# Strategies to Increase the Relative Participation of Industry in GDP and Mitigate Brazil's Deindustrialization Process

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#### ABSTRACT

Deindustrialization is a phenomenon that affects the economic performance of developed and developing countries. However, academic studies that evaluate strategies to promote the industrialization of a country, through information provided by industry experts, are scarce. This article aims to offer strategies to increase the relative participation of Brazilian industry in Gross Domestic Product (GDP), in order to mitigate the process of deindustrialization in the country. The DPSIR (Driving forces – Pressures – State – Impacts - Responses) method was used, as a means of mapping information from experts directly involved in industrial development in the areas of Economics, Public Law, Scientific Research, and Public and Private Management. Additionally, the TOPSIS method was used to prioritize the experts' responses in the order of implementation urgency. The main result of this work has been to reveal strategies that must be prioritized if industrialization in the country is to be promoted. In this respect, there is an evident need for the implementation of a planning agenda that takes into account the current Brazilian position.

**Keywords**: Industrial Development, Economic Development, Deindustrialization, DPSIR, TOPSIS.

## 1. INTRODUCTION

Manufacturing is the main driver of technical progress, raising the standard of living through increased income and productive investment. This reinforces the idea that manufacturing

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production is a relevant development strategy to promote the prosperity of a nation. Morceiro (2012) and Fries et al. (2019) state that Brazil envisioned and experienced a period of industrial growth between 1930 and 1980, transforming its participation in Gross Domestic Product (GDP). However, Brazil's economic conjuncture deteriorated after the 1980s, primarily as a result of high inflation, and the last 30 years have witnessed a considerable drop in the relative participation of the industrial sector in the Brazilian economy.

Various studies have determined that the Brazilian economy has undergone a process of deindustrialization (FURTADO, 1974; TAVARES, 1979; JENKINS; BARBOSA, 2012; JENKINS, 2015), one in which its industry has reduced overall participation in GDP in recent years. According to Fries et al (2019), this deindustrialization occurred because of a reduction in public (in the form of subsidies and public policies to promote industrial development) and private investment across a wide range of industrial sectors, placing the country at a disadvantage in terms of international competitiveness. Low investment is a reflection of the obstacles and inefficiencies across three spheres: government, companies and universities (precisely the spheres that make up the so-called triple propeller). Such obstacles derive from ineffective public policies, mismanagement, a lack of planning, and a lack of strategic vision, among many other factors (FRIES et al., 2019).

Suzigan and Furtado (2006) argue that industrial policy aims to promote economic development by stimulating strategic sectors, innovation and coordination between different economic instruments. They emphasize the need for clear policies, innovation and a new institutional organization. The policy adopted by the government between 2003 and 2006, despite having positive aspects, such as an emphasis on innovation and clear goals, also identified weaknesses, such as an incompatibility with macroeconomic policy, inconsistencies between economic instruments, and deficiencies in infrastructure and the science, technology and innovation system, in addition to a lack of coordination and political will. To develop an effective industrial policy, Suzigan and Furtado (2006) posit that it is essential to ensure compatibility with macroeconomic policy, coordinate economic instruments in a coherent manner, strengthen infrastructure and innovation systems, and ensure a strong political commitment. This matter was similarly addressed by Tavares (1979), who stated that significant failures in the continuity and coordination of industrial policies over the years, as well as a lack of long-term strategy and solid policies, had caused fragmentation in Brazilian industry and a lack of effective direction for its recovery. Mazzucato (2022) argues that the

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state should be seen as an active agent in the economy, capable of directing economic growth through innovative and inclusive public policies. The author proposes a new approach to public policy that emphasizes the importance of collaboration between the public and private sectors to foster innovation and ensure that the benefits of economic growth are widely distributed. Mazzucato (2022) suggests that a redefinition of the state's role would lead to more balanced and sustainable development, reduce economic inequalities and promote social well-being through the creation of new market and development opportunities.

In the context of the entrepreneurial condition identified by Mazzucato (2022), research shows that developed countries increasingly implement industrial policies. The research carried out by Juhász, Lane and Rodrik (2023) proposes that the implementation of industrial policies is vital to the economic development of a country for various reasons, such as: (i) promoting reindustrialization and modernization of the industrial sector; (ii) fostering technological innovation in strategic sectors; (iii) correcting market failures through financial support for long-term projects and sectors that require greater initial investment; (iv) creating high quality jobs; (v) increasing economic resilience by strengthening national productive chains, with less dependence on imports in strategic sectors; (vi) fostering the use of regulations, government purchases and public-private partnerships as industrial policy instruments; and (vii) encouraging the use of green technologies as a means of leading the country towards sustainable development and a low-carbon economy. According to Juhász, Lane and Rodrik (2023), these reasons explain the growing intention of developed countries (such as the USA, China and others) to adopt and expand industrial policies as a means of facing contemporary economic challenges, promoting innovation and ensuring economic competitiveness within the global setting.

Several studies agree that Latin America has generally failed to provide effective industrial development plans, more so efficient and long-term industrial policies. Latin America had, and in many cases still has, an economy based on commodity exports, to the detriment of higher value-added manufactured goods. The situation in Brazil is not much different, the country having failed to develop competitive, well-managed industries across various sectors. Dependence on imported technology and inputs, coupled with a lack of investment in research and development, have compromised innovation and the competitiveness of Brazil's national industry. In addition, there have been failures in the continuity and coordination of industrial policies over time. The absence of a long-term

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strategy and consistent policies has resulted in fragmentation and a lack of effective direction in the promotion of Brazilian industry (VAN NEUSS, 2018; BRESSER-PEREIRA; GALA, 2010; BÁRCENA; BIELSCHOWSKY; TORRES, 2022).

It is from this context that the research problem of the present article stems: the loss of relative participation of the industrial sector in Brazil's GDP, and the absence of a plan for mitigating the process of deindustrialization in the country. To address this problem, the objective of the present research is to offer strategies that may increase the relative participation of the transformation industry in national GDP. To this end, the DPSIR framework was chosen, being a method which is focused on identifying final objectives and means, as well as fully supporting the process of defining the criteria to be adopted for decision making (MARTTUNEN; LIENERT; BELTON, 2017). Bell (2012), it is relevant to note, states that DPSIR aims to analyze interconnections between the environment and society, structuring the problem to be analyzed coherently and cohesively, as well as using an easy-to-understand methodology appropriate for non-specialists in the area of problem structuring methods.

The present study contributes to industrial policy literature in many ways. Firstly, although industrial policy studies have focused on building from a theoretical basis, there is a lack of investigation utilizing primary or quantitative data (Ferraz et al., 2021). In this sense, the present article contributes by presenting strategies for industrial development from the perspective of experts in the areas of economics, public management, private administration, public law and academic researchers who, possessing demonstrable expertise in the area of economic development, agreed to participate in the research by responding to the study questionnaires. Secondly, this work is innovative in its application of the DPSIR and TOPSIS methods in the context of the formulation and prioritization of strategies to enhance industrial development. The DPSIR method is relevant within this context because it focuses on intermediate and final objectives, and contributes to the structuring of the problem of deindustrialization in such a way that the connections between the actors are interrelated, generating a virtuous cycle. Additionally, having identified the real need to prioritize expert responses after applying the DPSIR method, the TOPSIS method was adopted. The latter compares unit criteria and alternatives, and functions as a technique that evaluates the proximity of ideas to an ideal solution and classifies and prioritizes responses using the geometric distance of this ideal solution (MARTTUNEN; LIENERT; BELTON, 2017). Thirdly, this article contributes to the formulation of strategies to promote industrial policy in

Brazil. Worthy of note is the fact that this type of strategic formulation may also assist future studies in other developing countries that lack strategic plans within the area of industry, such as India and South Africa (VAN NEUS, 2018).

This article is structured into 5 sections, including the preceding introduction. Section 2 critically reviews the bibliography on deindustrialization in the world and in Brazil. Section 3 presents the DPSIR and TOPSIS methods. Section 4 discusses the results and applications of the methods. Section 5 concludes the article by addressing final considerations relating to the contributions of the article.

#### 2. DEINDUSTRIALIZATION

The purpose of this section is to contextualize the process of deindustrialization, considering its influencer variables and nuances.

#### 2.1 Industrialization worldwide

According to Rodrik (2015), deindustrialization in developed countries occurred due to a loss of industrial employment as a percentage of total employment, rather than being due to industry's lost participation in GDP, indicating that such deindustrialization was mature. The author cites the United States, where the percentage of industrial employment over total employment has been constantly falling since the 1950s, from about 25% to less than 10% today. However, the participation of industry in GDP has remained constant during this period, supporting the view that the deindustrialization that occurred in the US, and in other developed countries, such as England, Japan, Germany and, more recently, China, was mature (RODRIK, 2015; OLIVEIRA, 2003).

In essence, there are three deindustrialization patterns in the world: (i) what happened in developed countries, where there was a significant drop in industrial employment percentage over total employment, but a constant participation of industry in GDP; (ii) what happened in Asian countries, where there was an increase in the percentage of industrial employment over total employment and increased industry in GDP; and (iii) what happened in Latin American and African countries, where there was a drop both in employment and the participation of industry in GDP (RODRIK, 2015).

Observing industrialization from the point of view of late industrialization, Oliveira (2003) states that the countries considered late industrializers (US, Germany and France)

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progressed based on the commercialization of surpluses produced initially by English industries, and then later national industry. This occurred because these countries soon learned to produce internally those goods that had been previously imported from England, thus generating both the industrialization desired and the qualified personnel to achieve it. Oliveira also emphasizes that financing industrialization in the countries mentioned was, mostly, done through state investment or via investment banks. This was especially true in Germany, where banks made major capital contributions to industry. Therefore, the late industrialization process reproduced the British production narrative, and gave rise to national capitalism similar to English capitalism: and from such observation we can place Germany, France and the USA together as late industrializers (OLIVEIRA, 2003; RODRIK, 2015).

Oliveira (2003) posits that this amounted to the first wave of late industrialization. The second wave occurred during the great depression between 1873 and 1896, of which Russia and Japan were precursors, with others following. At the same time the second industrial revolution took place, with the advent of electricity in factories, heavy chemistry and combustion engines.

According to Kim and Know (2017), the protectionism advocated by traditionalists to protect their industries against globalized production actually proved harmful to national economies, increasing production costs and making internal production and the maintenance of jobs unfeasible. As the authors attest, protectionism is a strategy that turns against an economy within a short period of time (KIM; KNOW, 2017).

According to Kim and Know (2017), neoliberals advocate that offshoring leverages the economy, as it enables developing countries to increase their job rates in industry (because they have lower labor costs) while developed countries could deliver cheaper and more competitive products to the globalized world, allowing them to devote greater time to the research and development of new products and technologies, thus adding value to the goods produced. Kim and Know (2017) and Tavares (1979) warn that in order for neoliberalism to work, it is necessary to decrease state intervention in the marketplace. Some neoliberal economists, such as Howard Pack and Kamal Saggi, further maintain that industrial policies are unnecessary when operating in a globalized and free-trade market.

Kim and Know (2017) claim that offshoring by the USA has brought with it jobs and technologies (knowledge) to producing countries, while leaving a gap regarding learning and innovation. According to the authors, the reverse occurred in South Korea, which had an

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increase in domestic employment and industrial capacity focused on technology and a knowledge-oriented economy, rather than inputs. This difference may be viewed as founded on the focus given in South Korea to knowledge and investment, via the development of collaborative innovation networks (comprised of real and effective partnerships between universities, companies and governments) (KIM; KNOW, 2017).

South Korea's recipe for success has been, Kim and Know (2017) state, governmental investment: in the form of political priority from the 2000s onwards, in the construction of an industrial ecosystem focused on innovation, and through the creation of research and development funding intended for innovation within governmental production institutes that, in collaboration with private companies, have produced new technologies and created a collaborative Korean innovation network. In the United States, while the Government gave simple tax credits for research and development and direct financial support to individual companies (as a rule, large corporations), the Korean government focused on innovative industrial networks and research consortia involving universities, companies (small and medium-sized, at first) and the government itself (KIM; KNOW, 2017).

China has achieved rapid growth since introducing economic reform and opening its market to the world in 1978, lifting over 700 million of its people above the poverty line in the process. Since entering the World Trade Organization (WTO) in 2001, China has welcomed many factories to its shores, in search of lower manufacturing costs as well as an abundant supply of capital and technology, which by means of knowledge, has enshrined its competitive advantage (LIN; WANG, 2020).

However, according to Harvey (2012), Harvey (2016) and Ruiz (2006), China already had the largest per capita income in the world until the 15th Century, with many technological innovations (for the time). Then, despite losing its position as world leader in terms of per capita income to Europe in 1500, it still boasted the largest national product until the early nineteenth century.

Masiero and Coelho (2014) and Nolan (2002) stress that China's industrial policy, based on the opening of its market between 1980 and 1990, was regulated and controlled by the state, ensuring that the plan was actually achieved. And, from the 1990s, when the Chinese economy opened in its most dynamic form, and especially in 2001 when China joined the WTO, the country greatly strengthened and enhanced its export economy, determining the economic structures of many countries impacted by China's industrial prowess. The extent of

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China's investment in manufacturing exports meant that in 2007 there were 1.7 million jobs in the R&D (Research and Development) sector, more than 80% of which were scientists and engineers: a percentage exceeding that which existed at the time in Japan, the United Kingdom, France and Germany (MASIERO; COELHO, 2014; NOLAN, 2002).

According to Van Neuss (2018), the process of industrialization in Latin America followed the development of industries based on intensive labor and construction. The author claims that Latin American countries began the process of deindustrialization in the 1980s, before industry had reached its peak in terms of technological development, which had a considerable impact on unemployment and income within the economically active population. This led these countries to focus their efforts on primary areas such as mining, extraction and agriculture, resulting in economic regression. In fact, the rise of globalization was a major cause of disruption for economies that were not sufficiently prepared to compete with the world's largest exporters at a global level. It is worthy of note that this economic phenomenon was similarly faced by African countries (VAN NEUSS, 2018).

The work of Corden (1984), who disseminated the concept of Dutch disease, is also worthy of mention. The author states that Dutch disease is an economic phenomenon that occurs when the discovery or exploitation of natural resources, such as oil, natural gas, minerals or even an expanding economic sector, results in negative consequences for a country's economy.

Corden (1984) attests that Dutch disease usually manifests itself through three main mechanisms: (1) appreciation of local currency; (2) deindustrialization; (3) "Income effect" (with the exploitation of natural resources, a country experiences a significant increase in income and profits, which may lead to a general increase in wages and production costs in other sectors of its economy).

Kaldor (2021) states that problems of taxation and economic development are interconnected. The tax potential of a country depends on administrative efficiency, the distribution of income, the use of resources and the political will to implement effective policies. Taxation, according to the author, plays a key role in promoting economic development.

#### 2.2 Deindustrialization in Brazil

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Furtado (1974) and Tavares (1979) point out that Brazil's economic development was strongly influenced by a model of industrialization and import replacement based on the belief that growth could be achieved through internal production and reduced external dependence. This led to a period of intense industrial activity and the increased production of manufactured goods within the country.

Protectionism was then applied to national industry through high import tariffs and restrictions on imports of manufactured products. These measures aimed to foster internal production and stimulate the growth of the industrial sector. Brazilian industry suffered, however, in the attempt to compete with imported products in terms of quality and cost (FURTADO, 1974; TAVARES, 1979; JENKINS; BARBOSA, 2012; JENKINS, 2015; CALLEGARI; MELO; CARVALHO, 2018).

Tavares (1979) notes that Brazilian industrial policy was marked by a series of state interventions, which aimed to promote industrialization and boost economic growth. The author points out that the state played a central role in the formulation and implementation of these policies through the creation of tax incentives and subsidies, thereby protecting the national industry. One of the main strategies adopted by means of Brazilian industrial policy was the substitution of imports. Through high import taxes and commercial restrictions, the country sought to stimulate internal production and reduce external dependence. Tavares recognizes that this strategy was successful in boosting industrialization in Brazil, allowing the growth of key sectors of the economy, but points out that, despite the advances, the country failed to develop competitiveness and sophistication in a number of industrial sectors. The author argues that dependence on imported technology and inputs and a lack of investment in research and development were factors that impaired innovation and the competitiveness of the national industry. Additionally, there was a failure in the continuity and coordination of industrial policies over time; the lack of a long-term strategy and inconsistent policies led to fragmentation and ineffectiveness in terms of the promotion of Brazilian industry (TAVARES, 1979).

Bacha and Bolle (2015) affirm that the future of Brazilian industrial development depends primarily on the integration of the primary, secondary and tertiary sectors - in a collaborative, innovative and efficient network. The authors claim that Brazil has continued to undergo a process of deindustrialization, characteristic of Dutch disease - especially after the 1990s - but believe that the process will be reversible with efficient public policies.

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Figure 1 details the participation of industry in Brazil's GDP from 1947 to 2021. In 1985 industry participated 48% of the value added to Brazilian GDP, the highest value in the historical series. After the Brazilian economy opened up to international competition in the 1990s, industrial participation in GDP fell, remaining stable (but low) between 1996 and 2013 at 26%, on average. After 2013 industrial participation in GDP continued to fall, reaching 21.1% in 2017, its worst level since the beginning of the series. Between 2014 and 2016, GDP fell 8%. Industry closed 2021 with a participation of 23.6% in GDP, representing a slight recovery (MISHRA; THEERTHA; AMONCAR; L, 2022; CNI, 2023). These statistics clearly demonstrate the process of slowdown in Brazil's industry. However, it is important to note that the country holds 13th place in terms of participation in global transformation industry production, at 1.48%. By way of comparison, China holds first place with 24.83% and the United States second place with 16.27% of global industrial production (CNI, 2023).



Source: CNI (2023).

From an analysis of articles taken for bibliographic review, drawn from the Web of Science, Scopus and Scielo databases to determine the factors that led to the deindustrialization process in Brazil, the main factors presented by the authors selected are given in Table 1.

Table 1 – The main factors that led to the industrialization process in Brazil.

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Factor	Description	Authors			
	Public policies to promote sectors in which Brazil already held a	(NASSIF; FEIJÓ; ARAÚJO, 2014); (SAUER; BALESTRO;			
1	certain competitive advantage, such as agriculture, mining and	SCHNEIDER, 2017); (MAGACHO; MCCOMBIE;			
	construction, to the detriment of the other sectors of the economy	GUILHOTO, 2018)			
2	Total and multilateral opening up of free trade in the 1990s	(FEIJÓ; STEFFENS, 2015)			
3	Overvaluation of the exchange rate	(SOUZA, 2017); (OREIRO; MANARIN; GALA, 2021);			
4	Outsourcing of manufacturing activities to service providers	(BERNARD; SMEETS; WARZYNSKI, 2017); (SQUEFF,			
		2012)			
5	Migration of industry and employment to countries where production costs are lower	(SQUEFF, 2012)			
6	Low rate of industrial investment	(SQUEFF, 2012)			
7	Increased commodity exports, generating financial dependence	(CORDEN, 1984); (Furtado, 1974); (NASSIF; FEIJÓ; ARAÚJO, 2014); (SAUER; BALESTRO; SCHNEIDER, 2017); (MAGACHO; MCCOMBIE; GUILHOTO, 2018); (TRINDADE; COONEY; OLIVEIRA, 2015); (FEIJO; LAMONICA, 2019); (SANTOS; SPOLADOR, 2018)			
8	High interest rates	(Bresser-Pereira; Araújo; Peres, 2020); (GAULARD, 2015); (OREIRO; PUNZO; ARAUJO, 2012); (CYPHER, 2015)			
9	Inability to coordinate government policy	(OREIRO; PUNZO; ARAUJO, 2012); (CYPHER, 2015)			
10	Chinese products at extremely competitive prices	(LIN; WANG, 2020); (FELIPE; MEHTA; RHEE, 2018); (Lábaj; Majzlíková, 2021); (JENKINS; BARBOSA, 2012); (JENKINS, 2015); (CALLEGARI; MELO; CARVALHO, 2018); (HIRATUKA; SARTI, 2017); (SILVA, 2019)			
11	High tax burden	(KALDOR, 2021); (JENKINS; BARBOSA, 2012); (JENKINS, 2015); (CALLEGARI; MELO; CARVALHO, 2018)			

## **3. RESEARCH METHOD**

The present research adopted a qualitative and quantitative approach using the DPSIR and TOPSIS methods. The research applied survey of experience as a qualitative approach, in which industrial development experts were interviewed through questionnaires to better understand the problem as analyzed. As a research method, survey of experience is exploited to obtain a new view of a problem, seen through different prisms (GIL; REIS NETO, 2021). In order to apply the DPSIR and TOPSIS methods, a survey questionnaire was prepared with questions based on these methods. Systematic literature review was additionally used in an attempt to identify the state of the art on the subject, thereby seeking to establish the main factors that led to Brazil's deindustrialization process according to researchers in the field (GIL, 2002; GIL; REIS NETO, 2021).

To this end, the inclusion criteria for the specialists chosen to participate in the present research were: those belonging to the areas of Economics, Public Law, Scientific Research, Public or Private Management; Economists operating for at least 5 years in private practice or in bodies related to economic development; Lawyers specializing in public law; Professor-Researchers from public universities in the area of economics; Public sector managers (current or former minister, secretary, superintendent or other leadership role in public agencies linked

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to economic development); and Directors, superintendents or those in other leadership roles in private companies in the manufacturing segment. Considering the inclusion criteria, a total of 170 specialists were contacted and invited to participate in the first research questionnaire, of which 21 responded (representing 12.35% of the total); for the second questionnaire, 19 of the 280 invitees responded (representing 6.79%); and for the third questionnaire, 8 of the 290 invitees responded (representing 2.76%). After considering the responses received, it was concluded that, although the sample size was small, the necessary distribution of professionals per area had been obtained. It is important to note that the profile of each of the invited experts had been studied prior to the invitation to participate in the research being sent, strictly obeying the inclusion and exclusion criteria, as mentioned above.

The research questionnaire process was, as previously stated, divided into 3 phases: phase 1 covered the application of questionnaire 1, which dealt with the level of agreement of the specialists regarding each of the factors that led to deindustrialization; phase 2, questionnaire 2, related to the application of DPSIR with the participating experts; and phase 3, questionnaire 3, related to the TOPSIS method and how the most urgent strategies should be prioritized.

#### **3.1 THE DPSIR METHOD**

The vast majority of published works concern the environmental area, and deal with problems related to land use and occupation, tourism, sustainability and natural resource management, such as those found in Gupta (2015) and Wu, CAO, Fang, Wang and LI (2022). However, it should be noted that the application of the DPSIR method is not limited to the environmental field, and DPSIR adoption has been expanded to other fields as a result of two factors: (i) the DPSIR structure indicators linked to the political objectives that arise from the problem analyzed; and (ii) because it is simple and clear: DPSIR attracts political actors when the constructions are causal relationships (GARI; NEWTON; ICELY, 2015).

DPSIR can be understood as: economic and social developments (driving forces - D) that exert pressure (P) on the environment, consequently changing the state (S) of the environment, causing impacts (I) on ecosystems, health and in society in general, resulting in a response (R) from society that feeds back to the driving forces, the state and/or the impacts through mitigation, adaptation or healing actions (MAXIM; SPANGENBERG; OCONNOR, 2009; TREVIZAN; SIQUEIRA; ARAGÃO; SANTOS; SABINO, 2022).

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Article	Authors	Title	Main applications			
1	Wu, Cao, Fang, Wang e Li (2022)	A systematic coupling analysis framework and multi-stage interaction mechanism between urban land use efficiency and ecological carrying capacity.	Presents a study on the unification of urbanization and economic efficiency through urban land use, enabling sustainable development.			
2	Xu, Wang, Tang e Ye (2022)	Tourism circular economy: identification and measurement of tourism industry greening.	Proposes an evaluation indicator system for the greening of the tourism industry based on DPSIR and presents policy suggestions to improve the development of regional tourism greening.			
3	Xiao, Chen, Wang e Lu (2022)	Regional green development level and its spatial spillover effects: empirical evidence from Hubei province, China.	DPSIR used to measure the level of green development in a Chinese region, and suggesting policy proposals for such development.			
4	Sun, Zhu, Zhang, Zeng, Li, Wang, Dong e Zhou (2022)	New indices system for quantifying the nexus between economic-social development, natural resources consumption, and environmental pollution in China between 1978 and 2018.	DPSIR used to propose a new index system in order to ascertain the connection between complex socioeconomic, natural and environmental resources.			
5	Li, Weng, Zhao, Zhao e Zhang (2021)	Research on the Evaluation of Real Estate Inventory Management in China.	DPSIR used to integrate economic, social and environmental factors to evaluate the performance of real estate management in China.			
6	Toloi, Bonilla, Toloi, Silva e Nääs (2021)	Development Indicators and Soybean Production in Brazil.	Categorized the 30 largest soy producing municipalities in Brazil with the help of DPSIR to establish classification factors, based on the influence of soybean production on local economies, the number of jobs generated, and the impact on the environment			

Table 2 – The main applications of DPSIR in terms of global economic development.

It is observed that no publication has been found relating DPSIR to deindustrialization. Notably, even when there are DPSIR applications in terms of development issues, they all also consider the environment.

#### **3.2 THE TOPSIS METHOD**

According to Hwang and Yoon (1981), the creators of the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method did so to judge that the chosen alternative must have the shortest distance from the ideal and, as far as possible, from the negative ideal solution. The logic is simple: imagine that each attribute has increasing (or decreasing) utility, which makes it easy to think that the ideal solution is made up of all the best attribute values achievable, and the ideal negative solution is the worst attribute values achievable (HWANG; YOON, 1981), the alternatives being classified in order of preference, from the most ideal to the least ideal.

The application of the method is given, sequentially, by calculating the weighted standard decision matrix of Equation 1 below, determining the positive and negative ideal

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solutions of equations 2 and 3, calculating the separation measurement of equations 4 and 5, and calculating the relative proximity of the ideal solution of equation 6.

$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1j} & \cdots & v_{1n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ v_{i1} & v_{i2} & \cdots & v_{ij} & \cdots & v_{in} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mj} & \cdots & v_{mn} \end{bmatrix} \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \cdots & w_j r_{ij} & \cdots & w_n r_{1n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ [v_{m1} & v_{m2} & \cdots & v_{mj} & \cdots & v_{mn} \end{bmatrix} \begin{bmatrix} w_1 r_{i1} & w_2 r_{i2} & \cdots & w_j r_{ij} & \cdots & w_n r_{in} \\ [w_1 r_{m1} & w_2 r_{m2} & \cdots & w_j r_{mj} & \cdots & w_n r_{mn} \end{bmatrix}$$
[1]

$$A^{*} = \{ (\max v_{ij} | j \in J), (\min v_{ij} | j \in J') | i = 1, 2, ..., m \} = \{ v^{*}, v^{*}, ..., v^{*}, ..., v^{*} \}$$
[2]  
1 2 j n

$$A^{-} = \{ (\min v_{ij} | j \in J), (\max v_{ij} | j \in J') | i = 1, 2, ..., m \} = \{ v^{-}, v^{-}, ..., v^{-}, ..., v^{-} \}$$
[3]  
1 2 j n

$$S^* = \sqrt{\sum^n (v_{ij} - v^*)^2} , \quad i = 1, 2, ..., m$$

$$i \qquad j = 1 \qquad j \qquad [4]$$

$$S^{-} = \sqrt{\sum_{i=1}^{n} (v_{ij} - v^{-})^{2}}, \quad i = 1, 2, ..., m$$

$$i \qquad j = 1 \qquad j$$
[5]

$$C^* = \underbrace{S_i^-}_{i} , \quad 0 < C^* < 1, \quad i = 1, 2, ..., m \quad [6]$$

$${}^i \quad S_i^* + S_i^- \quad {}^i$$

After execution of the calculations, the alternatives are classified in order of preference, from the most ideal to the least ideal.

#### 4. RESULTS AND DISCUSSION

#### 4.1 Factors that led to deindustrialization in Brazil

In the first phase of the survey with experts, of the 170 questionnaires sent, 24 were returned. A high percentage of the responders, 44.4%, have training in economics, and 83.3% have at least 16 years of experience in the area. The career positions held were: analysts and managers of private and/or public initiative, finance/investment/research/research directors,

university dean, investment bank director, university professors, consultants, an internationally renowned university course coordinator, and the director of a federal-level public agency.

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Regarding the geographical distribution of the 24 specialists who responded, 21 are from the southeast region, 1 from the southern region and 2 from the midwest. And of these 24, 12 are from private initiative and 12 are civil servants. This demographic profile corroborates the knowledge base of the experts participating in the survey and gives credibility to the information collected.

The experts responded to the questionnaire by noting their agreement with the eleven factors that led to Brazil's deindustrialization: factors established through the bibliographic review. A 5 -point Likert scale was used, varying between total or partial agreement, indifference, to total or partial disagreement. Table 3 present the factors and their respective levels of agreement, according to the experts who participated in questionnaire 1, classified in descending order. The factors that had at least 50% agreement amongst experts were considered those that had indeed led to deindustrialization in Brazil. Eight factors, specifically 9, 6, 8, 11, 3, 10, 2 and 5, reached this level of agreement. Table 3 presents this information as a means of validating the factors with the experts, by order by agreement, and with the objective of continuing to the application of the other questionnaires that follow.

Table 3 – Factors that led to the deindustrialization of Brazil and the levels of agreement among experts, classified in descending order.

	Factors that led to desindustrialization in Brazil	Level of agreement
9	Inability to coordinate government policy	87,50%
6	Low rate of industrial investment	83,33%
8	High interest rates	75,00%
11	High tax burden	66,67%
3	Over valorization of the currency exchange rate	62,50%
10	Chinese products at extremely competitive prices	58,33%
2	Total and multilateral opening of free trade in the 1990s	50,00%
5	The migration of industry and employment to countries where production costs are lower	50,00%
1	Public policies to promote sectors in which Brazil already held a certain competitive advantage, such as agriculture, mining and civil construction, to the detriment of the other sectors of the economy	37,50%
7	Increased commodity exports, generating financial dependence	33,33%
4	Outsourcing of manufacturing activities to service provision sectors	20,83%

#### 4.2 Strategies to reverse deindustrialization in Brazil

In phase 2, the same specialists who answered questionnaire 1 were invited to respond to questionnaire 2 – the DPSIR application – which consisted of five questions that contextualized DPSIR in the scenario evaluated. The questions were, in full:

1. Among the 8 factors presented above that led to deindustrialization, which do you think are the true motivators of deindustrialization in Brazil? (D)

- 2. Which pressures did the factors stated above trigger in the economic and industrial environment? (P)
- 3. How was the environment where changes occurred affected by the pressures mentioned earlier by you? (S)
- 4. What impacts were generated by pressures in the state, as a result of the factors that led to deindustrialization? (I)
- 5. What are your proposals to reverse the process of deindustrialization in Brazil?(R)

Each phase of the DPSIR was denominated as follows: D for Driving forces, P for Pressures, S for State, I for Impacts, and R for Responses. For each item relating to a specific phase, a unique sequential number corresponding to the letter representing its phase was given, such as D1, D2, and so on. Similar answers were grouped, following the result of the answers.

Table 4 – D – Driving forces

D - Driving forces
<ul> <li>Inability to coordinate governmental policy (D1);</li> </ul>
<ul> <li>Low rate of industrial investment (D2);</li> </ul>
- High interest rates (D3);
- High tax burden (D4);
<ul> <li>Over valorization of the currency exchange rate (D5);</li> </ul>
<ul> <li>Chinese products at extremely competitive prices (D6);</li> </ul>
<ul> <li>Total and multilateral opening of free trade in the 1990s (D7);</li> </ul>
- Migration of industry and employment to countries where production costs are lower (D8)

Table 5 - P - Pressures.

P - Pressures
- Lack of stimulation for internal production and emphasis given to the importation of manufactured goods (P1)
<ul> <li>Retraction, lack of competitiveness and innovation (P2);</li> </ul>
<ul> <li>Investments focused much more on reformulating depreciated productive capital than on expanding industrial productive capacity (P3);</li> </ul>
<ul> <li>The ineffective coordination of governmental policy causes pressures in the economic and industrial environment, since it does not outline actions to improve infrastructure, incentives for industrial diversification or provide incentives for new companies (P4);</li> </ul>
<ul> <li>Vicious cycle with poorly qualified labor and reduced job opportunities in medium and highly qualified occupations displaced to other countries (P5);</li> </ul>
- Globalization (P6);
<ul> <li>Cost pressures and increased competition (P7);</li> </ul>
<ul> <li>Instability and reduced profitability (P8);</li> </ul>
- Low investment rates in the sector (P9);
- Stimulation of importation (P10);
- High production costs (P11);
- Stimulation of rentism (P12).

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#### Table 6 - S - State.

S - State
<ul> <li>Unfavorable and uncompetitive business environment (S1);</li> </ul>
<ul> <li>Lack of perspective and incentives for investment (S2);</li> </ul>
<ul> <li>Pressured and strangled, where the brand strength is placed in check, to the detriment of the search for price (S3);</li> </ul>
<ul> <li>Importing manufactured products and exporting commodities, resulting in job creation in lower value-added sectors and negative environmental impacts, since commodities are intensive consumers of natural resources, leading to the scale effect (S4);</li> </ul>
<ul> <li>Migration of resources to the service sector (S5);</li> </ul>
<ul> <li>Weak development of technological skills in Brazilian companies, especially those resulting from R&amp;D efforts, even in sectors of low technological intensity (S6);</li> </ul>
- Most Brazilian regions have suffered from deindustrialization, leaving companies with
obsolete machinery, indebtedness and stiff competition from parallel substitute products
(Made in China) (S7);
<ul> <li>External open market without a strategic selective counterpart (S8);</li> </ul>
- Unstable and unprofitable markets (S9);
- Economic growth rates below the global average, unemployment and underemployment (S10)

# Table 7 - I - Impacts.

- Impacts
- Poor economic growth (I1);
<ul> <li>Little competitiveness among national companies (I2);</li> </ul>
<ul> <li>Decrease in employment and tax collection (I3);</li> </ul>
<ul> <li>Lower qualified employment (I4);</li> </ul>
- Loss of knowledge (I5);
<ul> <li>Innovation policies more focused on credit than economic subsidy (I6);</li> </ul>
<ul> <li>Unemployment in specialist sectors (17);</li> </ul>
<ul> <li>Closure of businesses within various economic sectors (18);</li> </ul>
<ul> <li>Reduced investment in R&amp;D across companies (I9);</li> </ul>
<ul> <li>Increase in the incidence of less-qualified services (I10);</li> </ul>
- Increased distance from technological skills dominated by Brazil in relation to those abroad (111);
<ul> <li>No replacement of obsolete capital (I12);</li> </ul>
<ul> <li>Aging production lines, low quality and high costs (113);</li> </ul>
- No entry into Global Production Chains (114);
<ul> <li>Lack of coordination between industrial and macroeconomic policies (I15);</li> </ul>
<ul> <li>Drop in sectoral income and national income levels (I16);</li> </ul>
<ul> <li>Reduction in investment in employee skills (I17);</li> </ul>
- Decreased employee income (I18);
<ul> <li>Fall in the consumption of industrialized Brazilian products (I19);</li> </ul>
<ul> <li>Retraction of the sector in the country (I20);</li> </ul>
<ul> <li>Increased informality and socioeconomic inequality (I21).</li> </ul>

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Table 8 – R – Responses.

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R - Responses
- Simplification of the Tax System with VAT (Value Added Tax) and Tax Reduction (Tax Reform) (R1);
<ul> <li>Economic public policies aimed at developing areas of excellence, bringing them to less privileged areas (R2);</li> </ul>
<ul> <li>Institutional change, since economic decisions come from groups of individuals who act according to the institutions defined by Douglass North, and from individual conduct as well (while it does not change, no policy will be effective beyond the years of each government and despite formal rules and norms existing, policies need to stay beyond four-year terms, regardless) (R3);</li> </ul>
<ul> <li>Critical analysis of the technological restrictions of industrial processes and products manufactured in relation to global markets, and, based on mapping from the analysis, establish financial means for research and development projects together with universities and research centers to reduce the existing technological gap (R4);</li> </ul>
<ul> <li>Increase the industrial investment rate, with subsidized interest and other measures (e.g. economic subsidy) for sectors that generate more innovation in both products and processes, ranging from base industries to the aerospace industry (R5);</li> </ul>
<ul> <li>A well-conducted opening up of commerce would help to strengthen industry (R6);</li> </ul>
- Slightly undervalued exchange rate, but without causing spurious competitiveness under terms suggested by Fernando Fajnzylber (Fernando Fajnzylber was an important thinker for Latin American development and created the new theoretical approach to ECLAC (Economic Commission for Latin America and the Caribbean) in the 1990s, which led to the project of "Productive transformation with equity". The main objective of his work was to overcome obstacles to constant economic growth and social exclusion in Latin America, seeking to create a development model that was less dependent and less excluding, while promoting economic growth and social equity). (R7);
- Investment in education at all levels (especially fundamental), incentivizing technical courses (R8);
<ul> <li>Implementation of a planning agenda that takes into account the current Brazilian position, with its weaknesses and potential (R9);</li> </ul>
<ul> <li>Implementation of charging mechanisms and the liability of beneficiaries of targeted public resources, as well as public agents responsible for the implementation of industrial policies (R10);</li> </ul>
<ul> <li>Industrialization in niches of opportunity (clear comparative advantages) seems to be a sustainable goal (R11);</li> </ul>
<ul> <li>- UNASUR (Union of South American Nations) regional block for CGV (Global Value Chain) in South America with lower transportation costs (R12);</li> </ul>
- Mapping industries and identifying their challenges in recent years/decades, recognizing at the same time that it is worth understanding the process of change in value chains around the world and the technological challenges that currently present themselves. However, the establishment of a channel of permanent dialogue with industrial sectors and representatives is required, to design a broader industrial policy and at the same time coordinate with other macroeconomic policies, aiming to ensure competitiveness and international partnerships for national industry (R13):
<ul> <li>Concession for state-owned companies with gross fixed-capital formation goals (R14);</li> </ul>
- Enable Direct Foreign Investment (DFI) in employment and income generating sectors: companies that are committed to bringing international monetary resources for investment in the country (R15);
<ul> <li>Monetary policy and National Infrastructure Investment Plan (R16);</li> </ul>
<ul> <li>Continuity for the advancement of labor reform (R17);</li> </ul>
- Administrative reform (R18);
<ul> <li>Minimum income for people with disabilities (R19);</li> </ul>
<ul> <li>Recovery of the macroeconomic tripod (fiscal responsibility, inflation goals and floating exchange rate) (R20).</li> </ul>
<ul> <li>Increased informality and socioeconomic inequality (I21).</li> </ul>

#### 4.3 Action Prioritization: Application of TOPSIS

In phase 3, 290 questionnaires were sent (questionnaire 3) to experts in the area of economic development, encompassing economic science, engineering, administration and law. Although only 8 experts responded, a low number was expected since the questionnaire included 160 questions, as a result of the application of the TOPSIS method. The participants of this phase comprised 6 economists, a lawyer and an engineer - 6 of whom had over 16 years of experience. In terms of location, 6 specialists hail from the southeastern region of Brazil, 1 from the southern region and 1 from the midwest.

The experts were asked to indicate (on a 5-point Likert scale) to what extent they agreed that a certain response resolved a certain factor that led to deindustrialization. The experts' responses were then calculated as an average of response and factor, as presented in Table 9.

Table 9 – Result of the averages of expert responses for each factor that led to deindustrialization.

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SPECIALISTS' RESPONSES TO RESOLVE THESE FACTORS	Inability to coordinate public policy (F1)	Low industrial investment rate (F2)	High interest rates (F3)	High tax burden (F4)	Exchange rate overvaloriz ation (F5)	Chinese products at extremely competitive prices (F6)	Total and multilateral opening of free trade in the 1990s (F7)	Migration of industry and employment to countries where production costs are lower (F8)
- Simplification of the tax system with VAT reduction of taxes and rates (tax reform) (R1);	6,00	6,25	3,50	6,75	3,50	5,50	4,50	6,25
<ul> <li>Economic public policies aimed at developing areas of excellence and bringing them to less privileged areas(R2);</li> </ul>	7,50	7,25	2,75	4,75	2,75	, 5,50	6,00	6,50
<ul> <li>Institutional change, as economic decisions start from groups, individuals who act according to the institutions defined by Douglass North, as well as individual conduct (while not changing, no policy will be effective beyond the years of each government and despite the exitisting formal rules and norms, policies need to stay beyond at least 4 years, regardless) (R3);</li> </ul>	5,50	4,75	3,75	4,50	4,50	4,75	4,75	5,25
<ul> <li>Critical analysis of the technological restrictions of industrial processes and products manufactured in relation to the international market. Based on mapping from the analysis, therefore, establish financing lines for research and development projects together with universities and research centers to reduce the existing technological gap (R4);</li> </ul>	7,00	6,50	3,50	5,00	3,50	6,25	5,00	6,75
<ul> <li>Increase the industrial investment rate, with subsidized interest and other measures (e.g. economic subsidy) for sectors that generate more innovation in both products and processes, but ranging from the base industry to the aerospace industry (R5);</li> </ul>	6,25	7,00	3,75	, 4,75	4,00	5,00	5,50	5,75
- Well-conducted open commerce aids in strengthening industry (R6);	5,00	4,00	3,50	3,25	, 3,25	, 3,25	4,50	3,75
- Slightly undervalued exchange rate, but without causing spurious competitiveness under Fernando Fajnzylber (Fernando Fajnzylber was an important thinker for Latin American development and created the new theoretical approach to ECLAC in the 1990s, which led to the project of "productive transformation with equity." His work had as its main objective to overcome obstacles to constant economic growth and social exclusion in Latin America, seeking to create a development model that was less dependent and less excluding, while promoting economic growth and social equity). (R7);	, 5,50	5,75	3,75	4,00	6,00	, 5,00	s,50	, 5,75
- Investment in education at all levels (especially fundamental), stimulating technical courses (R8);	7,00	6,50	3,00	4,00	3,25	5,00	4,75	7,25
- Implementation of a planning agenda that takes into account the current Brazilian position, with its weaknesses and potential (R9);	7,75	7,75	5,00	6,00	6,00	6,75	6,50	7,50
<ul> <li>Implementation of charging mechanisms and liability for beneficiaries of targeted public resources, as well as public agents responsible for the implementation of industrial policies (R10);</li> </ul>	6,25	5,50	3,00	4,50	3,75	4,25	4,75	4,50
<ul> <li>Industrialization in niches of opportunity (clear comparative advantages) seems to be a sustainable goal(R11);</li> </ul>	5,75	6,25	2,25	3,25	3,25	6,25	6,00	6,75
- UNASUR regional block for CGV (Global Value Chain) in South America with lower transportation costs (R12);	5,00	5,25	2,50	3,75	4,75	6,25	6,00	6,00
<ul> <li>Mapping industries and identifying their challenges in recent years/decades; at the same time deciding whether it is worth understanding the process of change in value chains around the world and the technological challenges that currently present themselves. However, this needs the establishment of permanent dialogue with industrial sectors and representatives to design a broader industrial policy and at the same time coordinate with other macroeconomic policies, aiming to ensure competitiveness and international partnerships for the national industry (R13);</li> </ul>	6,75	7,25	3,25	4,25	5,25	7,25	6,25	7,00
- Concession of state-owned companies with fixed gross capital goals (R14);	5,00	4,25	2,75	3,00	2,50	3,00	4,00	4,00
- Enabling Direct Foreign Investment (DFI) in employment and income generating sectors, companies that are committed to bringing international monetary resources for investment in the country (R15);	4,75	4,75	3,50	3,75	4,50	3,00	4,50	4,75
<ul> <li>Política monetária e plano nacional de investimentos em infraestrutura (R16);</li> </ul>	7,25	6,00	5,75	5,00	4,25	5,50	5,75	5,50
- Continuity of advancement in labor reform (R17);     - Administrative reform (R18):	3,25 3,50	2,75 2,75	1,75 2,75	2,75	2,00	2,75 2,25	3,00	4,00
- Minimum income for people with disabilities (R19);	5,50	5,25	2,75	2,50	2,50	3,25	4,00	4,25
- Recovery of Macroeconomic Tripod (Fiscal Responsibility, Inflation Goals and Floating Exchange) (R20).	3,75	4,00	3,25	4,75	4,25	3,25	3,75	3,75

Following this, the step-by-step TOPSIS analysis was carried out to build the normalized, weighted standardized matrix, the positive and negative ideal solutions, the separation measures, the relative proximity of the ideal solution, and the classification in order of preference, as given in Table 10.

Table 10 - Responses to resolve the factors that led to Brazil's deindustrialization after application of the TOPSIS method, classified by priority order.

SPECIALISTS' RESPONSES TO RESOLVE THE FACTORS	Relative proximity to the ideal solution (Ci*)
<ul> <li>Implementation of a planning agenda that takes into account the current Brazilian position, with its weaknesses and potential (R9);</li> </ul>	0,8869
- Monetary policy and National Infrastructure Investment Plan (R16);	0,7142
<ul> <li>Mapping industries and identifying their challenges in recent years/decades; at the same time deciding whether it is worth understanding the process of change in value chains around the world and the technological challenges that currently present themselves. However, this needs the establishment of permanent dialogue with industrial sectors and representatives to design a broader industrial policy and at the same time coordinate with other macroeconomic policies, aiming to ensure competitiveness and international partnerships for the national industry (R13);</li> </ul>	0,6494
<ul> <li>Critical analysis of the technological restrictions of industrial processes and products manufactured in relation to the international market. Based on mapping from the analysis, therefore, establish financing lines for research and development projects together with universities and research centers to reduce the existing technological gap (R4);</li> </ul>	0,6046
<ul> <li>Increase the industrial investment rate, with subsidized interest and other measures (egeconomic subsidy) for sectors that generate more innovation in both products and processes, but ranging from the base industry to the aerospace industry(R5);</li> </ul>	0,5957
- Simplification of the tax system with VAT, reduction of taxes and rates (tax reform)) (R1);	0,5920
<ul> <li>Slightly undervalued exchange rate, but without causing spurious competitiveness under Fernando Fajnzylber (Fernando Fajnzylber was an important thinker for Latin American development and created the new theoretical approach to ECLAC in the 1990s, which led to the project of "productive transformation with equity. "His work had as its main objective to overcome obstacles to constant economic growth and social exclusion in Latin America, seeking to create a development model that was less dependent and less excluding, while promoting economic growth and social equity). (R7);</li> </ul>	0,5658
<ul> <li>Public economic policies aimed at developing areas of excellence and bringing them to less privileged areas (R2);</li> </ul>	0,5549
<ul> <li>Investimento em educação em todos os níveis (com destaque para a básica), estímulo aos cursos técnicos (R8);</li> </ul>	0,5185
<ul> <li>Institutional change, as economic decisions start from groups, individuals who act according to the institutions defined by Douglass North, as well as individual conduct (while not changing, no policy will be effective beyond the years of each government and despite the exitisting formal rules and norms, policies need to stay beyond at least 4 years, regardless) (R3);</li> </ul>	0,4912
<ul> <li>UNASUR regional block for CGV (Global Value Chain) in South America with lower transportation costs (R12);</li> </ul>	0,4617
<ul> <li>Implementation of collection mechanisms and liability for beneficiaries of targeted public resources, as well as public agents responsible for the implementation of industrial policies (R10);</li> </ul>	0,4560
- Industrialization in niches of opportunity (clear comparative advantages) seems to be a sustainable goal (R11);	0,4548
<ul> <li>Enabling Direct Foreign Investment (DFI) in employment and income generating sectors, companies that are committed to bringing international monetary resources for investment in the country (R15);</li> </ul>	0,3896
<ul> <li>Recovering the Macroeconomic Tripod (Fiscal Responsibility, Inflation Goals and Floating Exchange)(R20).</li> </ul>	0,3407
<ul> <li>Well-conducted open commerce aids in strengthening industry (R6);</li> </ul>	0,3169
- Minimum income for people with disabilities (R19);	0,3002
<ul> <li>Concession of state-owned companies with gross fixed capital formation goals (R14);</li> </ul>	0,2421
- Administrative reform (R18);	0,1519
- Continuity in the advance of labor reform (R17);	0,0407

As can be seen, the priority response according to the experts following application of the TOPSIS method is R9, which states that to resolve the factors that led to deindustrialization and thus mitigate the ongoing deindustrialization process requires the implementation of a

planning agenda that considers the current Brazilian position, with its weaknesses and potential. The order of priority thus continues until the least prioritized, which according to the same experts is R17, to resolve the factors that led to the deindustrialization of Brazil requires a continuation of labor reforms.

#### **5** FINAL CONSIDERATIONS

The present research concludes that the strategies to maximize industry participation in GDP and mitigate the process of deindustrialization, using the DPSIR and TOPSIS methods, according to the experts (Table 10), may be summarized as follows: (i) implementation of a planning agenda that takes into account the current Brazilian position, with its weaknesses and potentials; (ii) creation of a monetary policy and national plan of infrastructure investments; (iii) mapping of industries and identifying their challenges in recent years/decades, and at the same time understanding the process of changes in the value chains around the world and the current technological challenges, establishing a permanent channel of dialogue with sectors and industrial representatives to design a broader industrial policy and at the same time coordinating with other macroeconomic policies, aiming to ensure competitiveness and international partnerships for the national industry.

Despite recognizing that the respondents of the present research mostly derive from the southeast region of Brazil, the opinions thus stated are believed to be representative of Brazilian industry as a whole, given that the industrial sector focuses on this region. In addition, the application of these strategies through government action plans, following the priority order established by TOPSIS, offers the potential to positively impact Brazil's industrial sector and economy as a whole. This is justified by the fact that, as previously elucidated, its industrial sector plays a crucial role in boosting a nation: because even in the age of technology, the transformation industry has the ability to generate income at scales larger than other sectors of the economy, even those that have a similar level of employment, precisely because of the scalability factor that industry has, one which needs other collaborative networks so that it is productive, efficient and generates financial assets for a nation.

If public authorities choose to invest in the future implementation of the strategies proposed by the specialists consulted in the present study, Brazil may witness a reversal of the process of deindustrialization. This would put the country in a more advantageous economic position than it currently enjoys. Furthermore, it is worthy of note that the strategies suggested

by the experts in relation to Brazil can equally serve as a guide in other developing countries where deindustrialization processes, with analogous characteristics, have been similarly faced.

In brief, the present research contributes to the expansion of scientific knowledge on the theme of deindustrialization by introducing a new application of DPSIR and TOPSIS as a method of analysis, alignment, triggering and prioritization of strategic responses to the problem of Brazilian deindustrialization, paving the way for future research on the operationalization of such strategies.

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On behalf of all authors, the corresponding author states that there is no conflict of interest. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

## Data availability statement

The data used in this article is available upon request from the authors, ensuring transparency and promoting research replicability.

## BIBLIOGRAPHY

Bacha, E. & Bolle, M. (2015). *O futuro da indústria no Brasil: desindustrialização em debate*. Civilização Brasileira.

Bárcena, A., Bielschowsky, R., Torres, M., (2022). El Pensamiento De La CEPAL (2009-2018): hacia una estrategia neoestructuralista de desarrollo basada en un enfoque de derechos. El Trimestre Económico. 73–109.

Bell, S. (2012). DPSIR=A Problem Structuring Method? An exploration from the "Imagine" approach. *European Journal of Operational Research*, 222(2), 350–360. <u>https://doi.org/10.1016/j.ejor.2012.04.029</u>

Bernard, A. B., Valerie, & Warzynski, F. (2017). Rethinking deindustrialization. *Economic Policy*, 5–38. <u>https://doi.org/10.1093/epolic/eiw016</u>

Bresser-Pereira, L. C., Araújo, E. C., & Costa Peres, S. (2020). An alternative to the middleincome trap. *Structural Change and Economic Dynamics*, 52, 294–312. <u>https://doi.org/10.1016/j.strueco.2019.11.007</u>

Bresser-Pereira, L. C., & Gala, P. (2010). Macroeconomia estruturalista do desenvolvimento. Brazilian Journal of Political 30(4), 663–686. Economy, https://doi.org/10.1590/s0101-31572010000400007

Callegari, J., Melo, T. M., & Carvalho, C. E. (2018). The peculiar insertion of Brazil into global value chains. *Review of Development Economics*, 22(3), 1321–1342. https://doi.org/10.1111/rode.12386

CNI-Confederação Nacional da Indústria. (2023). *Perfil da Indústria Brasileira*. Confederação Nacional da Indústria. Obtido 23 de fevereiro de 2023, de <u>https://industriabrasileira.portaldaindustria.com.br/grafico/total/producao/#/industria-total</u>

Corden, W. M. (1984). Booming Sector and Dutch Disease Economics: survey and consolidation. *Oxford Economic Papers*, 359–380.

Cypher, J. M. (2015). Emerging contradictions of Brazil's Neo-developmentalism: Precarious growth, redistribution, and deindustrialization. *Journal of Economic Issues*, *49*(3), 617–648. https://doi.org/10.1080/00213624.2015.1071961

Feijo, C., & Lamonica, M., Tostes. (2019). Policy space in a financially integrated world: TheBraziliancaseinthe2000s.Panoeconomicus,66(1),51–67.<a href="https://doi.org/10.2298/pan160502002f">https://doi.org/10.2298/pan160502002f</a>

Feijó, F. T., & Steffens, C.. (2015). Comércio internacional, alocação do trabalho e a questão da desindustrialização no Brasil: uma abordagem utilizando equilíbrio geral computável. *Revista De Economia Contemporânea*, *19*(1), 135–161. <u>https://doi.org/10.1590/198055271916</u>

Felipe, J., Aashish, & Rhee, C. (2018). Manufacturing matters...but it's the jobs that count. *Cambridge Journal Of Economics*, 19, 139–168.

Ferraz, D., Falguera, F. P. S., Mariano, E. B., & Hartmann, D. (2021). Linking economic complexity, diversification, and industrial policy with sustainable development: A structured literature review. *Sustainability*, *13*(3), 1265. <u>https://doi.org/10.3390/su13031265</u>

Fries, C. E., Müller Filho, R., Ferentz, D., & Christmann, F. (2019). DIAGNÓSTICO DO DESENVOLVIMENTO E DOS DE FATORES DE IMPACTO GRAU NA **IMPLEMENTAÇÃO** DA INDÚSTRIA 4.0 NO SETOR INDUSTRIAL CATARINENSE. Simpósio de Pesquisa Operacional e Logística da Marinha - Publicação https://www.proceedings.blucher.com.br/article-details/diagnstico-do-grau-de-Online. desenvolvimento-e-dos-fatores-de-impacto-na-implementao-da-indstria-40-no-setorindustrial-catarinense-34499

Furtado, C. (1974). O mito do desenvolvimento econômico. Círculo do Livro.

Gari, S. R., Newton, A., & Icely, J. D. (2015). A review of the application and evolution of the DPSIR framework with an emphasis on coastal social-ecological systems. *Ocean & Coastal Management*, *103*, 63–77. <u>https://doi.org/10.1016/j.ocecoaman.2014.11.013</u>

Gaulard, M. (2015). The Brazilian deindustrialization: financialization is not guilty. *Brazilian Journal of Political Economy*, *35*(2), 227–246. <u>https://doi.org/10.1590/0101-31572015v35n02a02</u>

Gil, A. C. (2002). Como elaborar projetos de pesquisa. Atlas.

Gil, A. C., & Reis Neto, A. C. dos. (2021). Survey de Experiência como Pesquisa Qualitativa Básica em Administração. *Revista de Ciências da Administração*, 22(56), 125–137. https://doi.org/10.5007/2175-8077.2020.e74026

Gupta, S. (2015). Decoupling: a step toward sustainable development with reference to OECD countries. *International Journal of Sustainable Development and World Ecology*, 22(6), 510–519. <u>https://doi.org/10.1080/13504509.2015.1088485</u>

Harvey, D. (2012). O neoliberalismo: histórias e implicações. Loyola.

Harvey, D. (2016). 17 contradições e o fim do capitalismo. Boitempo.

Hiratuka, C., & Sarti, F. (2017). Transformações na estrutura produtiva global, desindustrialização e desenvolvimento industrial no Brasil. *Brazilian Journal of Political Economy*, *37*(1), 189–207. <u>https://doi.org/10.1590/0101-31572016v37n01a10</u>

Hwang, C.-L., & Yoon. (1981). *Multiple Attribute Decision Making: methods and applications a state-of-the-art survey*. Springer Verlag.

Jenkins, R. (2015). Is Chinese competition causing deindustrialization in Brazil? *Latin American Perspectives*, 42(6), 42–63. <u>https://doi.org/10.1177/0094582x15593553</u>

Jenkins, R., & Barbosa, A. de F. (2012). Fear for manufacturing? China and the future of industry in Brazil and Latin America. *The China Quarterly*, 209, 59–81. https://doi.org/10.1017/s0305741011001482 Juhász, R., Lane, N., & Rodrik, D. (2023). *The new economics of industrial policy*. National Bureau of Economic Research.

Kaldor, N. (2021). El papel de la tributación en el desarrollo económico. *El Trimestre Económico*, 88(352), 1215–1244. <u>https://doi.org/10.20430/ete.v88i352.1346</u>

Kim, K. M., & Kwon, H.-K. (2017). The state's role in globalization: Korea's experience from a comparative perspective. *Politics & Society*, 45(4), 505–531. https://doi.org/10.1177/0032329217715614

Lábaj, M., & Majzlíková, E. (2021). Drivers of deindustrialisation in internationally fragmented production structures. *Cambridge Journal of Economics*, 46(1), 167–194. <u>https://doi.org/10.1093/cje/beab046</u>

Li, W., Weng, L., Zhao, K., Zhao, S., & Zhang, P. (2021). Research on the evaluation of real estate inventory management in China. *Land*, *10*(12), 1283. <u>https://doi.org/10.3390/land10121283</u>

Lin, J. Y., & Wang, Y. (2020). Seventy years of economic development: A review from the Angle of new structural economics. *China & World Economy*, 28(4), 26–50. https://doi.org/10.1111/cwe.12340

Magacho, G. R., McCombie, J. S. L., & Guilhoto, J. J. M. (2018). Impacts of trade liberalization on countries' sectoral structure of production and trade: A structural decomposition analysis. *Structural Change and Economic Dynamics*, 46, 70–77. <u>https://doi.org/10.1016/j.strueco.2018.04.003</u>

Marttunen, M., Lienert, J., & Belton, V. (2017). Structuring problems for Multi-Criteria Decision Analysis in practice: A literature review of method combinations. *European Journal of Operational Research*, 263(1), 1–17. <u>https://doi.org/10.1016/j.ejor.2017.04.041</u>

Masiero, G., & Coelho, D. B. (2014). A política industrial chinesa como determinante de sua estratégia going global. *Brazilian Journal of Political Economy*, *34*(1), 139–157. https://doi.org/10.1590/s0101-31572014000100009

Maxim, L., Spangenberg, J. H., & O'Connor, M. (2009). An analysis of risks for biodiversity under the DPSIR framework. *Ecological Economics: The Journal of the International Society for Ecological Economics*, 69(1), 12–23. <u>https://doi.org/10.1016/j.ecolecon.2009.03.017</u>

Mazzucato, M. (2022). The Inclusive Entrepreneurial State: Collective Wealth Creation and Distribution. *Institute for Fiscal Studies: London, UK, 1*.

Mishra, A. K., Theertha, A., Amoncar, I. M., & Manogna. (2022). Equity market integration in emerging economies: a network visualization approach. *Journal of Economic Studies* (*Glasgow, Scotland*), 50(4), 696–717. <u>https://doi.org/10.1108/jes-07-2021-0343</u>

Morceiro, P. (2012). Desindustrialização na economia brasileira no período de 2000-2011: abordagens e indicadores. *Cultura Acadêmica*.

Nassif, A., Feijó, C., & Araújo, E. (2014). Structural change and economic development: is Brazil catching up or falling behind? *Cambridge Journal of Economics*, *39*(5), 1307–1332. <u>http://www.jstor.org/stable/24695970</u>

Nolan, P. (2002). China and the global business revolution. *Cambridge journal of economics*, 26(1), 119–137. <u>https://doi.org/10.1093/cje/26.1.119</u>

OCDE (1993). OECD core set of indicators for environmental performance reviews, Organization for economic cooperation and development. OCDE.

Oliveira, C. A. (2003). *Processo de industrialização: do capitalismo originário ao atrasado*. Unesp.

Oreiro, J., Luis, Manarin, L., Luiz, & Gala, P. (2021). complexidade econômica e sobrevalorização cambial: o caso do Brasil (1998-2017). *PSL Quarterly Review*, 313–341.

Oreiro, J. L., Punzo, L. F., & Araujo, E. C. (2012). Macroeconomic constraints to growth of the Brazilian economy: diagnosis and some policy proposals. *Cambridge Journal of Economics*, *36*(4), 919–939. <u>https://doi.org/10.1093/cje/bes010</u>

Paula, G. M. (2016). Deindustrialization in Brazil? Em *The New Brazilian Economy* (pp. 63–85). Palgrave Macmillan US.

Rodrik, D. (2015). Premature deindustrialization. *Journal of Economic Growth*, 21(1), 1–33. https://doi.org/10.1007/s10887-015-9122-3

Ruiz, R. M. (2006). *Polarizações e desigualdades: desenvolvimento regional na China. Texto para Discussão*. UFMG/Cedeplar. <u>https://core.ac.uk/download/pdf/6519975.pdf</u>

Santos, P. F. A., & Spolador, H. F. S. (2018). Produtividade Setorial e Mudança Estrutural no Brasil – Uma Análise para o Período 1981 a 2013. *Revista Brasileira de Economia*, 72(2). <u>https://doi.org/10.5935/0034-7140.20180011</u>

Sauer, S., Balestro, M. V., & Schneider, S. (2017). The ambiguous stance of Brazil as a regional power: piloting a course between commodity-based surpluses and national development. *Globalizations*, *15*(1), 32–55. <u>https://doi.org/10.1080/14747731.2017.1400232</u>

Silva, J. A. (2019). Regional deindustrialization: concepts, causes, effects and the Brazilian case. *Gestão & produção*, 26(4). <u>https://doi.org/10.1590/0104-530x4682-19</u>

Souza, F. E. P. de. (2017). Para que desta vez seja diferente. *Estudos Avançados*, *31*(89), 111–123. <u>https://doi.org/10.1590/s0103-40142017.31890012</u>

Squeff, G. C. (2012). Desindustrialização em debate: aspectos teóricos e alguns fatos estilizados da economia brasileira. Radar: tecnologia, produção e comércio exterior.

https://portalantigo.ipea.gov.br/agencia/images/stories/PDFs/livros/livros/20150415\_livro\_di namica\_macrossetorial.pdf

Suzigan, W., & Furtado, J. (2006). Política industrial e desenvolvimento. *Revista de Economia Política*, 26(2), 163–185. <u>https://doi.org/10.1590/s0101-31572006000200001</u>

Xiang, Bokuan, Shuai, Heng, Kuai, Bin, Zhanfeng, & Zhou, C. (2022). New indices system for quantifying the nexus between economic-social development, natural resources consumption, and environmental pollution in China during 1978-2018. *Science Of The Total Environment*, 150–180.

Tavares, M. (1979). Da substituição de importações ao capitalismo financeiro: ensaios sobre economia brasileira. Zahar Editores.

Toloi, M. N., Vituri, Bonilla, S., Helena, Toloi, R., Carlo, Silva, H. R., Oliveira, & Nääs, I. (2021). *Development Indicators and Soybean Production in Brazil. Agriculture*.

Trevizan, F. F., Siqueira, R. M., Aragão, A. de S., Dos Santos, H. H., & de Oliveira Sabino, F. H. (2022). A Meta-Analytic framework for developing protocols to attend child and adolescent victims of sexual violence. *International Journal of Environmental Research and Public Health*, *19*(9), 5233. <u>https://doi.org/10.3390/ijerph19095233</u>

Trindade, J. R., Cooney, P., & de Oliveira, W. P. (2015). Industrial trajectory and economic development: Dilemma of the re-primarization of the Brazilian economy. *The Review of Radical Political Economics*, 48(2), 269–286. <u>https://doi.org/10.1177/0486613415591807</u>

van Neuss, L. (2018). Globalization and deindustrialization in advanced countries. *Structural Change and Economic Dynamics*, 45, 49–63. <u>https://doi.org/10.1016/j.strueco.2018.02.002</u>

van Neuss, L. (2018). The drivers of structural change. *Journal of Economic Surveys*, *33*(1), 309–349. <u>https://doi.org/10.1111/joes.12266</u>

Xiao, Y., Jun, Xiaolin, & Lu, X. ([s.d.]). Regional green development level and its spatial spillover effects: empirical evidence from hubei province, china. Ecological Indicators.

Xu, A., Wang, C., Tang, D., & Ye, W. (2022). Tourism circular economy: Identification and measurement of tourism industry ecologization. *Ecological Indicators*, *144*(109476), 109476. https://doi.org/10.1016/j.ecolind.2022.109476

Wu, Q., Cao, Y., Fang, X., Wang, J., & Li, G. (2022). A systematic coupling analysis framework and multi-stage interaction mechanism between urban land use efficiency and ecological carrying capacity. *The Science of the Total Environment*, *853*(158444), 158444. <u>https://doi.org/10.1016/j.scitotenv.2022.158444</u>