Socio-Economic Review, 2025, Vol. 00, No. 00, 1–22
https://doi.org/10.1093/ser/mwaf045
Article

OXFORD

Article

When does industrial policy fail and when can it succeed? Case studies from Europe

Angela Garcia Calvo [1,2,*] **and Bob Hancké** [3]

[1]Henley Business School, University of Reading, Reading RG6 6UD, United Kingdom
[2]WZB Berlin Social Science Center, Berlin D-10785, Germany
[3]London School of Economics and Political Sciences, London WC2A 2AE, United Kingdom

*Corresponding author. Henley Business School, University of Reading, Whiteknights, Reading RG6 6UD, United Kingdom. E-mail: a.garciacalvo@henley.ac.uk

Abstract

When does industrial policy succeed and fail in advanced economies? Most approaches to these questions concentrate on policy design and state power. Instead, we draw attention to the historical legacies, industrial structures, and institutional arrangements that shape industrial policy outcomes. We use insights from historical institutionalism and international business to develop a relational argument based on two first-order conditions: a critical mass of firms with sufficient capabilities to leverage the resources resulting from industrial policy, and the alignment between industrial policy goals and national institutional systems. Industrial policy could succeed, given the important second-order conditions that many have examined, when one of these conditions is present and public intervention produces the other. But industrial policy is certain to fail when both conditions are absent. Using a most different systems design, we assess our framework through short case-studies of industrial policy success and failure in Europe in the past 6 decades.

Key words: industrial policy; institutions; economic policy; growth; Europe; high-tech.

JEL classification: O25 Industrial policy, O38 Government policy, O43 Institutions and growth

1. Introduction

In a shifting global order defined by economic and geopolitical competition, an accelerating climate crisis, and the rise of new general-purpose technologies, industrial policy—measures coordinated by governments to create or strengthen competitive advantage in new or existing industries deemed strategic—has made a return. Since 2021 alone, the USA and the EU

have set aside almost $800 billion each to support their semiconductor industries and stimulate the green transition (Council of the European Union 2020; US Congress S1260 2021; Aghion 2023). Further, at the time of writing, the EU has made plans to free up significant sums in the member states and in the centre to revitalize its defence infrastructure, also with important ramifications for Europe's manufacturing base. This return of industrial policy has attracted considerable scholarly attention (Bulfone 2023; Juhász et al., 2023), advocating state intervention, exploring how political tensions translate into policymaking, or evaluating the design of specific policies. Yet, despite all this political and intellectual effort, little attention has gone to the conditions for policy success—defined here as the generation of durable competitive advantages in goods and services that justify the investment incurred. Given the important sums and increasing attention dedicated to industrial policy, the ability to distinguish initiatives that are likely to lead to costly mistakes from those that can set the basis for future prosperity is increasingly urgent.

In this article, we offer elements of such an evaluation framework. We argue that industrial policy success is possible if one of two broad first-order conditions is present: local firms with strong dynamic capabilities that can engage the industrial policies, or an alignment between the policies and existing institutions that govern the production of and access to innovation, skills, and capital. When one of the two conditions is present, industrial policies can fill in the missing element, enabling private firms to generate competitive advantages. However, if both are absent, government intervention is unlikely to create them simultaneously and industrial policy will almost certainly fail. When both conditions are present, firms can already rely on supportive policies for transformation without the need for a fully-fledged industrial strategy.

While we do not deny the importance of factors such as consistent administrative support or adequate long-term funding, our analysis suggests observers and policymakers first need to ascertain to what extent these policies mobilize existing first-order institutional and proto-competitive advantages. In this relational approach to industrial policy, state capacity matters, therefore, but is circumscribed by other elements in a political economy.

Analyses, and partly, reinterpretations of historical cases of industrial policy in Europe's most advanced economies since the 1960s in three technology-intensive industries—energy (nuclear power), electronics, and motor vehicles—underpin this argument. While broad, our selection also leaves out other relevant cases, a critique that we address through succinct, shorter pointed comparisons with other industries such as computers, advanced semiconductor equipment, and biotech.

These case studies combine data from a variety of primary and secondary sources into coherent analytical narratives: interviews, archival research, policy statements, legislation, company annual reports, news outlets, and published research. In contrast to much of the existing industrial policy literature, we pay attention to both successes and failures of industrial policy. Successes help us identify sufficient conditions. The analysis of failures, often a blind spot in industrial policy studies, informs us about necessary conditions (Ragin 1987; Mahoney 2004). Expressed formally, the organization of our case studies reflects a *Most Different Systems* research design (Przeworski and Teune 1970; cf Mill 1874): despite important differences across many important elements in the cases that could help explain divergent outcomes—such as long-term economic and industrial histories, national institutions, structure and ideology of governments, market structures, policies, and even specific post-war time periods—successes invariably reflect our argument that one condition

was present while industrial policy produced the second. In contrast, the *ex ante* absence of both conditions has always led to failure.

We start this paper with a short review of the debate on industrial policy and then develop our approach, before moving on to the case studies that unpack the mechanisms at the heart of our argument. The last section concludes, discusses the implications of our research, and highlight its limitations.

2. Making sense of industrial policy

State intervention has long been an area of interest to political economists and developmental scholars. Starting with Gerschenkron (1962), political economists studying Western Europe (Hall 1986; Katzenstein 1978; Zysman 1983; Katzenstein 1985), saw industrial policy as an instrument to accelerate industrialization, technological, economic, and social modernization. However, industrial policy fell out of favour after the neoliberal turn of the 1980s (Majone 1997). Further, institutional changes and political-economic shifts, such as the liberalization of banking, the ensuing financialization of the economy, and new fiscal constraints, deprived governments of key industrial policy instruments (Amable et al., 2019; Lechevalier et al., 2019).

In the aftermath of the Global Financial Crisis, however, political concerns related to globalization drove a revival of industrial policy (Warwick 2013; Garcia Calvo and Coulter 2022). In the last decade, geopolitical tensions and ongoing debates about strategic autonomy (Farrell and Newman 2023; McNamara 2024) have provided additional impetus for industrial policy. The recent vintage of papers distinguishes between 'old' industrial policies aimed at creating national champions within protected national economies and 'new' policies that support the development of globally competitive firms (Bulfone 2023; Coyle 2024). Within this new perspective, three main strands have developed. The first articulates the (mainly economic) rationales for government intervention—externalities, agglomeration failures, and public input provision (Juhász et al., 2023)—and articulate the need for government intervention to address public interests and needs (Mazzucato 2021; Mazzucato and Rodrik 2023). Some authors focus on reliance on government facilitation and coordination rather than sector-specific interventions (Warwick 2013), while others rationalize industrial policy by responding directly to its critics. Mazzucato (2013), e.g. addresses the benefits and costs of failure in high-risk investment and Di Tommaso et al. (2017) propose a methodology to mitigate information asymmetries.

A second strand in recent studies concentrates on implementation: the capacity of the state to formulate appropriate policy goals for different types of objectives (Aiginger and Rodrik 2020), the adequacy of policy instruments and funding (Rodrik and Stantcheva 2021), performance evaluation criteria (Lane 2020), and the competencies of civil servants (Chang 1994; Wade 2016; Haggard 2018). The third and final group is more empirical and comments primarily on the structure of recent policy initiatives, especially in the context of US-China tensions (Peters 2023; Han and Lee 2023; Veugelers et al., 2024).

Each of these makes an important contribution to our understanding of industrial policy but they also face problems. While the first line of argument represents a major normative departure from mainstream economic orthodoxy, it says practically nothing about the conditions for success of industrial policies. The second (and to some extent third) perspective, with its focus on executive power (Weiss 1998) and policy design, addresses part of this by

framing debates on policy success or failure as a question of state capacity and technical competence. Again, while these aspects are crucial, these studies sidestep the logically prior question of how successful industrial policy may depend on the contingent alignment between technological challenges, state institutions, and business capabilities (Zysman 1994).

This relational view of industrial policy is also at the basis of our argument. We identify two first-order factors that even the most capable governments are unable to influence directly, and definitely not in the short run. The first is the existence of firms with actual or embryonic dynamic capabilities to leverage the goods and services that industrial policy produces and on which they rely to generate competitive advantages. The second factor consists of institutions that govern the supply of collective infrastructural goods and services necessary for firms (Hall and Soskice 2001). Without considering both the characteristics of existing firms and institutions, even the most competent governments and the most technically perfect policies are likely to fail.

In capitalist economies, governments have unique capabilities that give them a central responsibility for coordinating industrial policy (Vogel 2023). But this capacity also faces limits, since governments share that role with firms, which are ultimately responsible for the decisions that result in higher-quality or more complex outputs, more efficient processes, and more effective organizational structures (Porter 1990). Since policy requires both actors, the capacity of firms to engage with public interventions is critical to industrial policy success. This capacity depends on the bundles of assets, skills, know-how, and routines that enable firms to generate competitive advantages (Barney 1991). Dynamic capabilities are particularly important in this context. These internal organizational routines enable firm to realign assets and activities to respond to changes in their competitive environment (Teece et al., 1997; Teece 2007). They include the capacity to make and evaluate strategic decisions about technological opportunities; to mobilize and allocate resources to generate and absorb knowledge; to develop alliances and combine teams with different types of expertise; and to integrate knowledge that resides in different parts of an organization with knowledge outside the organization (Eisenhardt and Martin 2000; Teece 2014). Firms with weak dynamic capabilities are unable to grasp the importance of the opportunities that industrial policies offer, and even when they do, they are unable to leverage them to generate and capture value. Firms with strong dynamic capabilities, in contrast, can exploit those.

Our second point on the success of industrial policies has its roots in historical institutionalism in political economy (Zysman 1983; Hall 1986; Evans 1995) and echoes the notion of functional fit between domestic institutions and the dominant product market strategies in a country. The value of government policies for firms and sectors is largely determined by the domestic and international institutions—the explicit and tacit norms that make an economy internally coherent (North 1990), i.e. the deeper, foundational normative layers, with regulations and public policies at the top. Institutions are different from policies in that they have a much broader and stabler, almost regime-like character than policies, which can change following government turnover. Their foundational nature and medium-term stability, and the fact that changes often have distributional consequences across the economy, makes institutions difficult to modify, at least in the short run, because they are linked to other institutions and because these shifts will be challenged by actors who stand to lose from the changes.

Institutional frameworks are important in industrial policy for a variety of reasons. They convey information to firms about the strategic pathways that are supported and

rewarded by the system and those that are not (Porter 1990; Whitley 1999). Firms respond to these signals by aligning their strategies with the opportunities and costs derived from institutionally generated incentives (Zysman 1994; Hall and Soskice 2001). In addition, institutional systems provide the organizational matrix for the provision of the collective resources and capabilities that firms need to develop competitive advantages (Fligstein 2001; Ferguson 2013). Those that govern systems for innovation, skill production, and capital provision are especially relevant. The first refers to the set of public and private research entities, policies, and incentive programmes that stimulate and support the development and diffusion of new knowledge (Nelson 1993). Skills institutions range from higher education to vocational (re-) training systems and the (usually job- and skill-related) wage-setting structures that undergird them. The financial system and its basic orientation in providing patient versus short-term capital to industry are the institutions through which the provision of capital takes place.

Combined, these three types of institutions constitute a production regime, which usually follows a coherent, mutually reinforcing and often distinctly national logic (Hall and Soskice 2001). Industrial and other policies that run counter to those stable institutional patterns will be handicapped in delivering the strategic signals and the types of resources and capabilities that firms need. For example, industrial policies that depend on the availability of specialized skills will be harder to implement in labour markets that concentrate on the deployment of general, mid-level skills and vice versa. Policy initiatives aimed at radically new outputs have higher chances of success in countries with world-class public and private scientific research institutions than in those in which the innovation system is organized around development and commercialization. Finally, where capital markets are strongly oriented towards the provision of patient capital, industrial policies that aim at bridging those gaps are more likely to succeed.

Table 1 synthetizes this discussion into four ideal-typical scenarios. The two cases where both factors are present or absent—strong (weak) institutional alignment and presence (absence) of dynamic capabilities—are analytically less interesting for large-scale industrial policy purposes. In the first setting—strong institutional alignment and firms with sufficient dynamic capabilities—we do not expect to see 'grand' industrial policy designs but rather public support policies operating in the background, ranging from training and quasi-public credit provision to fiscal incentives, and export promotion schemes (Garcia Calvo and Coulter 2022). Industrial policy is, as it were, already embedded in the social and political arrangements that govern economy and industry.

In the second configuration—where firms lack (embryonic) dynamic capabilities and policies go against the dominant institutional framework—industrial policies are unlikely

Table 1. Institutional/industry alignment matrix.

	Firms with strong dynamic capabilities	**Firms with weak dynamic capabilities**
Strong institutional alignment	Unobtrusive public support	Policies to stimulate entrepreneurship
Weak institutional alignment	Institution-building policies	Industrial policy failure

to produce the two conditions simultaneously. The reason: institution-building and entrepreneurial support for firms follow two distinct logics—the latter geared towards action in markets and the former towards intervention outside and beyond markets. In theory, a combination of market and non-market policies could accommodate the needs of different sectors or subsectors within an industry, while also serving as the basis for broad-based political coalitions in favour of successful industrial policy. In practice, however, such a 'mixed' approach is very difficult since it requires very high levels of centralized coordination, an immense effort to reallocate national resources and perhaps impossible compromises between affected actors. While such efforts succeeded in East-Asian catch-up processes in the past (Johnson 1982; Haggard 1990), not even those countries have been able to replicate their successes after they joined the club of the advanced capitalist economies (Garcia Calvo 2021).

The remaining combinations (strong/absent and weak/present) provide the most interesting cases for our analysis. In the first (suitable institutions but no firms, top-right quadrant), industrial policy efforts can succeed when they stimulate entrepreneurship. Policy packages in this instance typically entail innovation policies or public training and skills efforts, technology transfer involving research institutes and firms, industrial extension schemes, low-tax zones to attract FDI, or other large funding packages—the types of tools, in other words, that are usually identified with large-scale industrial policy.

In the second scenario (domestic firms with competitive potential despite a weak institutional context, in the lower left quadrant)—industrial policy success involves building an institutional infrastructure that supports further development of the sector and attracts additional investment by existing or new firms. The regime-like character of institutions, their foundational nature, and the distributional consequences associated with institutional change, can impede the processes of transformation that industrial policy aims to engender. We, therefore, expect the processes to be relatively easier in new markets or technologies that are not (yet) governed by existing institutions: building entirely new institutional arrangements or repurposing existing institutions without formally changing them can be easier than finding the consensus necessary to undertake major institutional reform. Where institutions already exist, change is more likely under any of three conditions: (1) when political leaders become aware of the strategic importance of the industry (Abbate 2000; Garcia Calvo et al., 2024); (2) when a major crisis galvanizes support in favour of transformation from across the political spectrum; or (3) when a powerful minority can leverage external pressures to build domestic political support where it would have been otherwise politically costly or impossible (Putnam 1988). Each of these scenarios facilitates institutional transformation because they create momentum for institutional change and ease opposition from vested interests.

Our argument is based on two basic assumptions. First, even though these four scenarios in our framework are stable, they do not amount to static success. While we define industrial policy success as the creation of durable competitive advantages, durable does not mean forever: competition and innovation will eventually erode or destroy competitive advantages. We operate with a time-horizon of two decades, which is the typical lifespan of long-term investments in physical infrastructures such as broadband (Garcia Calvo 2012). Second, our argument assumes a basic congruence between the governance structures of the sectors targeted through industrial policies and domestic institutional endowments (Kitschelt 1991). In the absence of such congruence, we expect industrial policies to fail

(Zysman 1977). We highlight the alignment between an industry's micro-foundations and institutions in Section 3.1 through a comparison between the success of French nuclear energy and the failure of the Plan Calcul.

3. Case studies

We now examine our four basic scenarios systematically through case studies (see Table 2). We start with the two scenarios where we think industrial policy can succeed before moving on to the cases of failure and supportive rather than steering industrial policy.

3.1 Strong institutional alignment and weak dynamic capabilities: French nuclear power in the 1970s and 1980s

France is a world-leading producer of nuclear power and nuclear reactors (IAEA, 2020; World Nuclear Association 2022). The expansion of France's nuclear fleet began in earnest with the 1974 Messmer Plan, which aimed to reduce France's dependence on foreign energy sources (Hancké 2002: 119). The Plan leveraged three features of the French institutional system: centralized, hierarchical decision-making, high levels of public involvement in critical infrastructure sectors, and tightly knit economic and policy elites. As a result, and surprisingly for such an important policy, the Plan was never debated in parliament but remained in the hands of the executive throughout (Parliament of the Commonwealth of Australia 2019). The state-owned monopoly, Electricité de France (EDF), was responsible for its implementation (Hancké 2002: 118). The problem for EDF was uncertainty: technological, organizational and political. EDF had relatively little experience with cutting-edge technology, having relied on traditional fossil-fuel sources and a few renewables until then. It had, therefore, few internal operations and external links with suppliers that could support the shift into nuclear power, and even though it was insulated from direct political contestation in parliament, nuclear power spanned several administrative levels, from the local to the national, in which opposition could emerge.

EDF addressed these uncertainties by exploiting the degrees of freedom that the elite-centred French institutional system offered. The strategy relied on a small group of mutually coopted engineers around a few visionaries. This group had high operational independence, was politically backed by the Prime Minister, and faced what we would now recognize as a soft budget constraint to cover problems as they arose. EDF then set out to produce its almost proprietary network of dedicated supplier companies for the new energy, by sending out its engineers as start-up founders—which also reduced EDF's direct exposure if things were to go wrong. After this initial start, EDF thus was able to rely on a small number of

Table 2. Institutional/industry alignment matrix: cases.

	Firms with strong dynamic capabilities	**Firms with weak dynamic capabilities**
Strong institutional alignment	German automotive industry (1980s–2000s)	French nuclear energy (1970s–1980s)
Weak institutional alignment	European Electronics (1980s–2000s)	UK automotive industry (1970s–1980s)

highly capable private sector suppliers with exclusive partnership arrangements (Thatcher 2007). EDF's leading role in the energy committees of the government standards agency AFNOR ensured that EDF's suppliers were often the only ones able to meet the demanding technical standards, creating a closed, tight community.

The profound uncertainties at the start implied that much could have gone wrong, from basic technology over supplier network to skills. That they did not is less a consequence of deep capabilities within EDF: EDF was a public bureaucracy, co-managed with the trade unions in an increasingly unstable arrangement (Moynot 1982), that had developed relatively little strategic sense on technology and markets (Wievorka and Trinh 1989; Hancké 2002). Instead, the relative success is better understood as resulting from the interaction between the burgeoning civil nuclear strategy and the institutional features that were mobilized to meet the new needs of the energy company. The centralized hierarchy facilitated the concentration of R&D efforts on a single type of nuclear reactor, lowering costs. Political and social opposition to nuclear power, which could have delayed efforts (as happened elsewhere in Europe), was neutralized by the elite-led imposition of measures. An exclusive group of firms with complementary capabilities facilitated coordination, which was essential to accelerate the research-intensive project and minimize the risk of errors and therefore potential nuclear accidents. In short, previously existing institutions in the areas of innovation, skills, and capital markets, all part of France's state-centred post-war economy (Kuisel 1981), supported the administrative and bureaucratic advantages that propelled EDF into nuclear power.

Similarly, cheap, long-term credit for government-sanctioned projects was provided by the state-owned commercial banks (Zysman 1983), while publicly owned firms such as EDF benefited from low borrowing costs for investment because of government guarantees on debt. These features played a critical role in France's nuclear strategy: of the estimated FF400 billion cost of the nuclear program (€125 bn today, not adjusted for inflation), commercial loans accounted for 42 per cent, EDF for 50 per cent, and the state for the remaining 8 per cent (World Nuclear Association 2022).

Thus, every element in the institutional framework, from innovation over organization to capital, which existed before the Messmer Plan, was mobilized in favour of an accelerated development of nuclear power. The scale of the project, the availability of cheap capital, and the guarantee of public procurement substantially lowered the costs and uncertainties of entry, and guaranteed that firms would move up the learning curve quickly, building competitive advantages for eventual exports. EDF's managerial competence, its power over standard setting and its capacity to generate and later coordinate a complex, tight network of suppliers fed the project and was a success despite its costs. Along the line, EDF and its suppliers gained significant expertise, which allowed them to expand internationally in the 1980s and 1990s.

Until very recently, the policies described above would not have been feasible in 21st century France. In the late 1990s, the cost of nuclear power, both financially and environmentally, forced EDF to reconsider its energy mix. In addition, French commercial banks are now privately owned, integrated into international financial networks and, therefore, less likely to support government French industrial policy, while the EU has banned direct subsidies to industry except in a few exceptional circumstances. In addition, open standards and procurement systems have made the tight coordination across different firms in the industry near-impossible. That, in turn, has affected training: French top-level schools still

produce many excellent nuclear engineers, but the more open nature of the industry imposed by the rules of the Single European Market has opened the labour market to outsiders. In short, most of the broad institutional foundations of success in the sector vanished, and the economic rationale was severely weakened while the political support shifted.

Things changed rapidly in favour of nuclear power when the 2020 Covid pandemic and awareness of the climate crisis were followed by deep policy shifts that enabled France to launch a new nuclear strategy. The Covid crisis prompted the EU to pass a 'once in a lifetime' €2 trillion stimulus package to 'help rebuild Post-Covid Europe' (European Commission 2024). In addition, in 2023, the Commission also passed a so-called Block Exemption Regulation that enabled it to legalize subsidies that help speed up the EU's green and digital transition (Commission Regulation 2023/1315). These two major policy shifts seem to imply embryonic institutional changes that allowed the French government to renationalize EDF and launch a nuclear investment plan, at an estimated cost of some €50 billion. Meanwhile, France insisted on including nuclear power in the list of zero-emissions industries approved for 'green' subsidies. This reliance on EU policies and funding to launch a renewed nuclear plan demonstrates, in an ironic twist, to what extent French voluntarism is constrained, underlining the importance of pre-existing institutions (and their earlier demise in the Single Market) that are well-suited to developing a particular industry.

The success of French nuclear power is not a variation on the familiar story of a highly capable French state engaging in advanced industrial policy projects (Cohen 1992). In fact, during the same period, and for similar motives that we would now associate with 'strategic autonomy', the same technocratic elites were central to the attempt to develop an early-stage commercial computer industry in France. Yet, instead of success, France witnessed a dramatic industrial policy failure. The industry never emerged, and the computer company at the centre of the policy, Bull Computers, never truly left crisis mode (Hancké 2002: 179 ff.).

The *Plan Calcul*, launched in 1966 and abandoned in the early 1980s, was France's attempt to match US prowess in computers, and to protect its young domestic industry from takeovers (Mounier-Kuhn 1995). Over the next 10 years, the Gaullist governments launched several initiatives in education and training in the new sector, and organized state-led mergers and acquisitions. Between 1967 and 1975, the French state subsidised the venture at the rate of (then) 300 million Francs (adjusted for inflation about €316 million in 2020; see Forest 1971: 20), after which subsidies to the newly formed company CII Honeywell Bull shot up for several years to FF 2 billion annually (inflation-adjusted about €2.1 bn today). The state also used its public procurement system to favour French firms, and by the end of the 1970s subsidised many companies in computer peripherals and software. To no avail: the sector permanently limped behind the US giants in PCs–IBM, Apple, and Intel. In the early 1980s, the *Plan Calcul* was silently abandoned, and the state retreated from the sector, leaving a small number of relatively well-performing telecommunication companies but no viable French or European computer industry.

Why did the policy fail? As Zysman (1977) has persuasively argued, French organizational culture, built on hierarchy and low trust, impeded performance in an industry that required frequent and informal exchanges of information between different groups of employees inside and outside the company. But that organizational bottleneck, important though it was, existed in other industries as well. The restructuring of the French car

industry in the late 1980s and early 1990s, e.g. also involved flatter hierarchies and more experimentation, yet appeared perfectly compatible with the highly centralized low-trust French organizational model (Freyssenet 1998). The failure of the *Plan Calcul* seems to have more to do with the problems that we have flagged. In contrast to nuclear power, where a top-down French approach worked very well, the *Plan Calcul* imposed a plan thought out in Paris by distant elites without any business experience, on a sector that was undergoing rapid change, and in which a single model of industrial adjustment or even a single end point was impossible to identify *ex ante*. In the mid-1970s, three perfectly viable different approaches to the future of computing existed—large mainframes, which did not disappear until a decade or more later, IBM's personal computer, which had only just emerged as a stand-alone product and was initially seen as a waste of money, and the alternative PC-inspired upstart Apple. Production processes were also in flux: semiconductor manufacturing was relatively new and concentrated in the USA, while many mainframes were produced in Asia. In short, the early commercial computer sector faced significant endemic technological, economic, and organizational uncertainties that almost demanded decentralized experimentation. This was very hard to reconcile with the centralized French institutions of industrial policymaking.

Equally important, existing French computer firms were very weak—the reason for industrial policy in the first place—and remained so. When the single company that survived the *Plan*, Bull Computers, which had specialized in mainframes when the industry had resolutely turned towards PCs, was eventually privatized in 1996, it did so after many years of astronomical subsidies to cover losses. In short, none of our two conditions for a successful industrial policy were present in the case of the *Plan Calcul*. The result was failure.

In our next case study, we examine how industrial policy resolved the opposite problem, where firms are well-placed but institutions for innovation are relatively weak. In the case of the GSM standard in mobile telephony, the European authorities marshalled the innovative capacities of hardware producers and telephone companies to create a virtuous circle in which markets and standards reinforced each other, with the effect that the European GSM standard became, despite the initial fragmentation of the sector, the de facto global standard.

3.2 Strong dynamic capabilities and weak institutional alignment: European electronics (1980s–2000s)

In the early 1980s, European firms in telecommunications technology in the UK, France, and the Nordics were among the world's most technologically advanced (Sandholtz 1992; McKelvey et al., 1998; Abbate 2000). Yet, as mobile telephony moved from analogue G1 to digital G2, firms faced soaring R&D costs and growing levels of technical complexity that required pooling multiple types of expertise (Sandholtz 1992). Problematically, all firms in the sector faced, in the absence of deep inter-firm coordination, the near certainty of competing and mutually exclusive standards—and, since many were national phone companies, they were unable to cooperate easily. This set-up deterred them from fully committing to the development of any communication technologies based on specific standards, which, in turn, held up the development of the entire industry across the continent and globally. Despite its strong starting position, the European mobile telecom industry faced a dark future because of high R&D costs and technical uncertainty.

A solution to the conundrum was offered by the European Commission. It involved an industrial policy strategy that allowed electronics manufacturers based in different European countries to build on and combine their individual strengths, thus lower the endemic uncertainty surrounding standards, and develop a global competitive advantage as a result. The strategy comprised three key institutional elements: the adoption of a common standard, the creation of a new standard-setting body, and the launch of cross-country collaborative research programs. In 1982, the EU clinched the process by adopting the Global System for Mobile Communications (GSM), an EU-wide, open, non-proprietary, interoperable network compatibility standard (Pelkmans 2001). A common standard eliminated the prospect of a long and expensive standard war among European firms and vastly reduced risk and uncertainty for individual companies. In addition, a common standard ensured that infrastructures and mobile equipment were compatible across the region, enabling international roaming. This led to vast economies of scale and rapid, large-scale investment in mobile infrastructures by national operators. In short, the GSM standard stimulated upstream investment in network technology and downstream investment in infrastructure, changing incentives for business from negative to positive.

The GSM standard also acted as a catalyst for cross-firm and international collaborative research within the EU. To encourage such cooperation, the European Commission launched two specialized programs: RACE and ESPRIT. Even though the measurable outcomes of these programs were limited, they provided a basis for sustained collaboration across EU firms (D'oultremont 1988; Bach 2000). Finally, the Commission supported the development of EU-wide competitive advantages by creating a European Telecommunications Standards Institute (ETSI). The institute was instrumental in ensuring that components and modules produced by different firms in different countries were interoperable and their specifications publicly available (Bach 2000). This had two clear benefits: it created a larger, EU-wide market, enabling firms to capitalize on their investments; and it accelerated service launch, granting European firms a first-mover advantage.

In sum, the European Commission succeeded in helping European firms pool their specialized skills and innovation capabilities, stimulated investment by telecommunication operators, and lowered the uncertainties associated with creating innovation that is new to the world by adopting a common standard. In doing so, the Commission turned a negative scenario of a standards war among many competing national operators into a situation where firms developed joint first-mover advantages against potential Asian and US competitors. By the mid-1990s, Ericsson and Nokia were the world's largest mobile handset manufacturers (McKelvey et al., 1998) and by the early 2000s, the GSM standard had become the de facto global standard for mobile communications. The launch of Apple's iPhone in 2007 displaced European hardware producers almost three decades after the introduction of GSM. Nonetheless, some of these early firms have remained competitive as producers of network equipment.

It is only fair to acknowledge that the European Commission's role in the GSM process may weaken our argument, because its actions are much narrower and the results more instrumentalized than the regime-like national institutions that we have invoked. However, the development of ASML, the world's sole producer of Extreme Ultra Violet (EUV) lithography systems (Van Duijn 2024), followed a very similar logic as GSM, but this time more closely aligned with national institutional regimes. In the early 1980s, EUV lithography was

a potentially groundbreaking technology to shrink the size while increasing the density of transistors on a semiconductor, making cutting-edge chips faster and more powerful. Although the foundational technology existed, the development of an industrial application required innovation in almost all areas of the lithography machine (Hofman 2022). This was impossible without pooling multiple types of technical expertise, coordinating the efforts of thousands of specialized partners, and raising vast amounts of patient capital for a high risk, high cost, long-term project. Because of the complexity of the product and process, ASML's success has not been replicated anywhere else to date.

As we have hypothesized, ASML did not start from scratch. The company's close ties to Philips, then Europe's largest electronics company, and Philips' managerial talent, were critical assets (Chuma and Aoshima 2003). The links between ASML and Philips were so deep that ASML's first commercial product was called Philips Automatic Stepper (PAS) 5500 because it derived from a line of systems initiated by Philips (Hofman 2021).

Public efforts concentrated mainly on supporting the establishment of ASML as an independent entity, providing a framework for sustained partnerships with organizations that had essential technical skills and capabilities, and facilitating access to state-of-the-art research facilities. Specifically, the Dutch government encouraged Philips to explore EUV, provided initial research funding, sponsored partnerships with Dutch universities, and brokered the joint venture with ASM, a pioneering Dutch semiconductor equipment manufacturer, for the establishment of ASML in 1984 (Benschop 2024; Van Duijn 2024)

Work on EUV lithography industrial applications started in earnest in 1997, led by a former Philips scientist (Hofman 2022). Between 1998 and 2000, the EU's Project EUCLIDES, provided a framework to establish an industrial consortium between ASML, Carl Zeiss and Oxford Instruments to solve major technical problems with EUV lithography (CORDIS 1999). ASML initially also benefited from a partnership with IMEC, an emerging Belgian research lab with onsite state-of-the-art infrastructures that had been established with a grant from the Flemish government (Chuma 2006; IMEC 2024). Similarly, a collaboration with Germany's Fraunhofer institutes helped establish cooperation with laser producer Trumpf for the development of the light source necessary to make EUV lithography viable (Trumpf 2020).

ASML's success was, therefore, built on the combination of embryonic capabilities that resided in ASML and other organizations located in close geographical proximity on the one hand, and industrial policy efforts geared towards the development of a suitable governance framework on the other—exactly as we propose in our framework.

The relevant industrial policy initiatives in this case combined domestic, international, and EU levels. As in the GSM case, this reflects the nature of the larger electronics industry, which, from the 1980s onwards, has shifted towards networked, oligopolistic yet geographically dispersed forms of industrial organization encompassing multiple and interdependent systems and subsystems (Thun et al. 2025).

After these detailed analyses of industrial policies in industries where one of the two conditions was absent, and where industrial policy was successful by developing those, we now turn to the scenarios in which both were fully absent or present. We start with the British car industry, where, as our framework predicts, industrial policy failed because of the lack of either of our preconditions.

3.3 Weak institutional alignment and weak dynamic capabilities: the UK's automotive industry in the 1970s and 1980s

The evolution of the UK car industry between the mid-1960s and the late 1980s demonstrates how the absence of dynamic capabilities and a supportive institutional framework produces a stalemate that industrial policy is unable to overcome. In 1968, following four years of output decline, the Labour government orchestrated a merger of three smaller car producers (Leyland, Morris, and Austin) into a 'national champion' called British Leyland (BL). From its inception until it faced bankruptcy in 1974, BL was unable to articulate and deliver a viable business strategy, faced serious organizational problems including managerial incompetence (Pfeifer et al., 2019), high labour costs, outdated and underperforming equipment, inefficiencies in economies of scale, low utilization capacity, the absence of central R&D for models and parts, and fragmentation among its divisions (Ryder 1975). In short, BL lacked the dynamic capabilities necessary to use its resources to turn things around.

Faced with the prospect of bankruptcy and unemployment, the Labour government nationalized the company in 1975, with the National Enterprise Board (NEB) as the industrial policy agency that managed public ownership. However, this plan was implemented in a severely adverse institutional context, especially in industrial relations, which handicapped any attempts at revitalization. First, BL's workplaces were organized by many unions who competed for members through militant wage bidding wars. Since part of BL's wages were based on piecework, they required almost constant renegotiation at the plant level. With a 170,000-strong labour force (Ryder 1975) and 70 production plants, this usually led to complex, lengthy negotiations, rising wages because of internal leapfrogging, and increasing industrial strife. In 1977 alone, BL lost more than 32 million worker-hours to wildcat strikes (Schwartz 2008)—almost 24 working days per worker.

In addition, institutional ownership by government played a significant role in the process of decline. By offering permanent subsidies to a failing company, the British government effectively created a 'soft budget constraint' (Kornai et al., 2003)—a perennial bailout clause for management—which led to systematic underperformance. Because of the subsidies, all parties in the company faced perverse incentives: managers were paid regardless of performance and strong unions negotiated rising wages that bore little relation to productivity or profitability. These outcomes, in turn, necessitated a new round of subsidies to cover the subsequent losses, resulting in a vicious cycle. This soft budget constraint closed the circle that started with poor performance before the BL merger and nationalization, by removing competitive pressures from management and producing, in a context of competitive unionism, fast-rising wages. High wages and strikes ultimately led to the collapse of the company.

In sum, throughout this saga, industrial policy was unable to compensate for both the gaps in the firm's abilities and the adversarial institutional framework. Not only was the company unable to develop a viable business strategy, but institutions, in particular adversarial unions in an industrial relations framework that rewarded wage militancy, exacerbated the problem. As expected, industrial policy failed. Between 1975 and 1978, the NEB and the Labour government presided over the further collapse of the company, leading to yet another reorganization, this time into a holding company. By 1984, and after more than 15 years of industrial policy to keep the sector alive, BL went bankrupt. When BL was sold to British Aerospace in 1988 (Pardi 2017), the industrial policy saga had run its course. In

less than twenty years, and despite an injection of £11 billion in inflation-adjusted public funding (Schwartz 2008), the company transformed from a pillar of UK exports into a relatively small, foreign-owned company.

This was not an industry-specific story of a declining sector, unsavable even under the best of circumstances. As the analysis of the German automotive industry below suggests, firms could move up-market to steer off competition when supported by domestic institutions in labour and capital markets. In other words, when our two first-order conditions were *ex ante* met, automakers were able to adjust by relying on the existing framework without requiring a large-scale industrial policy plan.

3.4 Strong institutional alignment and strong dynamic capabilities: the German automotive sector from the 1980s to the early 2000s

In the 1980s, the German automotive sector, like elsewhere, faced oil price volatility and increased competition from Japanese manufacturers. But in contrast to its counterparts in other countries, German firms responded to these shifts in their environment by moving up-market, away from standard mid-sized cars towards high-quality, semi-customized, mass-produced motor vehicles and luxury cars. Remarkably, they did so without recourse to a large-scale public industrial strategy. The key to the transition was a combination of the capacities of firms to manage supplier networks and supportive domestic institutions that governed skills and wages, innovation networks, and the provision of patient capital (Turner 1991).

The German training system conveys deep industry-specific skills and has been remarkably flexible in periods of technological upgrading (Streeck 1987; Kern and Schumann 1989)—exactly what was necessary during those years. When adjustment required flexibility in production processes and diversity in product markets, unions and employers negotiated significant changes in training systems, shifting from numerous narrow job classifications to a smaller number of broader job profiles. This allowed firms to adapt their workforce throughout the life of their vehicle models rather than lay off existing and hire new workers—a very expensive adjustment strategy in an industry with high employment protection rules. In addition, trade unions negotiated wages, and works councils approved new working time arrangements and team-based work organization models to fit the requirements of the turn towards 'diversified quality production' (Sorge and Streeck 2018). Workers in the German car industry thus upgraded their skills alongside the product upgrades, and the result was a high-skill, high-productivity, high-wage labour market.

Relations between the car manufacturers and specialized suppliers, a crucial part of innovation in the auto industry, followed a similar pattern. One of the inadvertent effects of the proliferation of models during this period was that car makers could no longer shoulder the financial cost of product development on their own. They, therefore, turned to their suppliers who were induced to upgrade their operations alongside the car manufacturers (Casper and Hancké 1999) and became part of the core development team (Casper et al. 1999). This restructuring process was underwritten by the German banks, who provided the necessary patient capital and presided over the process through their role in the company supervisory boards (Jürgens et al. 2002).

In short, instead of relying on a 'grand', sector-specific policy, German automakers transformed through a combination of internal resources and capabilities, including their ability to restructure production processes and manage relationships with suppliers, with a

set of almost invisible and implicit policies. Automakers shifted from standardized mass production (epitomized by the VW Beetle) to semi-customized high-quality products such as Mercedes and BMW cars. Even mass market-oriented models such as the VW Golf appeared in multiple versions to appeal to various market segments (Streeck 1989). Existing skills and union policies accelerated the companies' strategic reorientation. Industrial training systems upgraded rapidly, unions and plant- and company-level works councils cooperated in the adjustment, and banks provided patient capital.

This negotiated, cooperative setup provided the framework to handle the transition from vertical integration to modular production, the integration of CEE countries into the EU, and two competitive macroeconomic shocks (unification and EMU) in the 1990s and early 2000s. These pressures raised the prospect of relocation to lower-wage countries and a reconfiguration of the German production model to focus on cost rather than quality. However, the industry demonstrated significant resilience thanks to the renegotiated institutional framework in labour markets (Krzywdzinski 2014). The Great Financial Crisis of 2008–9 posed a different challenge, as did the Covid-19 pandemic; but in both cases the German government refrained from engaging in full-on industrial policies and relied instead on furlough schemes and subsidies to keep things afloat. In other words, the German car industry's governance system was not one of externally developed industrial policies but of an 'endogenous' institutional recombination, combining supportive government action and associational governance.

The German biotech sector in the 1990s and the late 2000s offers an interesting counterpoint to the automotive case that illustrates the limitations of the German system (Casper 2007). In the case of biotech, the educational system provided the skills necessary for the creation of multiple startups, but the absence of deep capital markets restricted funding for risky projects. Furthermore, employment protection legislation made workforce adjustment nearly impossible in a sector with high levels of uncertainty that required a parallel degree of flexibility. In other words, the micro-foundations of the industry were out of sync with the capabilities of the German institutional model. Surviving firms were able to thrive only after the industry had consolidated by specializing in more stable advanced industry segments aligned with the dominant institutional features of the German economy (Casper 2007).

4. Conclusion

Today, when governments in advanced economies are committing important resources to industrial policies, understanding the conditions under which such policies can support the creation of durable competitive advantages in strategic high-tech sectors is vital. Our framework raises questions about optimistic political voluntarism, demonstrating both the need for industrial policy and to look beyond policy instruments for a deeper analysis of the industrial structures and institutional systems in which these policies are implemented. The upshot: some policies will inevitably fail—those aimed at industries or industry segments with very few or no incumbents and where set-up costs for new operations are very high and returns low; where innovation systems follow a different logic than the industry; where wages and skills are not aligned with the high- or low-productivity models that dominate specific industry segments; and where capital requirements cannot easily be met by existing

financial systems. These first-order conditions are critical to industrial policy—both its failure and its success—in complex capital- and research-intensive industries.

Our paper has argued for a multidisciplinary approach grounded in debates in historical institutionalism and business strategy. If industrial policies address problems at a particular point in time and space, then we need to understand that historical context better, both in its functional and its political-institutional dimensions: the specific formulation of the problem, the precise range of possible solutions given the strengths and weaknesses of the key actors, and how those are conditioned—positively and negatively—by historical legacies.

This argument has important practical implications for government efforts to increase European technological capabilities, including those that facilitate the transition to the digital economy and clean energy. Our paper suggests that, in existing industry segments where European firms have a very weak position or are virtually absent today such as online platforms or cloud computing, it is unlikely that industrial policy will achieve the high levels of institutional reform and support for entrepreneurship necessary for European firms to thrive. Relatively simple semiconductors for durable consumer goods, a market currently dominated by Taiwanese and Chinese companies, is an example of that: no European incumbents, extremely high set-up costs for small margins, and an existing institutional framework that is geared towards higher skills and more sophisticated capital investment. By contrast, in industries in which European firms already show significant potential, but where the institutional framework is fragmented and there is not yet an established, dominant player, such as quantum computing or AI applications, Europe could concentrate on building institutional frameworks that provide firms with the best chances of developing competitive advantages. This may include producing public goods and other resources and capabilities such as high-end public training and technical standards that facilitate intra-European cooperation or infrastructure.

Finally, in stable sectors where European firms are already strong, policy efforts are more likely to succeed if they focus on existing capabilities to ensure firms can keep up with technological developments. In some cases, especially when new technologies are radically changing industrial configurations, as is the case in EVs, such support for adjustment may require more substantial industrial policy efforts than has been the case so far, e.g. in battery technology and standards, charging infrastructure, and an upgrade of the power grid to persuade potential EV customers. Europe potentially has strong companies in this sector given its history, and the institutional frameworks that support firms have also shown to be an asset. But the new economic and technological environment may require more active investment in public goods to help companies in the value chain and their workforce onto a new track. In short, industrial policy remains important, even in the new world that is emerging.

In conclusion, we should point out that despite its broad range, our paper has some key limitations, which may open avenues for further research and reflection. One, it looks back rather than forward. Many of our cases of success—e.g. French nuclear power and German automobiles—are today facing significant problems because of new technological or political environments. We also prefer to remain agnostic about the potential for success of current industrial policy initiatives across the advanced capitalist world, not least because of the many different rationales, from decarbonization over strategic autonomy to adaptation to new geo-economic and geo-political realities. The second demarcation of our paper is that we examine 'new' industrial policies, with the stated goal to construct or support newly

competitive industries. This stands in contrast to 'old' industrial policies, from postwar French planning over MITI in modern Japan to its equivalent in other European and Asian countries, whose main goals have been economic development to propel the country into the league of middle- and high-income nations. Finally, we are relatively silent on the deeper motivations for industrial policy. Recent debates on strategic autonomy suggest that geopolitical and geo-economic considerations are never far from advocates' and policymakers' minds. Yet addressing these factors fully would require a different paper. Our case study of nuclear power in France in the 1960s and 1970s (and the shadow case of the failed French computer industry in the same period) both reflected Gaullist considerations of strategic autonomy—energy independence and reduced technological dependence on the USA. Their success or failure, however, are not explained by these deep and strong motivations, but by the fit with competitive strategies and institutional frameworks that we developed here. In the end, we think, these first-order industry environment and institutional framework trump motivations and political will. That seems to us the most import lesson from our paper.

Acknowledgements

We wish to thank Steven Coulter, Saul Estrin, Kiryaki Gartzou-Katsouyanni, Peter Hall, Laurenz Mathei, Toon Van Overbeke, Dustin Voss, and John Zysman for discussions and helpful comments on earlier versions of this paper. The usual exculpations apply.

Conflict of interest statement. The authors report there are no competing interests to declare.

Funding

This paper did not receive funding from any external agency or entity.

Data availability

The data underlying this article are available in the article.

References

Abbate, J. (2000) *Inventing the Internet*. Cambridge: MIT Press.

Aghion, P. (2023) 'An Innovation-Driven Industrial Policy for Europe'. In: S. Tagliapietra and R. Veugelers (eds.) *Sparking Europe's New Industrial Revolution. A Policy for Net Zero, Growth and Resilience*, pp. 29–41. Brussels: Bruegel Blueprint Series 33.

Aiginger, K., and Rodrik, D. (2020) 'Rebirth of Industrial Policy and an Agenda for the Twenty-First Century', *Journal of Industry, Competition and Trade*, **20**: 189–207.

Amable, B. et al. (2019) 'New Approaches to Political Economy', *Socio-Economic Review*, **17**: 433–59.

Bach, D. (2000) 'International Cooperation and the Logic of Networks: Europe and the Global System for Mobile Communications (GSM)'. *BRIE Working Paper* 139.

Barney, J. (1991) 'Firm Resources and Sustained Competitive Advantage', *Journal of Management*, **17**: 99–120.

Benschop, J. (2024) My fluid flow. https://www.tudelft.nl/en/jmburgerscentrum/fluid-dynamics-in-the-netherlands/my-fluid-flow/jos-benschop, accessed 9 Aug. 2024.

Bulfone, F. (2023) 'Industrial Policy and Comparative Political Economy: A Literature Review and Research Agenda', *Competition & Change*, **27**: 22–43.

Casper, S. (2007) *Creating Silicon Valley in Europe: Public Policy towards New Technology Industries in Comparative Perspective*. Oxford: Oxford University Press.

Casper, S., and Hancké, B. (1999) 'Global Quality Norms within National Production Regimes: ISO 9000 Norm Implementation in the French and German Car Industries', *Organization Studies*, **20**: 961–85.

Casper, S., Lehrer, M., and Soskice, D. (1999) 'Can High-Technology Industries Prosper in Germany? Institutional Frameworks and the Evolution of the German Software and Biotechnology Industries', *Industry and Innovation*, **6**: 5–24.

Chang, H.-J. (1994) *The Political Economy of Industrial Policy*. New York: St Martin's Press.

Chuma, H. (2006) 'Increasing Complexity and Limits of Organization in the Microlithography Industry: Implications for Japanese Science-Based Industries', *Research Policy*, **35**: 394–411.

Chuma, H., and Aoshima, Y. (2003) Determinants of Microlithography Industry Leadership. RIETI Discussion Paper Series 03-E-003

Cohen, E. (1992) *Le Colbertisme High-Tech. Economie du Grand Projet*. Paris: Hachette.

CORDIS. (1999) Extreme UV concept lithographic development system. European Commission. https://cordis.europa.eu/project/id/28160/results, accessed 8 Aug. 2024.

Council of the European Union. (2020) COUNCIL REGULATION (EU) 2020/2094 of 14 December 2020. Official Journal of the European Union 22 December 2020. L 433 I/23

Coyle, D. (2024) 'Everything Everywhere All At Once: Competition Policy and Industrial Policy Choices in an Era of Structural Change', *Oxford Review of Economic Policy*, **40**: 718–28.

Di Tommasso, M. R., and Schweitzer, S. O. (2013) *Industrial Policy in America. Breaking the Taboo*. Cheltenham UK and Northampton: Edgard Elward.

Di Tommaso, M. R. et al. (2017) 'Industrial Policy and Manufacturing Targeting in the US: New Methodological Tools for Strategic Policy-Making', *International Review of Applied Economics*, **31**: 681–703.

D'oultremont, P. (1988) 'The RACE Programme: The European Route towards Integrated Broadband Communications', *Telecommunications Policy*, **12**: 119–26.

Eisenhardt, K. M., and Martin, J. A. (2000) 'Dynamic Capabilities: What Are They?', *Strategic Management Journal*, **21**: 1105–21.

European Commission. (2024) Recovery Plan for Europe. https://commission.europa.eu/strategy-and-policy/recovery-plan-europe_en, accessed 18 May 2024.

Evans, P. (1995) *Embedded Autonomy: States and Industrial Transformation*. Princeton: Princeton University Press.

Farrell, H., and Newman, A. L. (2023) *Underground Empire: How America Weaponized the World Economy*. New York: Henry Holt & Co.

Ferguson, W. D. (2013) *Collective Action and Exchange: A Game-Theoretic Approach to Contemporary Political Economy*. Stanford, CA: Stanford University Press.

Fligstein, N. (2001) *The Architecture of Markets: An Economic Sociology of Twenty-First-Century Capitalist Societies*. Princeton: Princeton University Press.

Forest, R. B. (1971) 'Close Cooperation: Europe's Best Hope'. *Datamation*. pp. 26–33. https://archive.org/details/bitsavers_datamation_14170580/page/n31/mode/2up?view=theatre, accessed 5 Feb. 2022

Freyssenet, M. (1998) 'Renault: From Diversified Mass Production to Innovative Flexible Production', In M. Freyssenet, A. Mair, K. Shimizu, G. Volpato, (eds.) *One Best Way? Trajectories and Industrial Models of the World's Automobile Producers*. Oxford: Oxford University Press.

Garcia Calvo, A. (2012) *Universal Service in the Context of National Broadband Plans*. Paris: OECD.

Garcia Calvo, A. (2021) *State-Firm Coordination and Upgrading: Reaching the Efficiency Frontier in Skill-, Capital-, and Knowledge-Intensive Industries in Spain and South Korea*. Oxford: Oxford University Press.

Garcia Calvo, A., and Coulter, S. (2022) 'Crisis, What Crisis? Industrial Strategies and Path Dependencies in Four European Countries after the Crash', *Journal of Economic Policy Reform*, **25**: 191–210. https://doi.org/10.1080/17487870.2020.1785297

Garcia Calvo, A., Kenney, M., and Zysman, J. (2024) Will Nation States Reassert Their Sovereignty over the Platform Economy? SSRN 4790191

Gerschenkron, A. (1962) *Economic Backwardness in Historical Perspective, a Book of Essays*. Cambridge, MA: Belknap Press of Harvard University Press.

Haggard, S. (1990) *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries*. Ithaca: Cornell University Press.

Haggard, S. (2018) *Developmental States*. Cambridge: Cambridge University Press.

Hall, P. A. (1986) *Governing the Economy: The Politics of State Intervention in Britain and France*. Oxford: Oxford University Press

Hall, P. A., and Soskice, D. (2001) 'An Introduction to Varieties of Capitalism', In: P. A., Hall and David Soskice (eds.) *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. Oxford: Oxford University Press.

Hancké, B. (2002) '*Large Firms and Institutional Change*', *Industrial Renewal and Economic Restructuring in France*. Oxford: Oxford University Press.

Han, H. J., and Lee, T. (2023) 'Varieties of Green Stimulus Policies: Comparative Analysis of the Green Growth and Green New Deal Policies in South Korea', *The Journal of Environment & Development*, **32**: 61–82.

Hofman, S. (2021) Three decades of PAS 5500. Lifecycle of a ground-breaking lithography platform. ASML. https://www.asml.com/en/news/storieAs/2021/three-decades-of-pas-5500, accessed 8 Aug. 2024.

Hofman, S. (2022) Making EUV: from lab to fab. https://www.asml.com/en/news/stories/2022/making-euv-lab-to-fab, published 30 Mar. 2022, accessed 9 Aug. 2024.

IAEA. (2020) Country Nuclear Power Profiles. France. IAEA. 2020. https://cnpp.iaea.org/countryprofiles/France/France.htm#:~:text=France%202020&text=France%20has%2056%20nuclear%20power, construction%20at%20the%20Flamanville%20site, accessed 10 Aug. 2022.

IMEC. (2024) Living its legacy: imec—independent R&D hub for nano- and digital technologies. IMEC, 40 Years. https://www.imec-int.com/en/about-imec/history, accessed 9 Aug. 2024.

Johnson, C. (1982) *MITI and the Japanese Miracle: The Growth of Industrial Policy*, 1925-1975. Stanford: Stanford University Press.

Juhász, R., Lane, N., and Rodrik, D. (2023) The New Economics of Industrial Policy. NBER Working Paper Series. Working Paper 31538. http://www.nber.org/papers/w31538

Jürgens, U. et al. (2002) 'The Arrival of Shareholder Value in the European Auto Industry a Case Study Comparison of Four Car Makers', *Competition & Change*, **6**: 61–80.

Katzenstein, P. J. (1978) *Between Power and Plenty: Foreign Economic Policies of Advanced Industrial States*. Madison: University of Wisconsin Press.

Katzenstein, P. J. (1985) *Small States in World Markets: Industrial Policy in Europe*. Ithaca and New York: Cornell University Press

Kern, H., and Schumann, M. (1989) 'New Concepts of Production in West German Plants', In P. Katzenstein (ed.) *Industry and Politics in West Germany: Toward the Third Republic*, pp. 87–110. Ithaca NY: Cornell University Press.

Kitschelt, H. (1991) 'Industrial Governance Structures, Innovation Strategies, and the Case of Japan: Sectoral or Cross-National Comparative Analysis?', *International Organization*, **45**: 453–93.

Kornai, J., Maskin, E., and Roland, G. (2003) 'Understanding the Soft Budget Constraint', *Journal of Economic Literature*, **41**: 1095–136.

Krzywdzinski, M. (2014) 'How the EU's Eastern Enlargement Changed the German Productive Model. The Case of the Automotive Industry', *Revue de la Régulation*, **15**: 1–61.

Kuisel, R. F. (1981) *Capitalism and the State in Modern France*. Cambridge: Cambridge University Press.

Lane, N. (2020) 'The New Empirics of Industrial Policy', *Journal of Industry, Competition and Trade*, **20**: 209–34.

Lechevalier, S., Debanes, P., and Shin, W. (2019) 'Financialization and Industrial Policies in Japan and Korea: Evolving Institutional Complementarities and Loss of State Capabilities', *Structural Change and Economic Dynamics*, **48**: 69–85.

Mahoney, J. (2004) 'Comparative-Historical Methodology', *Annual Review of Sociology* **30**: 81–101.

Mair, A. (1998) 'From British Leyland Motor Corporation to Rover Group: The Search for a Viable British Model'. In: M. Freyssenet, et al. (eds.) *One Best Way*?, pp. 395–417. Oxford: Oxford University Press.

Majone, G. (1997) 'From the Positive to the Regulatory State: Causes and Consequences of Changes in the Mode of Governance', *Journal of Public Policy*, **17**: 139–67.

Mazzucato, M. (2013) *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. London: Anthem Press.

Mazzucato, M. (2021) *Mission Economy: A Moonshot Guide to Changing Capitalism*. London: Allen Lane.

Mazzucato, M., and Rodrik, D. (2023) *Industrial Policy with Conditionalities: A Taxonomy and Sample Cases*. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2023.07).

McKelvey, M., Texier, M., and Alm, H. (1998) '*The Dynamics of High Tech Industry: Swedish Firms Developing Mobile Telecommunication Systems*', Brussels: European Commission.

McNamara, K. R. (2024) 'Transforming Europe? The EU's Industrial Policy and Geopolitical Turn', *Journal of European Public Policy*, **31**: 2371–96.

Moynot, J.-l. (1982) *Au Milieu du Gué*. Paris: Presses Universitaires de France—PUF

Mounier-Kuhn, P.-E. (1995) 'Le Plan Calcul, Bull et L'industrie Des Composants: Les Contradictions D'une Stratégie', *Revue Historique*, **1**: 123–53.

National Institute for Nuclear Science and Technology (INSTN). (2022) https://www.mastersportal.com/universities/256/cea-instn-national-institute-for-nuclear-science-and-technology.html#:~:text=The%20INSTN%20was%20established%20in,was%20introduced%20in%20the%201950's, accessed 18 Jul. 2022.

Nelson, R. A. (1993) 'Introduction', In R. A. Nelson (ed.) *National Innovation Systems: A Comparative Analysis*. Oxford: Oxford University Press.

North, D. C. (1990) *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

Pardi, T. (2017) 'Industrial Policy and the British Automotive Industry under Margaret Thatcher', *Business History*, **59**: 75–100. https://doi.org/10.1080/00076791.2016.1223049

Parliament of the Commonwealth of Australia. (2019) 'Not without your approval: a way forward for nuclear technology in Australia. Inquiry into the prerequisites for nuclear energy in Australia' Submission 16 - Supplementary Submission. file:///C:/Users/qq923714/Downloads/sub016.1.pdf, accessed 27 Jul. 2022.

Pelkmans, J. (2001) 'The GSM Standard: Explaining a Success Story', *Journal of European Public Policy*, **8**: 432–53.

Peters, M. A. (2023) 'Semiconductors, Geopolitics and Technological Rivalry: The US CHIPS & Science Act, 2022', *Educational Philosophy and Theory*, **55**: 1642–6. https://doi.org/10.1080/00131857.2022.2124914

Pfeifer, S., Pooler, M., and McGee, P. (2019) 'From Thatcher to Brexit: How UK Carmakers Were Forced into the Slow Lane.' Financial Times. https://www.ft.com/content/cf2a7dbe-368f-11e9-bd3a-8b2a211d90d5, published 22 Feb. 2019, accessed 7 Jun. 2022.

Porter, M. E. (1990) *The Competitive Advantage of Nations*. New York: The Free Press.

Przeworski, A., and Teune, H. (1970) *The Logic of Comparative Social Inquiry*. New York: Wiley.

Mill, J. S. (1874). *System of Logic*. New York: Harper & Brothers.

Putnam, R. D. (1988) 'Diplomacy and Domestic Politics: The Logic of Two-Level Games International Organizations', **42**: 427–60.

Ragin, C. (1987) *The Comparative Method: Moving beyond Qualitative and Quantitative Strategies*. Berkeley: University of California Press.

Rodrik, D., and Stantcheva, S. (2021) 'Fixing Capitalism's Good Jobs Problem', *Oxford Review of Economic Policy*, **37**: 824–37.

Ryder, D. (1975) '*British Leyland: The Next Decade. An Abridged Version of the Report Presented to the Secretary of State for Industry by a Team of Inquiry Led by Sir Don Ryder*', London: Her Majesty's Stationary Service.

Sandholtz, W. (1992) *High-Tech Europe. The Politics of International Cooperation*. Berkeley, Los Angeles; Oxford: University of California Press.

Sorge, A., and Streeck, W. (2018) 'Diversified Quality Production Revisited: Its Contribution to German Socio-Economic Performance over Time', *Socio-Economic Review*, **16**: 587–612.

Streeck, W. (1987) *Die Rolle Der Sozialpartner in Der Berufsausbildung Und Beruflichen Weiterbildung: Bundesrepublik Deutschland*. Luxemburg: CEDEFOP.

Streeck, W. (1989) 'Successful Adjustment to Turbulent Markets: The Automobile Industry', In P. Katzenstein (ed.) *Industry and Politics in West Germany: Toward the Third Republic*, pp. 113–156. Ithaca, NY: Cornell University Press.

Schwartz, N. D. (2008) 'A British Lesson on Auto Bailouts'. New York Times. https://www.nytimes.com/2008/11/18/business/economy/18car.html, published 17 Nov. 2008, accessed 10 Aug. 2022.

Teece, D. J. (2007) 'Explicating Dynamic Capabilities: The Nature and Microfoundations of Sustainable Enterprise Performance', *Strategic Management Journal*, **28**: 1319–50.

Teece, D. J., Pisano, G., and Shuen, A. (1997) 'Dynamic Capabilities and Strategic Management', *Strategic Management Journal*, **18**, 509–33.

Teece, David, J. (2014) 'The Foundations of Enterprise Performance: Dynamic and Ordinary Capabilities in an (Economic) Theory of Firms', *Academy of Management Perspectives*, **28**: 328.

Thatcher, M. (2007) *Internationalisation and Economic Institutions: – Comparing the European Experience*. Oxford: Oxford University Press.

Thun, E. et al. (2025) *Massive Modular Ecosystems: A Framework for Understanding Complex Industries in the Digital Age*. Policy Research Working Paper Series 11106, The World Bank.

Trumpf (2020) 'ZEISS, TRUMPF and Fraunhofer research team awarded the Deutscher Zukunftspreis 2020 for the development of EUV lithography'. Trumpf. https://www.trumpf.com/en_US/newsroom/global-press-releases/press-release-detail-page/release/zeiss-trumpf-and-fraunhofer-research-team-awarded-the-deutscher-zukunftspreis-2020-for-the-development-of-euv-lithography/, accessed 8 Aug. 2024.

Turner, L. (1991) *Democracy at Work: Changing World Markets and the Future of Labor Unions*. Ithaca, NY: Cornell University Press.

US Congress S1260. (2021) United States Innovation and Competition Act of 2021. 117th Congress (2021-2022). https://www.congress.gov/bill/117th-congress/senate-bill/1260, accessed 18 Mar. 2022.

Van Duijn, J. (2024) *ASML's Founding Story: Our Roots in the Semiconductor Industry*. ASML. https://www.asml.com/en/news/stories/2024/asml-founding-story, published 3 Apr. 2024, accessed 7 Jul. 2024.

Veugelers, R., Tagliapietra, S., and Trasi, C. (2024) 'Green Industrial Policy in Europe: Past, Present, and Prospects', *Journal of Industry Competition and Trade*, **24**: 1–22.

Vogel, S. K. (2023) 'Market Governance as a Balance of Power', *Politics & Society*, **51**: 319–36.

Wade, R. H. (2016) 'Industrial Policy in Response to the Middle-Income Trap and the Third Wave of the Digital Revolution', *Global Policy*, **7**: 469–80.

Warwick, K. (2013) 'Beyond Industrial Policy: Emerging Issues and New Trends', *OECD Science, Technology and Industry Policy Papers*, No. 2, Paris: OECD Publishing.

Weiss, L. (1998) *The Myth of the Powerless State*. Ithaca, NY: Cornell University Press.

Whitley, R. (1999) *Divergent Capitalisms: The Social Structuring and Change of Business Systems*. Oxford: Oxford University Press.

Wievorka, M., and Trinh, S. (1989) *Le Modèle EDF*. Paris: La Découverte.

World Nuclear Association. (2022) Country profiles France. https://world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx, accessed 21 Jul. 2022.

Zysman, J. (1977) *Political Strategies for Industrial Order: State, Market, and Industry in France*. Berkeley CA: University of California Press

Zysman, J. (1983) *Governments, Markets, and Growth: Financial Systems and the Politics of Industrial Change*. Oxford: Martin Press.

Zysman, J. (1994) 'How Institutions Create Historically Rooted Trajectories of Growth', *Industrial and Corporate Change*, **3**: 243–83.