**RESEARCH ARTICLE** 



# Analyzing industrial policy portfolios

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### Abstract

Industrial policy has regained political attention due to the challenges associated with global market integration, technological changes, and the need for sustainable transformation. However, the lack of a consistent understanding of industrial policy hampers systematic comparisons. This paper develops a novel concept of industrial policy portfolios that captures different dimensions of industrial policy outputs across countries and over time. We illustrate this approach by comparing the policy dynamics in the United States and Germany over the last four decades and show that despite similar dynamics of policy growth, the countries display pronounced variation in the areas and instruments they prioritized.

**Keywords** Industrial policy · Comparative analysis · United States · Germany · Policy change · Policy portfolios

# JEL classifications

L500 Regulation and Industrial Policy: General L520 Industrial Policy; Sectoral Planning Methods O380 Technological Change: Government Policy L400 Antitrust Issues and Policies: General

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# Introduction

There is little doubt that industrial policy is 'back in'. Contrary to its both academic and political neglect from the 1980s onwards in the context of dominant neoclassical economic doctrines, industrial policy has experienced a remarkable return. Since the mid-2000s and especially after the global financial crisis, more and more countries have developed elaborate political programs to actively propel their economic growth through the design of industrial policies (Andreoni & Chang, 2019). These endeavors include, amongst others, policy initiatives such as Germany's "Industrie 4.0" or the "America COMPETES Act". At the same time, a lively academic debate emerged with regard to the challenges of industrial policy in a dramatically changing world (Rodrik, 2008).

Several reasons account for this "rebirth of industrial policy" (Warwick, 2013; Aiginger & Rodrik, 2020). First, developing countries do increasingly reject the market-fundamentalist approach associated with the Washington Consensus, fueling a growing demand for proactive government policies that aim at diversifying and upgrading economies rather than simply relying on the market and deregulation. Second, advanced economies, and in particular the countries of the Eurozone, have faced similar challenges, with a weak labor market and the lasting impact of the financial crisis. Declining employment shares in manufacturing in the United States (US) and Western Europe, combined with the increasing competition from China on world markets, have further reinforced the need for active industrial policy. This demand is enhanced by disruptive technological changes such as automation, digitalization, Industry 4.0, and the so-called 'Internet of Things', i.e., the use of the Internet or other communication networks in physical objects such as cars or fridges. Third, an increased focus on broader societal and environmental goals comes with a renewed interest in the role of industrial policy to facilitate transformations towards green and sustainable growth (Rodrik & Sabel, 2019). In particular, climate change accentuates the need to rethink contemporary production mechanisms to prompt green transformation (Weiss, 2013). Finally, the COVID-19 pandemic, as well as political conflicts, in particular the Russian war of aggression, has demonstrated the vulnerability of domestic industries to the challenges of international interdependencies of resources and goods delivery (Tisdall, 2022). In short, various political challenges and negative externalities associated with global market integration led to a sharp increase in the attention on governmental strategies in industrial policy.

Remarkably, this renewed concern with industrial policy is in marked contrast to the prevailing fuzziness of what industrial policy actually means or comprises. Contrary to other policy fields, such as environmental, social, or migration policy, there is *no* generally accepted understanding of industrial policy. This is mainly because the rationales guiding industrial policies have been changing over time. Initially, the focus was only on creating an environment conducive to market dynamics. This was followed by a more active approach that promoted the protection of national champions through state ownership and the protection of domestic industries. A third approach to industrial policies has been to use them as a means to encourage institutions' evolution, promoting innovation through networking and collaboration (Cohen, 2009; Warwick, 2013; Andreoni & Chang, 2019).

The different interpretations of industrial policy have led to challenges in conducting empirical studies in this field. Due to the varying definitions and lack of consensus on what constitutes industrial policy, there is a shortage of comparative research on the development, similarities, and differences of national industrial policies. Without a systematic framework for measuring industrial policies, it is difficult to answer important questions such as the following: To what extent do industrial policies vary across countries and over time with regard to underlying policy targets and policy instruments? Are some countries developing more ambitious industrial policy programs than others? And to what extent do countries differ in their focus and forms of intervention? Until now, these questions have only been empirically addressed using budgetary indicators, which neglect the critical role of regulatory instruments such as production standards, environmental requirements, and incentives like tax breaks. Additionally, they fail to consider the importance of enforcement, compliance mechanisms, and monitoring efforts.

In this paper, we aim to tackle the challenging task of systematically assessing the patterns and dynamics of industrial policy development across countries and over time. Our objective is to make a twofold contribution to this field. First, we introduce a novel concept of industrial policy portfolios, which allows us to systematically map policy targets, instruments, and changes in the instruments' calibration over time. In doing so, we adopt a broad definition of industrial policy. We include any policy aimed at shaping industrial development, focusing on how policies are formulated and calibrated over time. Second, we provide new empirical evidence. We illustrate the analytical strength and applicability of our approach by studying industrial policy development in the US and Germany over more than four decades (1975 to 2020). These empirical findings can contribute to and enrich the ongoing theoretical discussions in the field of industrial policy and help to overcome the stagnation that has been observed in this research area (Rodrik, 2008).

We proceed in the following steps. After a brief review of the state-of-the-art and underlying challenges that prevent a common understanding and systematic assessment of industrial policy outputs (Section 2), we introduce our comprehensive portfolio approach in Section 3. In Section 4, we demonstrate the potential of our approach through a comparative empirical analysis of industrial policies in the US and Germany. Section 5 concludes and outlines prospects for future research.

### Gaps in industrial policy research

Despite its central and potentially far-reaching impact on a country's economic development, competitiveness, and technological innovation, industrial policy has been fairly neglected by scholars of Public Policy. The most obvious reason for this neglect is the fact that industrial policy lacks a clear and generally accepted definition (Evenett, 2003; Warwick, 2013). There is no "clearly identifiable set of goals, policy instruments, and institutions, such as a legislative framework to delineate the scope for the industrial policy or designated public agencies to execute it" (Riess & Välilä, 2006, p. 12). Instead, there is a very broad range of cross-cutting areas that have been discussed as constituting parts of industrial policy, such as the regulation of competition, technology policy, regional policy, research and education policy, as well as climate and environmental policy is basically any type of selective intervention or government policy that attempts to alter the sectoral structure of production toward sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention (...)" (p. 2). This wide and open conception of the policy field makes it difficult to precisely define and systematically record industrial policy

measures. Most recently, efforts have been made to translate industrial policy taxonomies into databases that facilitate empirical investigations (Evenett et al., 2024). However, these databases still face challenges in enabling the assessment of developments over several decades and the strategic shifts in how governments regulate this policy field.

Most of what we know about industrial policy is built on the foundational work of scholars from a few decades ago (including Hall, 1986; Wright & Pauli, 1989; or Atkinson & Coleman, 1989). Their research offers valuable insights into the complexity of industrial policies and the role of state interventions. By providing illustrative and convincing anecdotal evidence, they pave the way for further exploration into how governments intervene in the market. However, this research does not offer a framework for empirically and systematically comparing industrial policies across countries and over time. Against this background, the lack of systematic and comprehensive accounts of industrial policy outputs hardly comes as a surprise. Instead, academic assessments of industrial policy are characterized by two perspectives that reinforce rather than reduce this research gap: the dominance of normative perspectives and the reliance on state expenditure as an insufficient proxy for governmental policy outputs.

#### The dominance of normative debates over systematic policy assessments

The lack of a concise and generally accepted conceptualization of industrial policy is largely the result of the fact that its normative foundations have been subject to ongoing academic and political debates. Yet, the dominant preoccupation with the normative legitimization of industrial policy and underlying rationales of different policy designs led to a rather narrow understanding of actual policy developments. A focal point of industrial policy literature has been the normative controversy regarding whether countries should develop systematic approaches to intervene and steer industrial development at all. Scholars have comprised arguments in favor of and opposing governmental interventions that foster structural transformation. Scholars in favor of (stronger) governmental intervention argue that market imperfections and the need for structural transformation require the adoption of industrial policies. According to this view, governments can positively shape change and create competitive markets (Shapiro, 2007; Rodrik, 2008; Naudé, 2010; Capasso et al., 2019 a). The so-called market failure argument, by contrast, emphasizes the stabilizing role governments can have for the economy, given that markets themselves do not always operate smoothly and are subject to problems such as information asymmetries (Lee, 2013; Oqubay, 2020). Another argument in favor of industrial policy is the protection of infant industries. This reasoning builds on the assumption that manufacturing generates wealth and national production capacities and should thus be expanded. Infant industry protection entails the support of the domestic industry, especially in its early stages, before it becomes internationally competitive (Naudé, 2010; Oqubay, 2020). Academic literature endorsing industrial policy also links its arguments to present-day issues, such as climate change. Mazzucato (2016), for instance, argues that governments should not merely regulate existing markets but also actively create new ones, thus paving the route for broader change.

Inspired by neoclassical theory, arguments against industrial policy, by contrast, assume that governments lack sufficient information regarding which industries they should foster and protect (Rodrik, 2008). Critics of industrial policy also maintains that governments might not necessarily provide sufficient incentives for markets to transform. Free markets

and trade are viewed as a better alternative to industrial policy, stressing that markets can regulate themselves. Most prominently, this policy strategy has been reflected in the Washington Consensus (Weiss, 2020), a program originating in the 1990s and calling for open trade and the liberalization of markets (Kellermann, 2015). Yet, while policy advice has been based on the theoretical pros and cons of governmental intervention, it has generally not been supported by empirical evidence (Hausmann et al., 2007; Metge & Weiss, 2011). There hence appears to be no consensus between the two lines of argumentation, which is reinforced by the fact that normative arguments cannot be easily compared as they are not necessarily rooted in the same understanding of industrial policy.

In addition, theoretical explorations of industrial policy are hardly studied in conjunction with empirical approaches (Rodrik, 2008; Harrison & Rodríguez-Clare, 2010). The limited number of empirical studies yielded inconsistent results when it comes to the evaluation of governmental action (Naudé, 2010; Weiss, 2013). Empirical work typically focuses on selective policies or countries. Taylor and Montera (2021), for instance, present a compelling overview of the development of US industrial policy and introduce concrete policy examples to make their case. Hausmann and Klinger (2008) trace the development of South African industrial policy using historical examples. These articles give valuable insights into the domestic development of industrial policy in certain countries but do not allow for a systematic comparison of different national strategies. In short, "there has been an insufficient systematic evaluation of industrial policy and therefore an inadequate evidence in which to assess its effectiveness" (Warwick, 2013, p. 44).

#### State expenditure as problematic proxy for industrial policy outputs

In addition to the predominant normative focus on industrial policy, framework attempts to capture governmental decisions in this sector suffer from a biased focus on state expenditure capturing financial allocations to different industrial sectors as an indicator for governmental intervention (for overview see Pack & Saggi, 2006; Lane, 2020). Hence, most empirical studies on industrial policy are based on budgetary allocations and generally do *not* capture the political and regulatory decisions that underlie such fiscal outcomes. This might be a potential explanation for contradictory results in empirical studies on the effectiveness of industrial policy.

Weiss (2013) dissects the variance in the conclusions of empirical studies and traces these discrepancies back to the lack of systematic studies of "broad industrial strategies" (Weiss, 2013, p. 46). In their review of industrial policy, Pack and Saggi (2006) reflect on the potential of empirical evidence to resolve the aforementioned debate. From their review, it becomes evident that most research relies on a similar set of measurements and indicators. Research and Developments (R&D) investments, subsidies, and preferential loan rates are commonly used as explanatory variables for the development of gross domestic products and comparable econometric data (Pack & Saggi, 2006, Hausmann et al., 2008). Likewise, the United Nations Industrial Development Organization (UNIDO, 2019) relies on a set of econometric indicators to map industrialization. Indicators, such as R&D expenditure as a percentage of GDP, are used to measure the achievement of industrial targets (e.g., enhancing scientific research) and to develop an index that allows calibrating how close individual countries get to comply with the developmental goals. This index informs about developments are specific research. While these measures provide insights into how much governments

*invest* in their national industry, the provision of financial resources is only one of the many ways governments can intervene into the economy (Hood & Margetts, 2007). Budgetary indicators typically capture broad spending categories and often include indirect expenditures. Investments in education aimed at developing a skilled workforce are not adequately represented as industrial policy incentives. Additionally, financial flows are inherently complex and evolve over time. Many governments that once relied on traditional grants have transitioned to matching grants for external financing, reflecting a shift towards more collaborative and co-financed approaches in supporting industrial policies (Wilder, 2021). In order to achieve industrial policy objectives, regulatory policies are (at least) equally important as distributive measures. Regulations, however, are hardly reflected in the state budget. It is for that reason we also examine more intricate processes of governmental interventions that are not mirrored in budgetary allocations.

The number of studies using alternative variables is small and usually does not focus on governmental outputs. Chen and Xie (2019) shift the empirical perspective from fiscal measurements of industrial policy to the passing of legislative acts. They study the impact of industrial policies on economic growth in China using the total number of industrial policies per year as explanatory variables. The authors point out that their model assumes that industrial policy outcomes correlate with the number of policies. This approach represents an alternative to relying on econometric data. Yet, the concept is only of limited use if scholars are interested in comparative assessments of industrial policies across countries. Comparisons across countries based on the count of legal acts are often misleading, given that countries substantially differ in their legal traditions and hence in the number and length of the laws adopted (Ginsburg & Cooter, 2003).

In sum, the study of industrial policy involves several analytical difficulties, chiefly the focus on normative aspects and government spending. Yet, there also seems to be a consensus on the fact that research on industrial policy needs to be further developed (Rodrik, 2008; Mazzucato, 2016; Wilson et al., 2022). Studies rarely provide a sufficient differentiation of policy strategies and their objectives, fueling calls for more detailed analyses that provide information on the policy outputs governments adopt (Lane, 2020).

In response to this gap, we propose a differentiated analytical concept that systematically analyzes changes in industrial policy portfolios over time and across countries. This approach avoids bias towards merely distributive policy instruments. The comprehensive industrial policy framework we present in this paper serves as a complement to existing research. Seminal works in this field have laid the groundwork for examining the paradigms guiding industrial policy implementation (e.g., Hall, 1986; Atkinson & Coleman, 1989). By bridging theory and practice, we develop a typology that tracks how these paradigms translate into actual policies—a crucial step for empirically validating the substance of industrial policy theory. This method enhances our understanding of the practical implications of different policy paradigms by providing a more detailed and nuanced view. It is only on this basis that we are able to fully capture "the nature of the beast"; i.e., the empirical phenomenon that shall be explained and further analyzed in subsequent steps. In the following section, we present our concept in more detail.

## Conceptualizing industrial policy outputs: a policy portfolio approach

To comprehensively gauge governmental outputs in the field of industrial policy, we need to develop a concept that (1) depicts the broad range of different options for governmental intervention and (2) easily 'travels' from one temporal and spatial context to the other. Our conception is hence guided by the main purpose of being 'abstract' enough to compare countries and 'precise' enough to capture differences in the way national governments intervene across different policy industrial areas. In so doing, our analytical focus is primarily on the manufacturing sector, which covers industrial activities such as textile processing, car manufacturing, electricity generation, technology production, and pharmaceutical development. This focused approach to industrial activities aligns with previous economic research (Kaldor, 1981; Guerrieri & Meliciani, 2005) and encompasses the key economic sectors that make the most substantial contributions to gross domestic product (GDP) in most industrial-ized democracies.

Our approach builds on the *concept of policy portfolios* (Knill et al., 2012; Fernandez-i-Marin et al., 2021; Hurka, 2023). The portfolio concept provides an aggregate assessment of sectoral policy change over time and across countries. It allows us to systematically measure changes in the amount, composition, and intensity of national industrial policies over time. Our approach is based on the distinction of three analytical dimensions, namely *policy targets* relating to specific areas of industrial policy, *policy instruments* developed in order to achieve these targets, and *policy intensity* capturing changes in calibration of instruments over time.

In developing this distinction, we build on existing attempts to classify industrial policy. To differentiate among various industrial policy measures, some authors use the distinction between horizontal and vertical industrial policies. Horizontal measures are broad-based, aiming to improve the general business environment across the economy, while vertical policies are more selective, targeting specific sectors or activities, such as manufacturing or coal mining (van Dam & Frenken, 2020; Deineko et al., 2021). Cimoli et al. (2006) present an alternative framework of industrial policy, in which they outline different domains of governmental intervention, such as competition or scientific and technological innovation. They attribute a set of policy measures like education or R&D policies to those domains. Naudé (Naudé) expands this taxonomy and also includes instruments, such as export promotion, the attraction of foreign direct investments, or educational programs which serve for industrial capability accumulation. Weiss (2015) proposes a categorization of industrial policy along the stages of industrial development. He assumes that industrial policy measures are different in the early stages of industrial policies, compared to later stages. For instance, he expects that early-stage industrial policy will include key objectives such as the attraction of foreign direct investments which requires measures such as the adaptation to foreign technologies. Lastly, Warwick (2013) differentiates between policy domains and policy orientations. While policy domains present the area of intervention, the concept of policy orientation captures whether governments tend to adopt measures to improve the general business environment or focus on specific sectors or national champions.

Although these classifications differ in many ways, they share important commonalities that serve as a basis for our approach. First, all contributions distinguish between broader objectives or *areas of governmental intervention* (e.g., technology innovation), distinct *targets* that are addressed in these areas (e.g., science policies) as well as various *instruments*  or measures to address these targets (e.g. a science budget, establishing research centers). Additionally, we gauge the intensity of government intervention by analyzing the frequency of adjustments made to policy targets and instruments over time. This metric also accounts for the direction of these changes, offering insights into whether the industrial policy portfolio is expanding in regulatory scope.

### Policy targets in different areas of industrial policy

Policy targets capture all issues that are addressed by a government in a specific policy field. Depending on the policy sector, these targets can imply different aspects in practice. A policy target in climate policy is, for instance, the  $CO_2$  emissions from road traffic or aviation activities. In social policy, in turn, a policy target might be the support of single mothers or families in need (Knill et al., 2012). Yet, contrary to the mentioned examples, the identification of policy targets in the sector of industrial policy is a much more challenging task, given the broad and cross-sectoral nature of this policy field. To identify industrial policy targets, we, therefore, depart from a distinction of different areas of industrial policy.

To identify these areas and related policy targets, we considered a wide variety of relevant scientific literature and drew on national industrial policy programs and legislation, which we in turn compared with findings and indicators from UNIDO, the World Bank and OECD. Based on this assessment, we identified four industrial policy areas and related policy targets for our conceptualization, namely (1) innovation, (2) locational factors, (3) the regulation of competition, and the (4) push for green transformation. This distinction represents the leanest possible conceptualization of industrial policy, which nevertheless combines the different policy elements emphasized in the literature (Table 1).

The area of (1) innovation comprises policy targets such as the tapping into new markets, the promotion of technologies, and the stimulation of R&D. The background to these measures is the fact that innovative technologies generate momentous profits, thus increasing the value of domestic firms and industrial sectors (Huang et al., 2007). The area of (2) locational factors is not confined to the geographical location per se. It rather captures inputs that make it more attractive for firms to locate in a specific region, which ultimately promotes

Table 1 Areas and targets of industrial policy	Policy area	Policy target
	Innovation	Opening up new markets
		<ul> <li>Technological innovation</li> </ul>
		<ul> <li>Protection of innovation</li> </ul>
	Locational factors	<ul> <li>Provision of workforce</li> </ul>
		Cost coverage
		<ul> <li>Infrastructure provision</li> </ul>
		• Product quality
	Competition	Market entrants
		Antitrust
		• Trade
		<ul> <li>Import substitution</li> </ul>
		Critical infrastructure
	Green growth	Renewables
	-	Circular economy
		• Biofuels

industrial development (Leitham et al., 2000). Accordingly, this policy area covers targets such as the development and attraction of a skilled workforce, the reduction of production costs, the provision of physical infrastructure, and the ensuring of product quality. In the area of (3) competition, government measures can protect infant and domestic industries from external competition. Likewise, they can also create regulations that promote domestic competition. The latter encourages industrial actors to adjust and develop (Aghion et al., 2015). Competition policies target aspects such as market entry, antitrust, trade promotion, import substitution, and maintaining critical infrastructure. The latter refers to the protection of systems, assets, and industries that are essential to the functioning of a society and economy. This involves ensuring that key manufacturing industries remain viable and competitive even when they face challenges such as economic downturns, global competition, or technological disruptions. The area of (4) green transformation is a relatively new realm of industrial policies and moves beyond the notion of increasing productivity and generating wealth. In light of accelerating climate change and the exploitation of natural resources through industrial activities this policy area seeks to promote economic development that is decoupled from the harmful practices and explicitly integrates environmental concerns into all of its interventions (Jacobs, 2012; Altenburg, 2017; Capasso et al., 2019 b). We conceptualize green transformation policies as governmental incentives that promote sustainable structural changes. This includes the promotion of renewables and biofuels, as well as the shift from a 'linear' to a 'circular' economy.

#### Policy instruments

The dimension of policy instruments captures the means governments have at their disposal to achieve their policy targets. Each of the different targets identified above can potentially be addressed by the choice or combination of different policy instruments ranging from regulatory approaches (bans, process and product standards, permits and quotas, etc.) to more market-based forms of intervention (taxes, public investment, loan/credits, privatization). To open up new markets for industrial products, for instance, governments might rely in regulatory approaches (such as product standards) in order to protect their domestic industries from international competition. However, rather than relying on regulation, governments could also promote domestic producers by providing financial subsidies or incentives. Moreover, rather than relying on either one or the other instrument, governments can also opt for the combination of different instruments; i.e., so-called instrument mixes (Howlett & Rayner, 2013). Table 2 provides an overview and descriptions of all policy instruments considered.

#### Policy intensity

By identifying combinations of policy targets and policy instruments, we are able to make systematic statements on changes in the size and composition of industrial policy portfolios. Yet, this measure is *not* sensitive to changes in the level of existing policy measures. The level of a policy instrument changes when, for example, subsidies or tax reductions for certain industries become more generous, or when process standards for producing certain goods become stricter. We take this aspect into account in our measurement of policy inten-

Instrument	Description	
Drahibitian/Dan	Limitations (tatal an usetial multihitian)	
Promotion/Ban	concerning activities and products	
Planning	Measures defining areas or times deserving a particular treatment	
Data collection/ Monitoring	Specific program for collecting data	
Information exchange	Exchange of information between the state and businesses or between businesses among themselves	
Process standards	A measure prescribing the use of a specific technique or technology to produce goods	
Product standards	Safety, quality and other specifications and standards applicable to a product	
Permit/Quota	Permit: An authoritative document or status that allows somebody to engage in a specific activity	
	Quota: A fixed share that a business is bound to adhere to	
International agreement	Contract or agreement between two or more countries that impacts internal markets and the manufacturing sector	
R&D incentive	Measures that relate to research and development	
Procedural sequence	Legislative items that impose or remove regulatory barriers	
Taxation	Tax incentives and deterrents, that is govern- ment measures that encourage businesses to spend or save money	
Subsidy	A measure by which the state grants a finan- cial advantage to a certain product or activity or project-bound financial government grants that are not tied to a direct service in return	
Public Investment	State investment in specific assets (e.g., establishment of institutions, infrastructure investment)	
Privatization	Transfer of a public-sector means of produc- tion to private sector	
Loan/ Credit	Sum of money lent to a business/ manufac- turing sector	

 Table 2 Industrial policy

 instruments

sity. The dimension of policy intensity captures both the frequency of changes in the calibration of policy instruments and the direction of these changes (Knill et al., 2012).

Similar to policy targets and policy instruments that – depending on governmental decisions – may be adopted or dismantled over time, also the calibration of instruments can be subject to ups and downs, e.g., subsidy levels can rise or decrease or remain unchanged. As our goal is to provide an aggregate assessment of sectoral policy change, the measure of policy intensity captures the number of net changes in instrument calibration over time; i.e., the number of instances entailing level increases minus the number of instances entailing level decreases during our observation period. This way, we are able to identify the extent to which the calibration of an instrument has changed over time, indicating the level of governmental emphasis on regulating these aspects. This measure of regulatory activity in our framework goes beyond simply tracking the frequency of policy changes; it also captures the extent of industrial regulation by analyzing the direction of these changes. Higher intensity is characterized by frequent increases in the level of policy intervention. This measure addresses questions about the breadth of regulation applied to specific industrial policy targets or broader areas of industrial intervention. It also reveals whether certain instruments are frequently recalibrated, providing insights into the responsiveness and adaptability of the regulatory landscape.

The hypothetical example presented in Fig. 1 intends to illustrate the working of our portfolio approach. We report a hypothetical industrial policy portfolio for an exemplary country A for two points in time ( $t_1$  and  $t_2$ ). On the horizontal axis, we display the different



Fig. 1 Exemplary Policy Portfolios in Country A for two different time points

policy targets governments could potentially address. The vertical axis displays the range of potentially available policy instruments. The thick frame lines identify the target-instrument spaces for the different areas of industrial policy identified above (policy innovation; locational factors; competition; green growth from left to the right). White spaces indicate that governments have not adopted a certain target-instrument combination by the given point in time, i.e., a given policy target has not been addressed by a given instrument. Filled spaces, by contrast, indicate that a given target-instrument combination is in place.

While these measures provide information on the size and composition of national policy portfolios, we also report the extent to which adopted policy instruments have undergone change in the period of observation (policy intensity). This information is provided by coloring the boxes in different shades. The darker a given box (target-instrument-combination) is, the more increases in policy intensity occurred for a given instrument. In the given example, we observe that at observation point  $t_1$  (comparing the portfolio at time  $t_1$  to time point  $t_0$ ), a wide range of policy target and instrument combinations were already in place, as indicated by the relatively full portfolio. Compared to the previous time point  $t_0$ , the portfolio experienced minimal changes, as suggested by the relatively light boxes. By the time of the second observation point  $t_2$ , Country A significantly expanded the number of policy targets and instruments in the area of green growth. Moreover, our fictitious country has strongly increased the intensity of certain instruments (see e.g. international agreements as well as monitoring and subsidies), while other instruments were less affected by level changes.

### Empirical illustration: a comparison of US and German industrial policy

To showcase the advantages of our approach, we provide an explorative analysis of the industrial policy portfolios of the US and Germany. Both countries have highly developed and competitive economies, with a high manufacturing value added per capita (UNIDO, 2022). Yet, their industrial policy approaches are generally described as being highly different. The US is commonly considered a liberal market economy, which implies a lesser degree of intervention compared to Germany's coordinated market economy (Hall & Soskice, 2001). Unlike Germany, the US government has not openly endorsed industrial policies, as affirmed by state representatives (Stiglitz et al., 2013; Wade, 2014). Scholars have argued that attempts at implementing industrial policies in the US have faced obstacles due to coordination issues and a perceived lack of strategic direction (Ketels, 2007). In contrast, the German government has historically been recognized as a key and influential player in industrial policy, sometimes even accused of excessive regulation (Vitols, 1997). Johnstone et al. (2021) found that Germany is perceived as a proactive leader in industrial policy. Among EU member states, it is recognized for actively pursuing industrial regulation (Mazzucato, 2011; Chang et al., 2013).

Our analysis, as shown below, validates not only the viability of our approach but also highlights the renowned differences between the industrial policies of Germany and the US, thereby enriching the existing narrative. Initially, one might assume stark disparities in policy outcomes between the two countries, yet our examination reveals a more subtle differentiation. Both countries display steady growth trends in their industrial policy portfolios, employing comparable sets of objectives and means. Furthermore, they exhibit similar magnitudes of policy recalibration over time. However, there is a distinct variation in the utilization of certain policy instruments and the focus (policy area) of governmental action, corroborating previously documented accounts of German and US industrial policy.

Our investigation period spans from 1975 to 2020. We collected original federal laws using the advanced search features available on national legal databases and supplemented our data with secondary literature on national industrial policy measures. Our focus on national legislation ensures a uniform application across countries, making it a reliable and comparable metric. This approach simplifies comparison by providing a consistent measure of government intervention and reduces complexity by excluding the variability introduced by sub-national legislation. Our definition of a policy acknowledges that a single law may encompass multiple industrial policy measures. For each policy, we recorded its policy area, target, and instrument, along with the directionality of change, to assess its intensity. The data collection was carried out by team members and subsequently subjected to a secondary review by another team member to ensure methodological rigor.

Our data provides us with the ability to analyze changes in the number and composition of policy targets and policy instruments as well as policy intensity over time. of policy portfolios. To do so, we compare the industrial policy portfolios (similar to the example in Fig. 1) for both countries at beginning (1980), the middle (2000), and end (2020) of our observation period (see Fig. 2). This way, we are able to systematically compare changes in industrial policy outputs both across countries and over time.

#### General patterns of portfolio change

From a general perspective, our analysis reveals a range of common trends and developments characterizing policy developments in both countries. First, our data show that the size of their respective industrial policy portfolios was already substantial by 1980, indicating that many of the targets and instruments within the scope of these portfolios had already been implemented at that point in time. Overall, Germany had 102 target-instrument-combinations in place and the US 122, of 240 possible target-instrument-combinations. Second, and in view of an already rather saturated policy stock, the policy portfolios in both countries grew rather moderately in size over time. Over the course of our study period, only 17 new combinations of industrial policy targets and instruments were introduced in both countries.

Third, and again similar for both countries, we observe that dynamics of policy change manifested themselves to a much lesser extent in the introduction of new targets or instruments, but primarily in pronounced increases in policy intensity. In other words, policy changes occurred essentially through changes in the calibration of already existing policy instruments. Germany, for instance, already had established planning instruments to ensure a skilled workforce prior to 1981 when it initiated a new training program in response to emerging technological demands, marking a change of the existing policy rather than the introduction of an entirely new one. Similarly, the extension of the federal research program in the US in 1976, which introduced substantial grants specifically aimed at advancing electric vehicle technologies, brought about a shift in the intensity of the existing federal research framework by incorporating vehicles as a focus of research activities.



Fig. 2 Policy Portfolios of Germany and the US in 1980, 2000, and 2020

## Policy change dynamics across areas

Although these overarching patterns of policy change display relatively similar trends in both countries, significant distinctions emerge upon closer examination of specific developments. This holds in particular when taking a closer look at the areas that had been subject to higher or lower intensity changes over time. Our data show that the 'shading' of the different target-instrument combinations varies significantly between the US and Germany, indicating that intensity changes did *not* occur uniformly across all areas, targets, and instruments in the respective policy portfolios. In other words: there is considerable variation in the emphasis the two countries placed on different target-instrument combinations over the course of time.

obstacles in the advancement of energy technologies.

When examining innovation policies (*first thick box from the left*), a marked contrast is evident between the United States and Germany. Our analysis of portfolio data indicates a substantially greater increase in policy intensity in the US, reflected by a higher degree of shading. In contrast, Germany's target-instrument combinations show only minor darkening, implying that instrument calibration has not undergone the same level of change as in the US. Taken together, these findings suggest that the US has placed a much stronger emphasis on innovation within its industrial policy compared to Germany. The US has consistently made substantial public investments in fostering innovation, exemplified by the establishment of government agencies such as the Defense Advanced Research Projects Agency (DARPA) in 1958. Over the years, this policy instrument has undergone several recalibrations, with notable changes such as the passage of legislation in 2007 to create the Advanced Research Projects Agency-Energy (ARPA-E) specifically aimed at addressing

Exploring the topic of locational factors (*second thick box from the left*), by contrast, presents a strikingly different picture. German industrial policy has long prioritized this area, making it a major focus, while the US has demonstrated relatively little adjustment in its approach over time. Germany has consistently augmented its financial commitments to Small and Medium-sized Enterprises (SMEs) and has strategically fostered a robust framework that highlights the country as an optimal manufacturing hub, Germany has remained steadfast in escalating its financial support for SMEs, cultivating a sturdy infrastructure that underlines the country's suitability as an exemplary manufacturing hub. This is a stark contrast to the US approach, which has been relatively static and lacks the same level of commitment to locational factors.

This commitment is vividly illustrated in the government's handling of the German reunification. During this time, significant modifications were made to existing industry taxation policies, ensuring much-needed support for companies operating in the former Democratic Republic of Germany (GDR) and promoting balanced economic growth in economically challenged regions. For instance, in 1991, a groundbreaking law was enacted that enabled businesses in the former GDR regions to deduct between 8 and 12% of their total purchases of new assets for tax purposes. This proved to be a crucial incentive, sparking a surge of economic growth within these regions.

When turning to the area of competition regulation (*third thick box from the left*), similar trends can be observed in both countries. The calibration of existing instruments has been altered continuously, as evidenced by the gradual darkening of the policy portfolio in this area. Both countries have placed considerable attention on regulating and promoting competition and have made changes to their policy portfolios in this area. This suggests that the US and Germany did not solely rely on market forces to regulate competition but instead opted to increase the intensity of policies in this area. The US, for instance, had already introduced procedures to foster trade with foreign nations when it passed an Act in 1975 that created fast track authority for the President to negotiate trade agreements that Congress can approve or disapprove but cannot amend or filibuster. This change to the intensity of an existing policy was meant to foster competition and stimulate economic growth. In Germany, we can also trace several instances of policy change activities in this field of industrial policies. For instance, prior to 1981, the obligation to inform the cartel office about company mergers was only mandatory if they led to a market share of 25%. However, a revision to the competition law introduced an additional criterion: any entity acquiring 25% of a company

must also notify the office. This modification has amplified the level of scrutiny over cartel activities and bolstered the monitoring of merger proceedings. These examples are just two illustrations among numerous instances where both the US and Germany have increased the intensity of their competition policies.

Finally, the area of green transformation in the policy portfolio (fourth thick box from the *left*) reveals that the US initiated policies for promoting sustainable industrial growth much earlier, as seen in the portfolio figures for 1980 and 1990. During these early years of the investigation period, the US industrial policy portfolio is notably more "populated" in the area of green transformation. However, once introduced, rather few subsequent increases in policy intensity took place. In contrast, Germany introduced green transformation targets and instruments much later, yet subsequent developments reveal a much more dynamic development in policy intensity than in the US. This suggests that policy dynamics in the field of green transformation differ significantly, with the US advancing earlier and Germany exhibiting overall higher policy intensity. An early example of renewable energy policy in the US is the 1978 Public Utility Regulatory Policies Act (PURPA). This Act brought forth significant provisions, including the establishment of mandatory purchase obligations for renewable energy-generated electricity. The majority of Germany's renewable energy policies took root in the early 2000s. Yet, the country's enhanced inclination for policy adaptation became particularly evident in 2012 with the introduction of a market integration model specifically designed for solar energy generation. This innovative component harmoniously bolstered the pre-existing strategies for broadening the utilization of renewable energy sources.

#### Policy change dynamics across instrument types

Having examined the development of policy intensity across various areas of the industrial policy portfolios and their corresponding targets, our focus now shifts towards identifying the specific types of policy instruments that underwent more significant changes in their calibration over time. This analytical dimension can tell us more about predominant governance strategies the US and Germany utilized to achieve their overarching objectives. The darkening shading of the policy portfolios visualizes that – across the four areas – certain policy instruments have undergone more frequent changes than others. This enables us to discern national industrial policy strategies in greater detail.

The empirical evaluation reveals that the levels of taxes, subsidies, and permits underwent more increases in Germany than they did in the US. By contrast, in the US, there were more changes in instrument calibration of R&D support measures, planning instruments, and public investments. The intensity of certain policy instruments, such as product standards, was increased to a similar degree in both countries. Generally, the policy intensity of market-based instruments in the US has gradually increased, while changes in instrument calibrations in Germany mostly concern regulatory measures. In the US, we observe that the intensity of R&D policies has primarily evolved through incremental changes, such as increased federal grants and the establishment of dedicated research departments. Additionally, public investments have been consistently augmented and introduced on multiple occasions. A notable instance occurred with the enactment of the Stevenson-Wydler Technology Innovation Act in 1980. This legislation created the Office of Industrial Technology, which further reinforced the emphasis on technological advancements and innovation within the

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country. In contrast, Germany has employed highly specific operating regulations as a significant instrument of its policy approach. For instance, in 2006, a regulation was introduced that mandated the implementation of a stricter quality management system and outlined specific manufacturing practices for pharmaceutical facilities. This regulatory measure aimed to ensure quality standards and compliance within the pharmaceutical industry. Another facet of regulatory policy evolution in Germany involves the adjustment of the manufacturing permitting process. In 1990, for instance, a law was enacted that required permits for genetic engineering. Over time, the parameters of this law have been adjusted to accommodate different scenarios and evolving circumstances. These examples highlight the distinct approaches taken by the US and Germany in shaping their policy instruments.

# Discussion

Our research findings reveal that the rise in policy intensity differs in terms of focus between the two countries. In the US, there has been a significant increase in policy support for innovation, while in Germany, the emphasis appears to be more on locational factors, with a less pronounced trend of increased policy support for innovation. It is important to note that our article does not claim to offer definitive insights into the causes and consequences of these specific areas of national industrial policy. However, it is worthwhile to contextualize these findings within the broader framework of industrial performance as well as the existing theoretical literature. This approach allows us to evaluate whether our findings align with empirical evidence and theoretical accounts of industrial policies.

Our analysis demonstrates the importance of considering factors beyond governmental expenditures alone to gain valuable context for comprehending the variations in outcomes resulting from industrial policymaking. For instance, when using spending on R&D as a proxy of industrial policies aimed at fostering innovation, a superficial comparison suggests that Germany and the US are quite similar. However, despite both countries exhibiting similar levels of gross domestic expenditure on R&D (as illustrated in Fig. 3), the US surpasses Germany in terms of innovative capacity. This is evident in the 2022 Global Innovation



Fig. 3 R&D spending in percent of GDP compared to OECD average

Index, where the US ranked second, while Germany secured the eighth position. Moreover, previous assessments conducted by the World Intellectual Property Organization (2022) consistently rated the US higher than Germany. The disparity between R&D spending and innovative capacity indicates that government expenditure alone does not serve as an optimal proxy for evaluating the effectiveness of industrial policies. Consequently, it becomes evident that the nuances associated with different policy types can significantly contribute to explaining these outcomes. Specifically, when examining innovation-related industrial policies, our data reveals a substantially higher policy intensity in the US compared to Germany. This discrepancy potentially elucidates the differences in innovative capacity and emphasizes the significance of considering regulatory measures in addition to financial investments when assessing a country's policy portfolio. These findings underscore the limitations of relying on proxies in policy analysis.

Within the realm of policy outcomes, another intriguing contrast emerges between the US and Germany. The former showcases a notable inclination toward innovation, whereas Germany sets itself apart by achieving substantial value generated through its manufacturing sector. Germany has established itself as a robust manufacturing hub, with manufacturing contributing nearly one-fifth of the country's gross value added. Remarkably, manufacturing has consistently made a more substantial contribution to Germany's GDP than it has to that of the US over the span of several decades. In 2021, manufacturing accounted for 19% of Germany's GDP, while in the United States, it represented only 11%. This stark contrast is further emphasized when comparing it to the European average of 15% in the same year (World Bank, 2023). The substantial emphasis on locational factors in policy-making aligns with Germany's impressive manufacturing performance.

While our data thus suggest some association between high policy intensity and the areas in which the countries exhibit superior performance, it is important to note that this paper does not make any claims about causality. There are several plausible explanations for these findings. One possibility is that the emphasis on specific areas of industrial policy in both countries contributes positively to the observed outcomes. Conversely, it is also possible that policy changes are tailored to leverage national strengths. Furthermore, it is crucial to consider that other factors may influence these relationships. To gain a deeper understanding of these dynamics, future research could employ time-series analysis using our dataset, which holds the potential to provide valuable insights into these complex relationships.

The findings presented in this section challenge well-established theoretical assumptions regarding industrial policy. The prevailing perception has often depicted the US as having minimal market interventions, as portrayed in the Varieties of Capitalism (VoC) literature. According to this perspective, as a liberal market economy, the US would be expected to engage in fewer interventions in the realm of industrial policy (Hall & Soskice, 2001), resulting in lower overall policy intensity. Contrary to expectations derived from the VoC framework, our data demonstrates that the overall level of policy intensity in the US increased to a similar extent as in Germany, a country typically categorized as a coordinated market economy within the VoC literature. The US intervened in the market to a greater extent than initially predicted by consistently adjusting its industrial policies, particularly intensifying measures related to innovation. This finding is consistent with DARPA-related literature (Bonvillian, 2019). While the VoC approach argues that innovation in liberal market economies is driven by competitive market dynamics facilitated by reduced regulatory oversight (Hall & Soskice, 2001), our data diverge from this proposition. It suggests that the US employs numerous target-instrument combinations to foster innovation and frequently adjusts these, indicating a significant focus on regulatory intervention in this area of industrial policy. Given that a major criticism of the VoC framework is its tendency to downplay state action and view it as relatively static (Streeck & Thelen, 2005; Schmidt, 2007; Hancké et al., 2007), our approach addresses this by emphasizing the complexity of state action. We explore policy change in market regulation, with a primary focus on the dynamic nature of state intervention, which from a theoretical standpoint aligns well with the direction proposed by critics of the VoC framework. This approach demonstrates how a methodological

framework can further develop theories of market regulation.

# Conclusion

Although there is a growing body of research on the design and development of industrial policies, the field of political science that explores this topic through empirical investigation remains largely uncharted. In this article, we aimed to enhance the understanding of industrial policymaking by providing a conceptual framework that enables comparisons of government activities across different countries and time periods. We addressed gaps in existing research by moving away from normative considerations and the exclusive focus on government expenditure as the sole output of industrial policy. Instead, we applied the policy portfolio approach to the field of industrial policies. Our analysis of policy change was based on three analytical dimensions: the targets of industrial policy, the policy instruments employed to achieve those targets, and changes in the level of existing policy measures. The latter refers to adjustments in the intensity of a policy framework, such as changes to subsidies or permit requirements. Additionally, we identified four areas of intervention -innovation, location factors, competition, and green transformation- to facilitate the comparison of government priorities in industrial policymaking. This conceptualization incorporates elements of existing research while also enabling a systematic examination of intertemporal and cross-country patterns, dynamics, and forms of intervention.

To demonstrate the practical applicability of our approach, we conducted a comparative analysis of the industrial policy portfolios of the US and Germany from 1975 to 2020. In our data collection process, we recorded policy targets, instruments, and their specific calibration through federal laws. Unlike previous approaches that solely rely on financial proxies, our methodology additionally incorporates regulatory measures such as permits, procedural standards, and monitoring, which have often been overlooked. We found similar growth patterns in the overall size of the policy portfolios in both countries, with only a moderate increase in new target-instrument combinations. However, we observed a significant increase in policy intensity, indicating the evolving nature of industrial policy. We observed that neither country dismantled industrial policies by eliminating or reducing the scope of existing measures. This observation aligns with the literature on policy dismantling, which posits that dismantling is a much rarer phenomenon compared to changes that occur through increasing policy intensity (Jordan et al., 2013; Bauer & Knill, 2012). Notably, the intensity increases followed distinct patterns, with the US implementing more changes in the calibration of innovation-related policies compared to Germany, which focused more on adjustments to locational factors. Divergent dynamics were also observed in the area of green transformation, where the US pioneered policies and Germany caught up later but made more frequent changes in instrument calibration thereafter. In addition, our approach facilitated an examination of the methods employed by the countries. We observed that the US predominantly relied on increasing the level of market-based instruments, whereas Germany pursued a distinct approach by making more frequent changes in the calibration of regulatory measures. This difference in policy strategies between the two countries underscores the importance of considering the nuances and unique approaches adopted by different nations in their industrial policymaking processes.

While our approach has proven to be valuable in advancing the understanding of industrial policymaking, it does have clear limitations. For instance, our data only encompasses regulations in the manufacturing sector, which means that measures in other sectors such as the financial and service industries are not captured. However, the conceptualization we have developed can be expanded to encompass measures directed at regulating a wider range of industrial activities. One of the strengths of our approach is its flexibility, which allows for potential adaptation and inclusion of diverse policy measures beyond manufacturing, making it a versatile framework for studying industrial policies in various contexts.

In conclusion, the conceptual framework presented in this article offers an opportunity to advance the field of industrial policy research by providing a systematic and comprehensive approach to conducting comparative analysis, evaluating long-term effects, and exploring the interplay between industrial policy and other domains such as economics, social welfare, and environmental sustainability. Furthermore, the utilization of our policy portfolio approach allows for a deeper understanding of the dynamic nature of industrial policy and its potential impacts, including the rapidly emerging technologies like artificial intelligence. The integration of these approaches could ultimately lead to more informed and effective decision-making in industrial policy formulation and implementation, which can have significant implications for economic development and societal well-being.

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# References

Aghion, P., Cai, J., Dewatripont, M., Du, L., Harrison, A., & Legros, P. (2015). Industrial policy and competition. American Economic Journal: Macroeconomics, 7(4), 1–32.

Aiginger, K., & Rodrik, D. (2020). Rebirth of Industrial Policy and an agenda for the twenty-First Century. Journal of Industry Competition and Trade, 20(2), 189–207. https://doi.org/10.1007/s10842-019-00322-3

- Altenburg, T., & Rodrik, D. (2017). Green industrial policy: Accelerating structural change towards wealthy green economies. In T. Altenburg, & C. Assmann (Eds.), Green Industrial Policy. Concept, policies, Country experiences. UN Environment.
- and Industrial Policy for Developing Countries In D. Rodrik & M. Rosenzweig (Eds.), Handbook of Development Economics (Vol. 5, pp. 4039–4214). Elsevier. https://doi.org/10.1016/B978-0-444-52944-2.00 001-X
- Andreoni, A., & Chang, H. J. (2019). The political economy of industrial policy: Structural interdependencies, policy alignment and conflict management. *Structural change and economic dynamics*, 48(C), 136–150. https://EconPapers.repec.org/RePEc:eee:streco:v:48:y:2019:i:c:p:136-150
- Atkinson, M. M., & Coleman, W. D. (1989). Strong states and weak states: Sectoral policy networks in advanced capitalist economies. *British Journal of Political Science*, 19(1), 47–67.
- Bauer, M. W., & Knill, C. (2012). Understanding policy dismantling: an analytical framework. *Dismantling public policy: Preferences, strategies, and effects*, 30–56.
- Bianchi, P., & Labory, S. (2006). From ,old' industrial to ,new' industrial development policies. Edward Elgar Publishing.
- Bonvillian, W. B. (2019). The connected science model for innovation—The DARPA model. The DARPA Model for Transformative Technologies: Perspectives on the US Defense Advanced Research Projects Agency, 77–118.
- Capasso, M., Iversen, E. J., Klitkou, A., & Sandven, T. (2019a). Which region to choose for an industrial policy? A research path to highlight restructuring opportunities. *European Planning Studies*, 27(8), 1461–1482.
- Capasso, M., Hansen, T., Heiberg, J., Klitkou, A., & Steen, M. (2019b). Green growth–A synthesis of scientific findings. *Technological Forecasting and Social Change*, 146, 390–402.
- Chang, H. J., Andreoni, A., & Kuan, M. L. (2013). International industrial policy experiences and the lessons for the UK.
- Chen, J., & Xie, L. (2019). Industrial policy, structural transformation and economic growth: Evidence from China. Frontiers of Business Research in China, 13(1), 18. https://doi.org/10.1186/s11782-019-0065-y
- Cimoli, M., Dosi, G., Nelson, R. R., & Stiglitz, J. (2006). Institutions and policies shaping industrial development: an introductory note.
- Cohen, E. (2009). *Theoretical foundations of industrial policy, EIB Papers 4/2006*. European Investment Bank, Economics Department.
- Deineko, L., Tsyplitska, O., Hrebeniuk, N., & Deineko, O. (2021). Transition from Vertical to Horizontal Industrial Policy in Ukraine: Effects on Industrial Sector Growth. SHS Web Conf, 100, 01005. https://d oi.org/10.1051/shsconf/202110001005
- Evenett, S. J. (2003). Study on issues relating to a possible multilateral framework on competition policy. World Trade Organization Working Group on the Interaction between Trade and Competition Policy(228), 167.
- Evenett, S., Jakubik, A., Martín, F., & Ruta, M. (2024). The return of industrial policy in data. The World Economy.
- Fernandez-i-Marin, X., Knill, C., & Steinebach, Y. (2021). Studying policy design quality in comparative perspective. American Political Science Review, 115(3), 931–947.
- Ginsburg, T., & Cooter, R. (2003). Leximetrics: Why the same laws are longer in some countries than others. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.456520
- Guerrieri, P., & Meliciani, V. (2005). Technology and international competitiveness: The interdependence between manufacturing and producer services. *Structural Change and Economic Dynamics*, 16(4), 489–502.
- Hall, P. A. (1986). Governing the economy: The politics of state intervention in Britain and France. Oxford University Press.
- Hall, P. A., & Soskice, D. (2001). An introduction to varieties of capitalism. op cit, 21-27.
- Hancké, B., Rhodes, M., & Thatcher, M. (2007). Beyond varieties of capitalism: Conflict, contradictions, and complementarities in the European economy. Oxford University Press.
- Harrison, A., & Rodríguez-Clare, A. (2010). Trade. Foreign Investment.
- Hausmann, R., & Klinger, B. (2008). South Africa's export predicament. *Economics of Transition*, 16(4), 609–637.
- Hausmann, R., Rodrik, D., & Sabel, C. (2007). Reconfiguring industrial policy: a framework with an application to South Africa. *Harvard University Center for International Development Working Paper, No. 168.*
- Hood, C., & Margetts, H. (2007). The tools of government in the digital age. Bloomsbury Publishing.
- Howlett, M., & Rayner, J. (2013). Patching vs packaging in policy formulation: Assessing policy portfolio design. *Politics and Governance*, 1(2), 170–182.
- Huang, C. Y., Shyu, J. Z., & Tzeng, G. H. (2007). Reconfiguring the innovation policy portfolios for Taiwan's SIP Mall industry. *Technovation*, 27(12), 744–765.

- Jacobs, M. (2012). *Green growth: Economic theory and political discourse* (Vol. 108). Grantham Research Institute on Climate Change and the Environment London.
- Johnstone, P., Rogge, K. S., Kivimaa, P., Fratini, C. F., & Primmer, E. (2021). Exploring the re-emergence of industrial policy: Perceptions regarding low-carbon energy transitions in Germany, the United Kingdom and Denmark. *Energy Research & Social Science*, 74, 101889.
- Jordan, A., Bauer, M. W., & Green-Pedersen, C. (2013). Policy dismantling. Journal of European Public Policy, 20(5), 795–805.
- Kaldor, N. (1981). The role of increasing returns, technical progress and cumulative causation in the theory of international trade and economic growth Le rôle Des Revenus croissants, Du progrès technique et des effets cumulatifs dans la théorie du commerce international et de la croissance économique. *Economie Appliquée: Archives de l'ISMEA*, 34(4), 593–617.
- Kellermann, C. (2015). Die Organisation des Washinton Consensus. Der Internationale W\u00e4hrungsfonds und seine Rolle in der internationalen Finanzarchitektur: transcript. https://doi.org/10.14361/9783839405536
- Knill, C., Schulze, K., & Tosun, J. (2012). Regulatory policy outputs and impacts: Exploring a complex relationship. *Regulation & Governance*, 6(4), 427–444.
- Lane, N. (2020). The New Empirics of Industrial Policy. Journal of Industry Competition and Trade, 20(2), 209–234. https://doi.org/10.1007/s10842-019-00323-2
- Lee, K. (2013). Capability failure and industrial policy to move beyond the middle-income trap: From tradebased to technology-based specialization. *The industrial policy revolution I* (pp. 244–272). Springer.
- Leitham, S., McQuaid, R. W., & Nelson, J. D. (2000). The influence of transport on industrial location choice: A stated preference experiment. *Transportation Research Part A: Policy and Practice*, 34(7), 515–535.

Mazzucato, M. (2011). The Entrepeneurial State (S. Wight, Ed.). Demos.

- Mazzucato, M. (2016). From market fixing to market-creating: A new framework for innovation policy. Industry and Innovation, 23(2), 140–156.
- Metge, J., & Weiss, P. (2011). Protecting the domestic market: Industrial Policy and Strategic Firm Behavior. The Singapore Economic Review, 56(02), 159–174.
- Naudé, W. (2010). Industrial Policy. In (Vol. 2010). UNU-WIDER.
- OECD (2023). Gross domestic spending on R&D (indicator). Retrieved 29.3.2023 from.
- OECD (2022). OECD Reviews of Innovation Policy: Germany 2022. https://doi.org/10.1787/50b32331-en
- Oqubay, A. (2020). The Theory and Practice of Industrial Policy. In C. C. Arkebe Oqubay, Ha-Joon Chang, Richard Kozul-Wright (Ed.), *The Oxford Handbook of Industrial Policy*. Oxford University Press.
- Pack, H., & Saggi, K. (2006). Is there a case for industrial policy? A critical survey. The World Bank Research Observer, 21(2), 267–297.
- Riess, A., & Välilä, T. (2006). Industrial policy: A tale of innovators, champions, and B52s. *EIB Papers*, 11(1), 10–34.
- Rodrik, D. (2008). Normalizing industrial policy. World Bank Commission on Growth and Development Working Paper, No.3. https://openknowledge.worldbank.org/handle/10986/28009
- Rodrik, D., & Sabel, C. (2019). Building a Good Jobs Economy. In. Working Paper.
- Schmidt, V. A. (2007). Bringing the state back into the varieties of capitalism and discourse back into the explanation of change. CES Germany & Europe Working Papers, 7(3).
- Shapiro, H. (2007). Industrial policy and growth.
- Stiglitz, J. E., Lin, J. Y., & Monga, C. (2013). The rejuvenation of industrial policy. World Bank Policy Research Working Paper(6628).
- Taylor, T. K., & Montera, A. (2021). History Re-written: Misconceptions of U.S. Trade and Industrial Policy and the influence of Neoliberalism. *Review of Economic Perspectives*, 21(1), 3–25. https://doi.org/10. 2478/revecp-2021-0001
- Tisdall, S. (2022). 10.April 2022). Germany must shake off its torpor and play its full role against Putin. *The Guardian*. https://www.theguardian.com/commentisfree/2022/apr/10/germany-role-against-delusi onal-putin
- UNIDO (2022). United Nations Statistics Database https://stat.unido.org/.
- UNIDO (2019). Statistcial indicators of inclusive and sustainable industrial growth: Biennial Progress Report 2019. United Nations Industrial Development Organization. https://www.unido.org/sites/defaul t/files/files/2020-07/SDG\_report\_final.pdf
- van Dam, A., & Frenken, K. (2020). Vertical vs. Horizontal Policy in a Capabilities Model of Economic Development.
- Vitols, S. (1997). Financial Systems and Industrial Policy in Germany and Great Britain. Regime Changes: Macroeconomic Policy and Financial Regulation in Europe from the 1930s to the 1990s, 221.
- Wade, R. H. (2014). 14 the paradox of US industrial policy: The developmental state in disguise. TRANS-FORMING ECONOMIES Making Industrial Policy work, 379.
- Warwick, K. (2013). Beyond Industrial Policy: Emerging issues and new trends. OECD Science Technology and Industry Policy Papers, 2. https://doi.org/10.1787/5k4869clw0xp-en

- Weiss, J. (2013). Industrial policy in the twenty-first century: challenges for the future. Pathways to Industrialization in the Twenty-First Century: New Challenges and Emerging Paradigms, 393–412.
- Weiss, J. (2015). Taxonomy of Industrial Policy [Working paper]. Inclusive and Sustainable Industrial Development Working Paper Series, 08/2015. https://www.unido.org/api/opentext/documents/downlo ad/9925558/unido-file-9925558
- Weiss, J. (2020). Neoclassical economic perspectives on industrial policy. In C. C. Arkebe Oqubay, Ha-Joon Chang, Richard Kozul-Wright (Ed.), *The Oxford Handbook of Industrial Policy*. Oxford University Press.
- Wilder, M. (2021). Industrial policy. Handbook of Business and Public Policy (pp. 309–324). Edward Elgar Publishing.
- Wilson, J., Wise, E., & Smith, M. (2022). Evidencing the benefits of cluster policies: Towards a generalised framework of effects. *Policy Sciences*, 55(2), 369–391. https://doi.org/10.1007/s11077-022-09460-8
- World Bank (2023). Manufacturing, value added (% of GDP) Germany, United States. Retrieved 25.3.2023 from https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=DE-US
- World Intellectual Property Organization (2022). Global Innovation Index 2022: What is the future of innovation-driven growth?.
- Wright, R. W., & Pauli, G. A. (1989). Comparative government-industry relations: Western Europe, United States and. Journal of International Business Studies.

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