role in building up heavy industries such as airplanes, ships or "risky new markets where the large private sector banks were unwilling to lend" (Harries 1998, in Naqvi et al. 2018:677). KfW tied a small but important group of German firms to export financing, outward foreign direct investment (FDI) and development aid.

The power of the German economy rests on two main pillars: SMEs[17] and big industries. Herr and Nettekoven (2017) show the strategic economic position around 1300 'hidden champions'[18] of the SME sector have in Germany. The most important of which are the innovative types – or the "Schumpeterian SMEs" - creating multiple spillover effects in the economy. Hall (2015) notes that the institutional ecosystem of German SMEs is especially important for the manufacturing sector. The success of the postwar German economy furthermore depended on the educational system, high wages, social balance (Kattel et al. 2020) and organized civil society. The dual vocational training model based on theoretical and practical education resulted in a "workforce with high levels of industry-specific skills […] built on collaboration between trade unions and employer associations that are well-organized at the sectoral level" (Busemeyer/ Trampusch 2012, in Hall, 2015: 46). Other significant features characterizing the German model include non-market coordination (Hall and Soskice 2001) and cross-shareholding between firms (Goyer 2012, in Hall 2015), allowing them to monitor each other on the one hand, and support corporate networks on the other hand. The combination of competition and cooperation - or the "cooperative competition" – boosts innovation, productivity, and competitiveness among companies (Herr / Nettekoven 2017).

Germany's efficient science and research ecosystem[19] has been an integral part of the industrial production. For instance, the Fraunhofer Society has been closely linked to the Mittelstand in the manufacturing sector since its establishment in 1949, benefiting companies' "growth in turnover and productivity" (Kattel et. al 2020:21). As such, Germany's innovation and industrial policies are characterized by close regional alliances between industries and public research institutions - as argued by Kattel et. al. (2020:29-30): "these alliances are oriented towards generating new knowledge and diffusing it among stakeholders. Such stealth industrial and innovation policies focus on incremental innovations and is biased towards stable growth over a long period of time".

[16] The German definition of SMEs is different from the one of the EC. Many companies that exceed the SME threshold of the EU still define themselves as Mittelstand in Germany (BDI March 2021). Some of the most important features of Mittelstand are: family ownership and coordinated networks.

[17] Based on several statistical data, Herr and Nettekoven (2017) show that 99.6% of all German firms were SMEs in 2015, contributing around 60% of all jobs. They constituted about 54.9% of net value added and have generated 47.0 % of gross value added in the same year.

[18] Herr and Nettekoven (2017: 6) characterize hidden champions as "companies that are among the top three companies in their field worldwide, with around 70 to 90 per cent of the global market share, and that have highly specialised products or services, strong innovative power and strong export performance, yet are largely unknown to the public".

[19] Max Planck Society, Helmholtz Association, Leibniz Association, Fraunhofer Society, etc.

3.1 A 'Golden Child Syndrome'? Contextualizing German Automotive Industry

A key position held by the automotive industry within this economic and institutional set-up cannot be overemphasized. The remarkable success of the industry that was prevalent even after the 2007 financial crisis - as described by Krpata (2021) - was accomplished through three strategies: the leverage of the European single market[20], utilization of economic globalization and re-orientation on emerging markets, namely China, and the protection of high value-added in Germany. The industry substantially contributes to German exports - VDA (2020) notes that 75% of cars produced in the country were destined for exports in 2019. Germany is home to 43 Original Equipment Manufacturer (OEM) plants (in the car industry final producers) with a car supply industry consisting of almost 900 companies. Together they employ around 809,000 people with a turnover of more than EUR 80 billion per year (VDA 2020). 85% of the total suppliers are medium-sized SMEs / family-owned companies and provide 75% of value-added domestically.

It is important to embed the understanding of the industry's success a) in the context of the German Model, which – among other features - was based on a continuous provision of the high value-added manufacturing at home; and b) to contemplate broader institutional dynamics that characterized the postwar Fordist period: active industrial policies, heavy and targeted investments in R&D and technological advancement. Chang et al. (2013: 26) argue that "from the mid- 60s until the mid- 70s Germany's investments in basic science and industrial research tended to be sectoral and technology-targeted". Latter institutional, socio-economic, geopolitical and historical peculiarities provide an ample framework for comprehending a special position acquired by the auto industry. Nevertheless, looking through the prism of a critical state theory, a strand in the academic literature suggests that powerful sector-related actors, lobbyists and associations have played an increasingly important role in shaping, influencing and maintaining strong position of the auto industry in Germany (Germann 2022; Schneider 2023).

Meckling and Nahm (2017:5) argue that the 'corporatist' character of the German institutional governance structures where "industry and government coordinate technological transformations in consensus-driven negotiations", can limit the capability of the tactical sectoral transformation. The authors note that the 'corporatist' model often prioritizes the needs of incumbent firms - who benefit from the existing technological regime - over progressive policies. This became evident in the late 2000s when the urgency to revamp quintessential driving methods materialized. The German auto industry proved to be too rigid to transform while the government continuously backed the industry and zealously argued against the EU's mandatory CO2 emissions regulations for passenger cars (also see chapter 2); "Germany, fiercely opposed the design and stringency of the standards, considering them a direct threat to its premium carmakers" (Meckilng and Nahm, 2017:16). Krzywdzinski et al. (2022) show that the automotive industry has relied too long on its competitive advantage in the ICE technologies and has been reluctant to transition to electric vehicles (EVs). Furthermore, the country's industrial policy aiming at R&D of hybrid and electric cars, and battery cell

[20] Including the relocation of cost-cutting, low value-added activates to Central and Eastern European countries.

production was marginal[21] during the 2000s. A "high degree of coordination between the federal government and incumbent auto producers stalled technological change in favor of existing combustion technologies" (Meckling and Nahm 2017:3). On the other hand, Germann (2022) shows that while the controversial 'National Industrial Strategy (NIS) 2030'[22] received fierce opposition from the industry in 2019, some of its central policies were nevertheless put forward. This demonstrates state's ability to navigate different social interests while maintaining 'relative autonomy'- famously theorized by Poulantzas (1978).

3.2 IT Sector and a Changing Character of Innovation Policy

The German IT industry is heterogeneous, and it consists of hardware, software, and IT services (Statista 2021). Due to the growing significance of cloud services[23] and computing, AI and digitalization, this Section concentrates on IT services and software. With around 95,800 companies[24] and over 1 million employees, Germany was considered the largest software producer in Europe in 2021 (ITA 2022). Though the sector is best characterized by the dynamic and highly specialized SMEs (GTAI 2020), big international companies such as Microsoft, Apple, Dell, Adobe, IBM, Oracle also have large market shares (ITA 2022). Increased business demand for smart data products and cloud services are driving the German software market growth. Yet, compared to other European markets there is a relative immaturity of the cloud market (GTAI 2020). The IT industry cannot be analyzed separately from the overall developments in digitalization or cloud computing, as they are deeply interlinked.

Unlike the automotive industry – where traditionally targeted policies were continuously implemented by state institutions[25] especially in the Fordist period - the IT sector and digitalization didn't receive similar policy support. This is linked to broader German and European political and institutional developments. The execution of interventionist industrial policies – particularly ones implicating state subsidies – became restricted in the Maastricht Treaty era. Namely, the EU competition policy was rather hostile toward the state involvement as "it enshrines neoliberal economic policy principles (specifically by constraining the policy space for discretionary industrial policy) in a supranational – hard and soft – legal framework which is largely detached from democratic accountability" (Schneider 2023: 249-250) (also see chapter 2.1.). As such, policymaking shifted to a horizontal approach that aimed levelling out market failures predominantly in education, innovation, and R&D. Naqvi et al. (2018) argue that Germany continued using vertical industrial policies to a certain extent – for instance when developing renewables sector in the 2000s – however, "these forms of industrial policy played a subordinate role compared to Germany's 'stealth', pre-dominantly horizontal and

[21] For detailed analysis, see Meckling and Nahm (2017).

[22] Initiated by minister Peter Altmaier in 2019 - in the wake of growing competition from China (and protectionist US), NIS 2030 sought to reduce external dependencies, especially in the key fields of technology and battery cell production.

[23] Off-site (shared or private) pool for storage of big data, services, networks, applications; increasingly used by governments, banking sector and finance, healthcare, education.

[24] Hardware and software

[25] For example, in 2009 German government introduced an 'environmental premium' for automobiles. Officially, it was a measure of environmental protection. In reality, the premium was direct support for the automotive industry in the aftermath of the global financial crisis. After the outbreak of the Covid-19 pandemic, the industry demanded similar support programs among others in the context of the "Autogipfel" yet remained unsuccessful this time.

technology-open innovation policy approach" (Kattel et al. 2020 in Schneider, 2023:254). This does not negate the importance Germany paid to the development of advanced products and services, but in terms of innovation policies, the approach was rather universal and diffusion- rather than mission-oriented (Kattel et al. 2020). Moreover, while traditionally technological innovations have been the forte of the German economy, there has been a high concentration in manufacturing, particularly the automotive sector. GTAI (2022) shows that nine out of the country's top ten patent filing companies are in the automotive industry. Similar to the analysis undertaken for the automotive industry, it helps to understand idiosyncrasies of the IT sector in the context of the wider institutional framework.

One of the largest innovation programs, the High-Tech Strategy 2025 (HTS) was introduced in 2018. The goal of the HTS 2025 was to: "show how Germany can use research and innovation to shape its future. It aims to provide orientation for all the players involved" (BMBF 2020). The long-term objective of the HTS 2025 was to target the start-up scene in Germany along with fostering innovation across sectors. Catch phrases such as: "Strengthening entrepreneurial spirit", "Digital Hub Initiative", or "Business Incubation Centers" was often used (*ibid*. p.53). Even though the HTS 2025 offered some concrete measures[26], the overall policy approach was horizontal and in line with the 'stealth' industrial policy (Kattel et al. 2020) – it "created conditions" and "provided orientation" by increasing spending in education and R&D[27]."It [*HTS 2025*] functions mainly as an inter-ministerial coordination instrument in order to provide better alignment between the existing, largely diffusion-oriented science, technology and innovation policies and industrial landscape, and socio-economic challenges. It is very much a "missions-light" approach" (Kattel et. al. 2020:27). Additionally, as part of the HTS 2025 two noteworthy agencies were formed: the Agency for Innovation in Cybersecurity and the German Agency for Disruptive Innovation (SPRIN-D).[28] Interestingly, SPRIN-D was launched only in 2019 whereas the US counterpart exists since 1958.

4. Automotive and IT Industries at the Crossroads of Changing Global Dynamics

Schneider (2023) has argued that the postwar export oriented German economic model is reaching its limits and new policy priorities are emerging with the backdrop of shifting geopolitical and economic dynamics. How are these adjustments reflected in the discussed two industries?

Currently, the German auto industry is confronted with a multifaceted crisis due to a) the re-orientation and expansion of the industry into China after the global financial crisis which has intensified dependence on the Chinese market; b) increasing demands for clean and green production. Pressure is especially high because as Krzywdzinski et al. (2022) and

[26] For instance, tax incentives for private R&D investments. The Law on Tax Incentives for R&D was passed in 2019.

[27] In the coalition agreement forged between the CDU, CSU and SPD, it was agreed that a total of EUR 2 billion would be provided from 2018 to 2021 to achieve the 3.5% (of GDP) target incrementally (EFI 2019).

[28] It was created as part of the innovation policy in fields of AI and healthcare. It aims to develop a European Super Cloud (cloud infrastructure).

Meckling / Nahm (2017) show the industry has neglected the development of alternative drive technologies for a long time, instead focusing on optimizing the ICEs; and c) semiconductor and microchip shortages created by the coronavirus lockdown. Considering overall trends, the following trajectories can be observed: 1) German car manufacturers are faced with the inevitability of a shift to electric mobility; caused by the government (also see Chapter 2), civil society as well as foreign competitors such as Tesla. The demand for battery cells is rising, but battery cell production is barely occurring in Germany[29]. Rather, most of the production happens in China - currently leading the race in lithium-ion cell manufacturing, accounting for around 70% of total production worldwide (Coelho 2021). 2) German car manufacturers are also dependent on international firms for data management: "Some companies, such as the GAFAM[30], have an advantage in data processing. […] As a result, German car manufacturers are under increasing pressure from new oligopolistic digital players in making their own way into mobility services" (Krpata 2021: 19). 3) The volatility of global supply chains, now fully unveiled by the pandemic, poses a serious challenge to the pre-Covid structures of production and the previously existing forms of OEM-supplier interactions. German car manufacturers are seeking ways to reduce external dependencies; for instance, by reshoring activities domestically and realizing in-house production of battery cells. Transition to the new forms of car production and the initial uncertainties accompanied by it will be predominantly felt by the smaller suppliers and lower-tier subcontractors, as they are highly specialized in niche areas of the ICE cars. In September 2020 Deutsche Welle was reporting that the SMEs and car-parts suppliers were worst hit by the pandemic; this came in addition to the existing complications caused by the shift to electro mobility production (DW 2020).[31] SMEs were demanding more time to adapt to technological changes and more state aid in R&D.

Contrasting tendencies are found in the IT industry. The Covid-19 lockdown has amplified the demand for software technologies and cloud services both in Germany and globally. According to GTAI (2020), global spending on cloud infrastructure has increased by 34 percent in the first quarter of 2020. Yet, Germany has been behind on the latest digitalization processes. Even though the necessity for digitalization was acknowledged - for instance, the 'Online Access Act (OZG)'[32] was passed by the Federal Government in 2017 - the overall digital transformation has been slow. Bitkom (2022) notes that the biggest constraint to digitization for many German companies (70% in 2020) is the high level of investment needed. According to the European Investment Bank's study (2021) Germany's Corporate Digitalization Index is only moderate. Additionally, the sector is a slow mover in disruptive innovations and is highly dependent on global players[33] in cloud manufacturing. Klös (2020: 17, authors' own translation) notes that the main dynamics that lead to the emergence of new companies with "game changer" potential are not happening in Germany. Furthermore,

[29] Chinese CATL started EV battery cell production in Thuringia in 2022.
[30] Google, Amazon, Facebook, Apple, Microsoft
[31] Market leader Bosch announced that it will cut thousands of jobs, while Germany's second-largest parts maker Continental plans to save EUR 1 billion every year by reducing its headcount by 13,000 beginning in 2023. At ZF Friedrichshafen, the third-largest German auto supplier, some 15,000 jobs are in danger (DW 2020).
[32] The OZG obliges the Federal Government, the Länder and local authorities to offer their administrative services electronically via administrative portals.
[33] Amazon (Amazon Web Services), Microsoft (Azure), Google (Google Cloud Platform) and Alibaba held the largest share in 2019.

Bitkom's research (2021) found that 8 out of 10 German companies feel they are too dependent on importing hard- and software IT communication devices from abroad and 68 % depend on foreign AI services. This trend demands a rather shrewd approach considering that international counterparts such as the USA or China are ahead in terms of implementing industry-wide digitalization processes.

Importantly, the new dynamics occurring in the two industries are interlinked. For instance, software technologies and the IT industry – especially high-skilled software developers and engineers - have become an integral part of electric mobility. There has been a shift in the understanding of cars as 'products' to 'mobility services' (Krpata 2021). This entails the increasing importance of digital data collection and exchange (e.g., for navigation, connectivity, or maintenance) which on the other hand, requires a sizeable cloud infrastructure. Battery cell production will restructure traditional forms of manufacturing. Electric car engineering needs fewer components, and it is less labor-intensive: "by automating production, fewer workers are needed on the conveyor belt, but more in plant programming and control. Costly retraining is required" (VDA 2020: 24).

5. Tracing Roots of Shifting Policy Priorities in Germany

For valid reasons, the automotive industry holds a distinctive position in the German economic model. It is highly competitive yet vulnerable to technological change and global economic and trade dynamics. While traditionally it has received manifold state assistance and support, the interests of the industry-related actors and social groups have not always been in harmony with the broader societal goals (such as halting the 'twin transition' of the sector). Did the pandemic affect these dynamics or were there other underlying reasons?

The main argument is that the shift in German policymaking towards more selective and vertical industrial policy unfolded before the pandemic. For instance, Germann (2022) and Schneider (2023) meticulously depict[34] that growing competition from China, China -US trade rivalry and Germany's excessive industrial and technological dependence in key areas led to the shift which can be traced back to the NIS 2030. Proposing tighter FDI controls, formation of 'national and European champions' and a move away from "the horizontal, 'technology-neutral' approach that has dominated German industrial policy to date" (Schneider 2023: 249), NIS 2030 embodies the beginning of the industrial policy re-formulation in Germany. Importantly, NIS 2030 is an attempt to confront "the long-standing tension between industrial policy and EU competition law – thereby challenging a key component of the EU's new-constitutionalist economic architecture as it emerged in the 1980s" (ibid.). Perhaps not surprisingly, yet interestingly, the automotive and IT industries had opposing positions regarding the Strategy. Schneider (2023) argues that it was division between the Mittelstand and big industries over the question on how to deal with the Chinese competition, that created internal conflicts of interest. Germann (2022) depicts that SMEs in the electronics sector (the author includes IT software in this category), and big auto industry firms had contrasting

[34] Primary interest of both articles is the scrutiny of positions and interest that characterize different capital fractions of the German export 'power bloc'.

approach to the NIS 2030. Considering the 'protectionist' character of the document, the auto industry feared Chinese retaliation, which would imply the loss of the Chinese market access and its commercial benefits; the IT sector predominantly comprising of SMEs, less dependent on China but exposed to big US digital players, was more in favor of such measures.

The Covid-19 pandemic - revealing and deepening previously existing crisis concomitantly experienced by both industries - was used as a window of opportunity to institutionalize policy re-orientation. While the attempt to execute more vertical industrial policies have been made previously - in the name of the NIS 2030 - the state was not able to achieve consensus between different industrial stakeholders[35]. NIS 2030 remained a highly contested initiative politically and was "partly 'defused' in a process of compromise building within the German power bloc" (Schneider 2023:254). It was only during the pandemic that the shift in policymaking became possible. Kattel et al. (2020:40) find that with the Covid-19 response "Germany has taken another step; it is at the forefront of taking bold policy action reshaping the economy in the face of the pandemic". The authors suggest that there is a momentum for the policymakers to retract from diffusion-oriented innovation policies characterizing the pre-pandemic period.

5.1 Policies introduced during the pandemic: beyond immediate relief

The exigency of cleaner mobility and digitalization existed in Germany in the pre-Covid reality. Covid-19, however, intensified the urgency of the change. It unveiled the necessity of accomplishing the so-called 'twin transition' fast. Moreover, the dependence on GVC, strategic raw materials, and foreign digital players was fully problematized in the aftermath of the pandemic. Against this backdrop, a visible re-orientation of the policymaking to more proactive and targeted initiatives can be found inside the "corona funds" (Table 2).

[35] For more detailed analysis, see Schneider (2023) and Germann (2022).

Table 2: Policies implemented during the Covid-19 pandemic

Selected Programmes and Initiatives	Targets	Measures	Amount	Timeframe
Temporary Aid Programs (Phases: I, II, III, III Plus, IV) ***Überbrückungshilfe*** → in accordance with EU state aid rules	companies, self-employed persons and freelancers in all sectors	Immediate aid	Case-by-case	Various phases
The Economic Stabilization Fund (ESF) ***Wirtschaftsstabilisierungsfonds (WSF)*** → enabled by the EU State Aid Temporary Framework	companies in the real economy whose insolvency would have a significant adverse impact on the German economy or labor market	Federal guarantees for loans, including credit lines, and capital market products (borrowed capital)	originally had a total volume of EUR600 billion. As part of the WSF extension, the total size was adjusted to EUR 250 billion as of 1 January 2022.	March 2020 - June 2022
Economic Stimulus Package (ESP, *Konjunkturpaket)* and Future Package *(Zukunftspaket)*	Companies, households, municipalities	Tax reductions, Bridging aid program (up to EUR 25 billion) for SMEs	EUR 130 billion	From June 2020 onwards
	particular investment in research, environmental protection, mobility, digitalization and healthcare	Support for mobility, AI, Digitalization. Sector-specific		
Multiple KfW programs → enabled by the EU State Aid Temporary Framework	Instant loans to SME's. Expanding its credit offerings and guarantees for all sizes of firms, credit insurers and non-profit institutions	KfW was key to the Government's strategy, particularly in terms of the ESF	EUR 757 billion (IMF 2020)	From March 2020

Source: authors' own illustration based on the data by Deutsche Finanzagentur, BMWK, BMBF, KfW

Initiatives such as the Economic Stabilization Fund (ESF) and Economic Stimulus Package (ESP, Konjunkturpaket) included bridging aid programs, targeting immediate recoveries of the companies, among which were car manufacturers and perhaps more importantly, suppliers. For example, according to Deutsche Finanzagentur, car-parts supplier A-Kaiser GmbH received state aid in the amount of EUR 12.5 million in January 2021. In April 2020 Reuters reported that among others, auto supplier Leoni was going to obtain a multi-million-euro loan, 90% of which would be guaranteed by the federal government and the state of Bavaria. The "Automotive Industry Future Fund" that was created as part of the stimulus package (Krzywdzinski et al. 2022: 14) will focus on the sectoral SMEs and will support them in the

areas of digitalization, battery cell and electric motor production. The fund also entails adaptation and training mechanisms for the employees. Brunkow (2020/online) notes that "it was thus right for the German government to help the predominantly SME supplier industry with its economic stimulus package at the height of the crisis, and to provide funds to support the transition to even more sustainable and climate-friendly mobility".

Important instruments included in the ESP and Future Package go beyond recovery goals and pursue 'twin transition'. There are 57 individual measures integrated in the package (Dorn et al. 2020). For instance, Lechowski et al (2023:8 *forthcoming*) note that generous funds (around 8 billion euros) were mobilized for the automotive industry "intended to stimulate the "structural change" towards environmentally friendlier technologies in the sector". This implied the amount of EUR 9,000 for purely electric vehicles, and EUR 6,750 for plug-in hybrids[36] at a maximum net list price of EUR 40,000. Above a net list price of EUR 40,000 up to a maximum of EUR 65,000, an environmental bonus of EUR 7,500 is granted for purely electrically powered vehicles, and EUR 5,625 for plug-in hybrids (VDA 2020). Krzywdzinski et al. (2022: 3) note that while the dieselgate scandal was a turning point, the Covid-19 pandemic created a window of opportunity for the automotive industry to reorient its strategies and "the state responded with a massive economic stimulus program to promote and facilitate the transition to electric mobility". Furthermore, the proposal intends to diversify renewable energy sources. With the adoption of the draft on "National Hydrogen Strategy", the Federal Government established a framework for the future generation and the usage of hydrogen. In order to advance hydrogen production and rollout necessary technologies, a total of EUR 9 billion was allocated with the Future Package (Huber 2021).
Some of the additional measures and subsidies entailed in the ESP and Future Package (Dorn et al. 2020) include:

- Fleet renewal of buses, trucks, aircraft and ships to reduce the environmental damage
- 5 billion EUR equity to railway modernization, electrification, and expansion
- R&D in the field of electro mobility, new charging points and battery cell production
- Auxiliary funds for small municipalities
- Tax reduction for companies in R&D and investment
- Trainee bonus program for SMEs to maintain the number of training places
- Energy-efficient building refurbishment

While there were no Covid-19 policies specifically targeting the IT sector as such, generous funds mobilized under the Future Package will inevitably involve the industry. For instance, the nationwide rollout of 5G- and 6G-technology, digitalization, fiber-infrastructure, and investments in future technologies such as AI and quantum technology will be supported with EUR 16 billion (Latham / Watkins 2020). Additionally, structural changes occurring in the German automotive industry will entail the increasing role of software technologies, hence the IT ecosystem. For instance, large car parts suppliers such as Bosch are heavily investing in developing new technologies "which will be of critical importance for the production of electrified and IT-intensive 'next generation' vehicles" (Krzywdzinski et al. 2022: 9).

[36] Government incentives for plug-in hybrids ended in December 2022.

Moreover, Krzywdzinski (2021:528) argues that a shift in the workforce structure is already happening "and the share of engineers and computer scientists is rising sharply".

Taking overall developments into account, policy interventions introduced during the pandemic correspond to the challenges affecting the two industries (outlined in Chapter 4). Importantly, the measures are geared toward long-term goals in the context of 'twin transition'. Being in the middle of a critical structural transformation, the automotive industry gets special institutional attention, yet the IT sector and wider digitalization trends become important pillars of German policymaking.

Conclusion

Prior to the pandemic, both Germany and the EU were confronted with quickly changing dynamics in the global economic, political, ecological and technological terrains. For example, supporting transition towards electric vehicles and battery cell manufacturing received a fairly recent significance in German policymaking. At the same time, horizontal innovation and industrial policies were distinctive characters of the broader institutional and political landscape of the post Maastricht Treaty period, anchored in EU legislation since the 1980s.

The multilevel crisis induced by the pandemic has altered this approach and intensified the urgency of rapid digital and green transition. The dynamic was equally influenced by the supply chain distortions, and an increased geopolitical competition on digital as well as EV markets. This affected the reshaping of EU industrial policy leaning towards more vertically oriented green and digital industrial policy. As part of the crisis management, there were massive state intervention in the form of additional financial resources, most notably the NGEU, and significant changes within competition policy. State aid regulation, which is in line with the horizontally oriented post Maastricht Treaty period, was temporarily suspended triggering debates on reforming competition policy beyond the crisis mode. In the meantime, IPCEIs represent a "vertical loophole" in the otherwise quite horizontal oriented treaties. These dynamics at the EU-level allowed member states more scope for action. In particular, Germany channeled these NGEU funds to the digital and green transition.

As a result, the recovery plans introduced by Germany and the EU during the pandemic embody more bold and targeted economic incentives that go beyond immediate relief policies. There is a transformation of the industrial policy model – from horizontal to more interventionist. This implies a reconfiguration of the role of the state towards a more active-interventionist state in support of the digital and green transition via industrial policy. State actors at the EU level are increasingly intervening and steering production processes beyond purely regulatory approaches aimed at actively shaping markets.

It's been argued that the re-orientation towards more vertical policymaking predates Covid-19 in Germany. Namely, incentives such as NIS 2030 sought to reduce external dependencies, especially in the key fields of technology and battery cell production back in 2019. However, this highly controversial document was not able to attain intra-industrial consensus. The Covid-19 crisis – divulging and intensifying existing conflicts - was used as a window of opportunity to institutionalize this type of industrial policies that address external

dependencies and tackle the on-going domestic challenges, especially in the direction of 'twin transition'.

The two sectors - automotive and IT services - examined by the paper have had different implications for Germany's economic model, at different times. While the automotive industry has been one of the central pillars of the Germany economy, the IT sector is gaining an increasing momentum in the era of digitalization and car industry electrification. This is evident from the simultaneous 'twin transition' envisaged by the EU. Next to sector-specific regulatory approaches, this 'twin transition' is further accelerated through green industrial policy, which is primarily relevant to the automotive industry and digital industrial policy, which has expanded its focus to IT services. This is reflected in concrete policy measures such as ESP and the Future Package introduced during the pandemic at the German member state level. However, whether the policies introduced in the context of the pandemic and the 'twin transition' are moving into the direction of a 'mission-oriented' (Mazzucato 2018) industrial policy, remains to be seen.

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Appendix

A.1. List of Industrial Alliances in the EU

- Alliance for Zero-Emission Aviation
- European Raw Materials Alliance
- European Solar Photovoltaic Industry Alliance
- European Clean Hydrogen Alliance
- European Battery Alliance
- Circular Plastics Alliance
- European Alliance for Industrial Data, Edge and Cloud
- Industrial Alliance on Processors and Semiconductor Technologies
- Renewable and Low-Carbon Fuels Value Chain Industrial Alliance
- Alliances on processors and semiconductor technologies
- Alliance for Industrial Data, Edge and Cloud

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