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Middle income trap and heterogeneities in manufacturing's contribution to development during the Global Value Chain era: a comparative analysis between China and Brazil

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Abstract: This paper measures and analyses the contributions of Brazilian and Chinese manufacturing sectors to development at the height of global value chains (2000–2019) in comparison with other major middle-income countries (MICs). Using shift-share and structural decomposition techniques, we assess manufacturing's contribution to development along two dimensions: (i) productivity and (ii) average wage growth. The literature gap is that although it extensively analyzes the definitions and causes of deindustrialisation as well as changes in the international organization of industry, the literature still lacks empirical efforts to measure how these phenomena affect manufacturing´s contribution to development. The results support the paper's hypothesis that manufacturing's contribution to development is heterogeneous across countries and technological segments, rather than following a uniform pattern among MICs. Brazil recorded the weakest productivity performance among the 20 MICs with the largest manufacturing sectors, with a decline of 15.6% against an average growth of 107.7%. The decline was pervasive across all technological groups, concentrated in 2000–2010, and driven entirely by the intra-sectoral component. Wages did not fall, but their growth remained far below the MIC average and was relatively uniform across segments, including those with the sharpest productivity losses. China, in contrast, recorded the highest productivity growth among the MICs (357%) and the highest wage growth (476%). Intra-sectoral gains dominated at all technological levels, while structural change made a substantial contribution in high- and medium-high-technology industries, accounting for 22.5% of their productivity growth over the period, with a stronger contribution after 2010. Wage gains were broad-based but disproportionately larger in higher-technology segments.

Keywords: Middle-Income Trap, Deindustrialisation, Structural transformation, Economic development, Technological innovation

JEL codes: O11, O57, F43, O47.

1. Introduction

Premature deindustrialisation, marked by a decline in manufacturing's shares of employment and GDP before high levels of per capita income are reached, may constrain the capacity of economies to overcome the middle-income trap (Lee 2013, 2019; Lin and Wang 2020; Rekha 2022). Difficulties in moving towards more technologically advanced productive structures raise questions about the conditions under which manufacturing continues to support development (Lee 2019; Dosi et al. 2021, 2022; Kastelli et al. 2023). Through a comparative examination of Brazil and China, this paper addresses these questions in the context of the transformations in the international organisation of production during the global value chain (GVC) era.

Brazil and China represent two distinct paths of industrial development. Brazilian deindustrialisation may be interpreted as a paradigmatic case in which middle-income countries face persistent difficulties in building an endogenous core of innovative learning capabilities that would enable a more virtuous insertion into the emerging techno-economic paradigm – one that combines the consolidation of key sectors of the Third Industrial Revolution with the restructuring of global value chains since the 2000s (Nassif et al. 2015; Diegues and Rossi 2020; Morceiro and Guilhoto 2023). In contrast, China presents a dynamic counterexample, marked by strategic industrial upgrading within this evolving paradigm (Chen and Naughton 2016; Naughton 2021; Andreoni and Tregenna 2020; Arestis et al. 2021). These contrasting experiences provide a basis for examining the heterogeneous contributions of manufacturing to development in two of the leading countries of the Global South.

The main goal of this paper is therefore to measure and analyse the contributions of Brazilian and Chinese manufacturing to development between 2000 and 2019, taking the patterns observed among the main middle-income countries (MICs) as a comparative reference. The analysis focuses on sectoral contributions to productivity and average employee compensation, with manufacturing sectors grouped by technological intensity.

The first two decades of the twenty-first century, spanning the period from China's accession to the WTO in 2001 to the eve of the COVID-19 pandemic, marked the great expansion of GVCs. Although their origins date back to the last quarter of the twentieth century, with the emergence of what Sturgeon (2002) terms a new model of American industrial organization based on the paradigm of modular production, the organisation of

manufacturing around GVCs expanded substantially from the early 2000s onwards. This expansion intensified the fragmentation of production processes, with the increasing relocation of assembly-intensive stages to what subsequently became known as Factory Asia (Baldwin 2013; Baldwin and Forslid 2014; Gaulier et al. 2007).

Alongside this fragmentation of production, a reorganisation also took place in the dynamics of value appropriation along manufacturing chains. As commoditisation advanced in certain stages of the production process, what the literature refers to as the smile curve took shape. Within this configuration, activities located at the two ends of the curve and primarily associated with knowledge-intensive services became increasingly important in shaping competitive asymmetries within these chains. Consequently, they captured growing shares of the value generated within GVCs (Dedrick et al. 2010; Kapeller et al. 2024).

These transformations, together with servitisation and increasing digitalisation, introduced new conditioning factors for understanding the relationship between industrialisation and development (Chang and Andreoni 2021; Andreoni and Chang 2017; Tregenna and Andreoni 2020; Andreoni 2020). Understanding how the connections between accumulation, investment and industrialisation translated into a virtuous development trajectory would therefore require new analytical mediations beyond those presented by the classical development theorists of the 1950s and 1960s.

In particular, the reconfiguration of global production networks has reshaped the relationship between production, value creation and value capture (Kapeller et al. 2024; Diegues et al. 2023b). These processes do not necessarily coincide within the same territory and timeframe, weakening the territorial connections that characterised, at least partially, the productive structures of the Second Industrial Revolution. From this perspective, manufacturing's contribution to development in middle-income countries is conditioned by their mode of integration into GVCs, through both imports and exports, and by their capacity to appropriate value from such integration.

Accordingly, the international literature suggests that differences in the capacities of middle-income economies to respond to these transformations give rise to heterogeneous patterns in the relationship between industrialisation and development, even among countries with similar per capita income levels (Dosi et al. 2021, 2022). This provides the basis for the paper's hypothesis that manufacturing's contributions to productivity and

average employee compensation vary across countries and sectors of different technological intensities, rather than following a homogeneous pattern among middle-income economies.

The sustainability of the prevailing organisation of GVCs, however, faced renewed challenges with the crisis triggered by the COVID-19 pandemic. Amid intensifying techno-nationalist tensions and efforts to reorganise production networks according to a logic in which resilience gains priority over considerations strictly associated with competitive efficiency, the limits of GVCs as enablers of virtuous development strategies have come under increasing scrutiny. This turning point motivates the restriction of our analysis to 2000–2019, allowing us to examine manufacturing's contribution to development under the conditions prevailing before the pandemic, in the golden era of GVCs.

For the purposes of this analysis, development is understood as a process of surplus generation and accumulation, coupled with investment and technical progress in the productive sphere, that promotes structural transformation. Since investment is an important vehicle for incorporating technical progress into productive activities, structural transformation is inextricably linked to the dynamics of creative destruction (Schumpeter 1934). One of the main outcomes of this process would be the reconfiguration of the productive structure through the emergence, consolidation and increasing relative weight of activities characterised by greater productivity, higher wages and greater export sophistication. Productivity and average employee compensation are therefore treated as two dimensions through which manufacturing's contribution to this broader process can be empirically assessed.

A review of the international literature on manufacturing and development reveals a substantial body of research on deindustrialisation. Prominent debates address its causes (Tregenna 2009; Chang and Andreoni 2021; Dosi et al. 2021), its definitions (Tregenna 2016; Rodrik 2016, 2017; Özçelik and Özmen 2023), and its relationship with per capita income (Castillo and Martins 2016; Felipe et al. 2018; Vu et al. 2021). *Although it extensively analyzes the definitions and causes of deindustrialisation as well as changes in the international organization of industry, the literature still lacks empirical efforts to measure how these phenomena affect the contribution of manufacturing to economic development.*

Within this debate, the contribution pursued here is to complement analyses of manufacturing's declining relative weight with a comparative assessment of its contribution to productivity and average employee compensation, distinguishing between sectors of different technological intensities. This focus addresses a central concern underlying both the literature on transformations in global industry and the renewed interest in industrial policy: the capacity of manufacturing to support long-term development (Kastelli et al. 2023; Cherif and Hasanov 2019; Aiginger and Rodrik 2020; Chang and Andreoni 2021; Mazzucato et al. 2020; Mazzucato and Rodrik 2023).

To this end, the paper employs structural decomposition using the shift-share technique, drawing on McMillan and Rodrik (2011), UNCTAD (2016), Timmer and de Vries (2009), and De Vries et al. (2015), as detailed in Section 3. By distinguishing between intersectoral and intrasectoral components, the analysis examines how changes within sectors and shifts in the productive structure contributed to productivity and average employee compensation in Brazil and China, relative to the patterns observed among the other MICs considered. The transformations associated with GVCs provide the historical context and interpretative framework for examining these trajectories.

The remainder of the paper is organised as follows. Section 2 reviews the literature on manufacturing and development, premature deindustrialisation and the middle-income trap. Section 3 presents the methodology, and Section 4 discusses the results. The final section presents the concluding remarks.

2. Literature review: manufacturing contribution to development, deindustrialisation and middle-income trap

The understanding of development as a process involving accumulation, investment driven by technological progress towards activities with higher levels of productivity and structural transformation has historically and theoretically assigned a central role to manufacturing in the economic discussion (McMillan and Rodrik 2011; UNCTAD 2016; De Vries et al. 2015). This perspective, dating back to Hamilton (1791) and List (1841), underscores the interdependence between industrialization and development.

Classical development economists since the mid-20th century argued that the industrial sector possesses characteristics that elevate its role in economic development. Subsequently synthesized in what is conventionally called Kaldor's Laws (1966, 1967), such characteristics would generally result from the higher value added and productivity

of industrial activities, from their high capacity to allow for positive returns to scale and to transmit the gains from technical progress, and finally from their ability to alleviate external constraints on development, given the greater income elasticity of demand for their products compared to non-manufactured goods.

In line with the guidelines suggested by development strategies based on Kaldor's laws, industrial policy in MICs since the mid-19th century has generally aimed at promoting productive structure density as a way of catching up with High-income Countries (HICs). In other words, an industrial policy would be the more virtuous the greater its capacity to promote and expand the local industrial value-added in a generalized way.

Empirically, the logical relationship between manufacturing and development is understood as the capacity of structural transformation to positively influence (i) productivity growth and (ii) the increase in average remuneration. Such a relationship persists as a constitutive element of productive development (McMillan and Rodrik 2011; UNCTAD 2016; De Vries et al. 2015).

It is in this context that the debate on premature deindustrialisation and its implications for the growth and development trajectories of MICs has emerged in the literature, especially since 2008. The seminal interpretations of the deindustrialisation process go back to the work of Rowthorn, including Rowthorn (1995), as well as Rowthorn and Ramaswamy (1997, 1999) whose main objective was to relate this phenomenon to the possibilities of sustainable growth in high-income countries. Based on these contributions, several attempts have been made to estimate a relationship between the level of industrial employment as a share of total employment and the level of per capita income in countries. In general, it has been shown that this relationship is characterized by an inverted U-shape. In other words, a relationship has been estimated which shows that as per capita income increases over time, there is a corresponding increase in industrial employment, with a simultaneous decrease in the share of agricultural employment, up to a certain point. After this point, an inverse phenomenon is observed, with a reduction in the share of manufacturing employment relative to total employment in the economy, as well as a decline in manufacturing value added as a share of GDP. This phenomenon would characterize a normal deindustrialisation.

In developed economies, deindustrialisation begins at a high level of per capita

income and is considered a "normal" phenomenon because it is the result of a country's own industrial maturity. It therefore refers to a decline in the share of manufacturing in national GDP without a absolute in value added (Palma 2005). Conversely, in the case of developing countries, the decline of the manufacturing sector in terms of employment and value added occurs before the formation of a diversified, productive and innovative industrial sector, that is, at a much lower per capita income than in advanced economies (Tregenna 2016). This, in turn, consistently reduces the capacity of the industrial sector to drive development (Tregenna and Andreoni 2020).

In addition to this qualitative difference, empirical work has shown that the inflection point of the inverted U curve has been systematically lowered in recent decades. In this sense, between the 1980s and 1990s, the inflection point moved from $21,000 to just over $10,000, indicating that deindustrialisation primarily affected advanced countries in the 1980s and middle-income countries in the 1990s. In other words, the phenomenon of deindustrialisation has been observed to be increasingly premature (Tregenna and Andreoni 2020).

The middle-income trap arises when emerging economies struggle to sustain a virtuous cycle of structural transformation, specifically the shift towards more complex, technologically intensive, and innovative activities. As suggested by Lin and Wang (2020) as well as Rekha (2022), this situation often links premature deindustrialisation with the middle-income trap, as it hinders the reconfiguration of productive structures. According to Lee (2013, 2019), overcoming these challenges depends on dynamic capabilities and the domestic business structure.

To enhance the role of manufacturing in development within global value chains, industrial and technological policies must address capability and size failures, as well as the obstacle of intellectual property dominated by incumbents. Thus, they should be based on (i) building domestic technological and innovative capabilities, (ii) promoting large enterprises to address size failures, (iii) leveraging GVCs for innovative learning, and (iv) exploiting windows of opportunity during major transformations in technologies characterized by short cycles (Lee 2013, 2019). Only in this scenario would it be possible to reorganize a dynamic of transformation of the productive structure towards permanent creative destruction, thus increasing the contribution of manufacturing to development.

3. Data and methods

The measurement and analysis of manufacturing's contribution to development carried out in this paper is based on a structural decomposition of productivity and salary, using shift-share techniques, as in OECD (1987), Timmer and De Vries (2009), McMillan and Rodrik (2011), Haraguchi (2015) and specially De Vries, Timmer and De Vries (2015). Data were collected from the United Nations Industrial Development Organization (UNIDO) Industrial Statistics Database at the 2-digit level of ISIC (INDSTAT2), which provides disaggregated data on the manufacturing sector. This analysis is supplemented with GDP (Purchasing Power Parity, PPP) per capita in current US dollars, obtained from World Bank's DataBank. In order to provide a very brief perspective to Brazilian and Chinese manufacturing contribution to development, we also measured and analyzed these indicators for the 20 main MIC that had all data available in the period (Table 1)[1].

The value-added and salary dataset were calculated in local currencies and posteriorly deflated through World Bank's Consumer's Price Index for each country, with 2019 as the base year.

1 Due to the lack of data, Argentina, Kazakhstan and Ukraine, which were previously among the top 20 manufacturing parks in the MIC, were excluded from the sample (see Table 1).

Table 1. MIC sample, share in world manufacturing value added and employment, manufacturing value added as proportion of GDP (%, 2019)

	Share in world manufacturing value added (%)	Share in world manufacturing employment (%)	Manufacturing value added as proportion of GDP (%)
Middle Income Countries			
Brazil	1,79%	3,21%	10,30%
China	28,01%	34,76%	27,90%
Colombia	0,24%	0,33%	11,80%
Egypt	0,34%	0,91%	15,30%
India	1,64%	7,4%	14,50%
Indonesia	1,89%	2,9%	20,30%
Iran	0,44%	0,83%	13,90%
Malaysia	0,62%	1,04%	22,20%
Mexico	1,35%	2,02%	17,10%
Morocco	0,13%	0,39%	15%
Oman	0,13%	0,04%	9,50%
Pakistan	0,27%	1,16%	12,10%
Peru	0,24%	0,34%	12,80%
Philippines	0,22%	0,64%	19,40%
Romania	0,19%	0,54%	19%
Russia	1,78%	3,15%	13,20%
South Africa	0,34%	0,54%	12,20%
Thailand	0,74%	1,89%	25,80%
Türkiye	0,70%	1,76%	16,30%
Viet Nam	0,71%	3,51%	24,20%
Total	**42%**	**67%**	

Source: Authors, based on World Bank – DataBank and UNIDO – SDG 9 Monitoring.

Following Tregenna and Andreoni (2020), manufacturing was disaggregated into 23 sub-sectors, at the 2-digit level of ISIC Rev. 3 and grouped by the technological intensity as proposed by Galindo-Rueda and Verger (2016) and UNIDO (2010), as Table 2.

Table 2. Sub-sectoral technological classification

Low-tech	Medium-tech	High-tech
Food and beverages (15) and Tobacco products (16)	Coke, refined petroleum products, nuclear fuel (23)	Chemicals and chemical products (24)
Textiles (17)	Rubber and plastics products (25)	Machinery and equipment n.e.c. (29) and Office, accounting and computing machinery (30)
Wearing apparel, fur (18) and Leather, leather products and footwear (19)	Non-metallic mineral products (26)	Electrical machinery and apparatus (31) and Radio, television and communication equipment (32)
Wood products (excl. furniture) (20)	Basic metals (27)	Medical, precision and optical instruments (33)
Paper and paper products (21)	Fabricated metal products (28)	Motor vehicles, trailers, semitrailers (34) and Other transport equipment (35)
Paper and paper products (21)		
Furniture; manufacturing n.e.c. (36) and Recycling (37)		

Source: Tregenna and Andreoni (2020), according to Galindo-Rueda and Verger (2016) and UNIDO (2010).

Labor productivity was measured by the ratio of value-added to employed population in industrial sectors. Mean salary was measured by the ratio of total salary to the number of employees. GDP at current PPP in USD was calculated as the simple average from 2000 to 2019.

3.1 The shift-share techniques

This paper employs a shift-share technique, as used by OECD (1987), Timmer and De Vries (2009), McMillan and Rodrik (2011) and Haraguchi (2015), to analyze the decomposition of productivity and salary variation. Specifically, by adopting the

methodology of De Vries, Timmer and De Vries (2015), it is possible to capture the impact of sectoral productivity and salary variation through different components: intrasectoral, intersectoral (static structural change), and dynamic structural change. Accordingly, in a virtuous process of structural change, all components are expected to be positive, i.e., associated with the reconfiguration of the productive structure towards activities that increase productivity and salaries.

Formally, the applied model for productivity variation is derived as follows. The same steps apply when the observed variable is mean salary. The only modification is the use of this variable instead of labor productivity.

T = Σ of all sectors i;
S_i = participation of sector i in the total number of employed population;
L_i = employed population;
fy = final period;
by = initial period;
Q_i = value added;
LP = labor productivity.
t = time

First, we measure the share of the respective industrial sector i in the total number of the employed population:

$$\boldsymbol{S_i = \frac{L_i}{\Sigma L_i}} \quad \textbf{(1)}$$

Next, labor productivity was measured by the ratio between the value added of industrial transformation and the employed population:

$$\boldsymbol{LP_i = \frac{Q_i}{L_i}} \quad \textbf{(2)}$$

$$\boldsymbol{LP_T = \frac{Q_T}{L_T}} = \frac{\sum_i Q_i}{\sum_i L_i} = \sum_i \left(\frac{Q_i}{L_i}\frac{L_i}{L}\right) = \sum_i LP_i S_i \quad \textbf{(3)}$$

Differentiating equation 3 in time (from t-k to t, where t>k), we obtain

$$\boldsymbol{LP_t - LP_{t-k}} = \Delta LP_t = \sum_i LPP_{i,t} S_{i,t} - \sum_i LP_{i,t-k} S_{i,t-k} \quad \textbf{(4)}$$

The level of productivity for the years of analysis (2000, 2010 and 2019) were calculated taking into account the final and initial analysis periods.

As in De Vries, Timmer and De Vries (2015), productivity growth (4) was decomposed in 3 components, as follows:

$$\boldsymbol{\Delta(LP_T)} = \frac{\boldsymbol{LP_{T,fy} - LP_{T,by}}}{\boldsymbol{LP_{T,by}}} = \boldsymbol{I + II + III} \quad \textbf{(5)}$$

Or, as in the growth-rate form, where:

$$\frac{\boldsymbol{\Sigma_{i=1}^{n} LP_{T,by} (S_{i,fy} - S_{i,by})}}{\boldsymbol{LP_{T,by}}} \quad \textbf{(6)}$$

I

Equation (6) represents the first term by the right side of Equation (5), term I, and it accounts for the intersectoral, or static, component of the structural transformation. This component stands for the contribution to productivity growth from changes in the allocation of labor between the differing industrial segments. In accordance with literature, it is assumed that in a progressive development process, the relative share of employment shifts from low productivity sectors to those with above-average productivity rates, raising the overall labor productivity of the economy and making this component positive in the process (McMillan and Rodrik 2011).

$$\frac{\boldsymbol{\Sigma_{i=1}^{n} (LP_{i,fy} - LP_{i,by}) (S_{i,fy} - S_{i,by})}}{\boldsymbol{LP_{T,by}}} \quad \textbf{(7)}$$

II

Term II, the dynamic component of structural transformation is represented by Equation (7). It essentially captures the interaction between the change in labor productivity and the change in the relative share of employment across all sectors of the economy. This component is basically the internal product of productivity levels at the end of the analysis period and represents the change in the share of employment across sectors. Thus, in a virtuous process of structural transformation, the relative share of employment is expected to be positively correlated with the reallocation of resources towards industries with rapid productivity growth.

$$\frac{\Sigma_{i=1}^{n}\left(LP_{i,fy}-LP_{i,by}\right)S_{i,by}}{LP_{T,by}} \quad \textbf{(8)}$$

III

As for Term III, represented by Equation (8), it stands for the intrasectoral component of the structural transformation and captures the productivity growth within the different industrial segments, mainly through improvements in innovation, scale, or other internal variables to each sector. Similarly, if the change in this component is positive, then the contribution of this component to structural change is also expected to be positive (McMillan and Rodrik 2011).

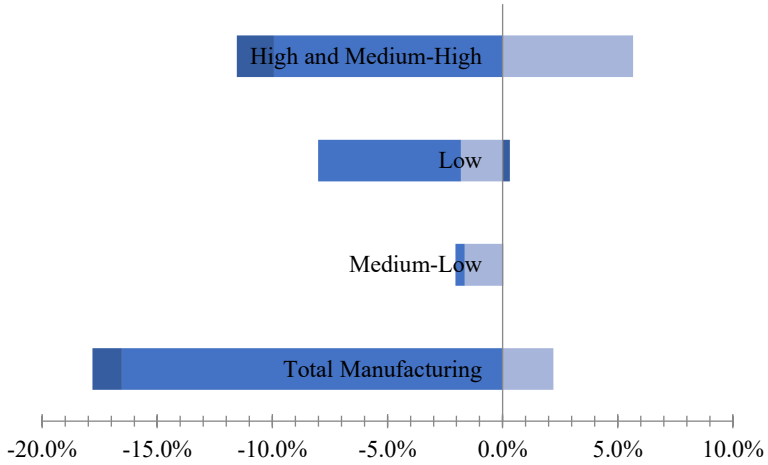
4. Results: Manufacturing´s contribution to development in Brazil and China

4.1 Manufacturing´s contribution to development in Brazil

The first noteworthy observation is that Brazil exhibited the worst performance among the 20 MICs with the largest manufacturing structures between 2000 and 2019 (Figure 1). While the average productivity growth for these countries during this period was 107.7%, Brazil's manufacturing experienced a productivity decline of 15.6%. Notably, this downward trend in productivity was observed across all technological segments of Brazilian industry, as also shown by Iasco-Pereira and Morceiro (2024). Although it uses a different methodology, this result is consistent with the conclusions presented by Nassif et al. (2015) and Nassif et al. (2020), since they also show a relationship between structural regression and the decline in Brazilian manufacturing

productivity, whether in relative terms vis-à-vis the international technological frontier or even in absolute terms.

Fig. 1. Manufacturing productivity growth - structural decomposition according to tech intensity - Brazil (2000 to 2019)



	Total Manufacturing	Medium-Low	Low	High and Medium-High
Structural change (static component)	2.20%	-1.7%	-1.8%	5.7%
Intra-sectoral component	-16.54%	-0.4%	-6.2%	-9.9%
Structural change (dynamic component)	-1.28%	0.0%	0.3%	-1.6%

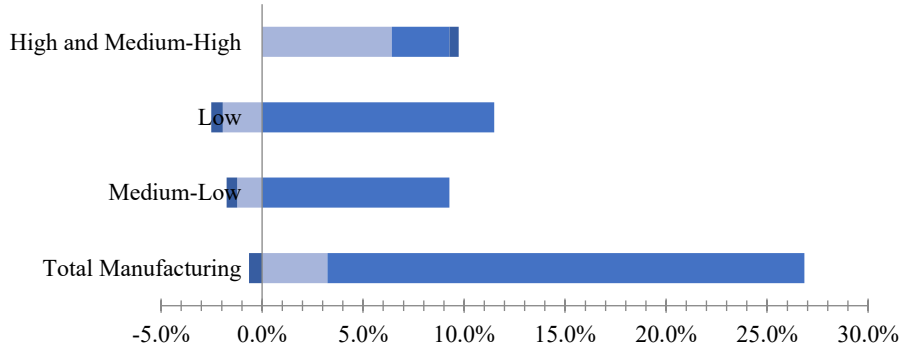
Source: Authors, based on Indstat-Unido, World Bank and IMF.

Notably, the intra-sectoral component alone accounted for the entire decline in productivity in Brazilian manufacturing sector. Unlike the other components of the structural decomposition, which are affected by the dynamics of the sectoral reallocation of productive activities, the performance of the intra-sectoral component is affected by the internal dynamics of the firm or sector. In other words, the variation in productivity is conditioned by variables such as capital stock, dynamic capabilities, accumulated knowledge, degree of technological sophistication of the production process, among others (Pisano 2017; Teece et al. 1997; Cohen and Levinthal 1989). It is also constrained by the absorption capacity of the systemic nature of learning (Freeman 1995; Nelson 1993; Lundvall 1992, 2016), the high degree of uncertainty and high financial costs for the

development of disruptive innovations (Mazzucato 2013) and the need for minimum scales of efficiency to make the budding technologies economically competitive.

Despite the premature deindustrialisation movement and the fact that Brazilian manufacturing sector had the worst performance among the MICs in terms of productivity growth between 2000 and 2019, it can be seen that this movement was not associated with a reduction in average wages. Nevertheless, the growth of local industrial wages was significantly lower than the average among MICs (150% versus 26.2%) (Figure 2).

Fig. 2. Manufacturing mean salary growth - structural decomposition according to tech intensity - Brazil (2000 to 2019)



	Total Manufacturing	Medium-Low	Low	High and Medium-High
Structural change (static component)	3.24%	-1.2%	-1.9%	6.4%
Intra-sectoral component	23.61%	9.3%	11.5%	2.9%
Structural change (dynamic component)	-0.64%	-0.5%	-0.6%	0.5%

Source: Authors, based on Indstat-Unido, World Bank and IMF.

Another factor worth highlighting when analyzing the behavior of average industrial wages in Brazil is that their growth is widespread and relatively similar according to different technological intensities. Thus, even the segments that showed a strong decline in productivity, such as the high and medium-high tech and low-tech sectors, showed a real growth in average wages.

Thus, the increase in the average wage was not the result of sectoral restructuring, with workers moving towards sectors with greater technological sophistication and, therefore, higher wage levels, as would be expected in a virtuous trajectory of

manufacturing's contribution to development. This movement seems to have stemmed more from the persistence over most of the period observed (between 2003 and 2018) of a deliberate policy of increasing the real minimum wage by Brazilian policy makers. From 2006 onwards, in line with a growth strategy based on eliminating extreme poverty, reducing inequality and expanding the local consumer market, a regulation was established by the Worker´s Party national government´s that the minimum wage should be readjusted annually by the amount of inflation observed in the immediately preceding year plus the GDP growth observed in the previous two years. Thus, between 2003 and 2019 alone, the real growth of the minimum wage was 97%.

Since the minimum wage in the Brazilian economy has historically had an indirect impact on the construction of the wage pyramid among different occupations, there has been upward pressure on wages in occupations at the bottom of the manufacturing occupation pyramid, even in a deindustrialisation scenario (Calixtre and Fagnani 2018; Singer 2015).

4.1.1 Results discussion: premature deindustrialisation and manufacturing development in Brazil

The limits of Brazilian manufacturing's contribution to development reflect, to some extent, the country's premature deindustrialisation and the associated difficulties in overcoming the middle-income trap. In line with the literature on recent Brazilian deindustrialisation, these limitations can be understood in terms of two sets of hypotheses.

The first refers to a more conventional interpretation of the negative effects of deindustrialisation on the local capacity to promote investment and generate a virtuous cycle of productive and technological transformation. In this block, productivity decline is determined by the relatively low level of investment in machinery and equipment to replace depreciated capital goods, update them or incorporate new technologies associated with digitalization. It is also influenced by the relatively low rate of innovation in Brazilian manufacturing sector, as well as its low level of investment in R&D. (Nassif et al. 2018; Nassif and Castilho 2020; Nassif et al. 2015; Morceiro and Guilhoto 2023; Baltar et al. 2016; Hiratuka and Sarti 2017).

The second block of explanations for this decline is based on Diegues and Rossi's (2020) interpretations of the relationship between deindustrialisation, integration into

global value chains, and the reorganization of the accumulation dynamics of Brazilian manufacturing in the post-2000 period. According to the authors, after decades of deindustrialisation, Brazil's industrial bourgeoisie reorganized the competitive and accumulation strategies of their firms. This reorganization gave rise to a phenomenon they call the Brazilian Disease.

In a scenario of deindustrialisation marked by the Brazilian disease, the last two decades have seen the emergence of strategies that guarantee the profitability of capital allocated to the industrial sphere, with an increasing degree of disconnection from strictly productive performance. These strategies are based on a competitive logic oriented towards a defensive and regressive reaction, with a constant search for cost reductions - for example, in labor and taxes - that are not linked to an increase in investment, productivity and innovation. These facts, in turn, bring important elements that allow us to conclude that a domestic productive structure with a lower capacity to contribute to development seems to be increasingly consolidated.

Thus, the dynamics of competition and accumulation of the Brazilian productive structure in the 2000s, which would characterize what Diegues and Rossi (2020) calls the Brazilian disease, would be based on:

> i. a permanent defensive strategy on the part of local industrial agents, in which the search for competitiveness does not occur in parallel with a virtuous structural transformation, with an increase in the complexity of the production process and a consequent increase in productivity. On the contrary, this search is supported by regressive strategies based on a permanent pressure to reduce production costs. It is also worth noting that the intensification of the pressure to compress these production costs must be understood in a scenario of limited space for the use of the instrument par excellence for increasing competitiveness in industrialization strategies - a relatively devalued exchange rate. This is because devaluation would be associated with short-term negative effects on local accumulation, given the reconfiguration of the production structure towards an essentially import-oriented integration into global production.
>
> ii. a new form of complementarity with international productive capital, made possible by the reorganization of productive activities in the form of the

so-called "smile curve", in which the domestic productive sector increases its participation in activities related to firms' local representation (commercial, financial, and marketing functions) and in the adaptation of imported products to local demand conditions;

iii. the search for increasing competitiveness and accumulation through constant pressure for fiscal and tax incentives of various kinds. These include benefits associated with the Manaus Free Trade Zone and other special sectoral or regional tax regimes, pressure to reduce wage costs, state and municipal incentives, among others. In other words, the drive to increase competitiveness and boost accumulation focuses on static elements and shifts away from a dynamic cycle resulting from investments linked to technological and innovative learning, as seen in the successful catch-up strategies of countries like Japan and Korea.

According to this interpretation, the decline in productivity in Brazilian manufacturing sector, even in terms of the intra-sectoral component, could be explained by the growing specialization of local industrial firms in activities not linked to production dynamics, with an emphasis on integration into global value chains through imports of parts and components. This, in turn, would contribute to a reduction in the local value added of production, with implications for productivity. In addition, the fall in productivity could be understood as the result of the reorganization of the dynamics of accumulation towards a logic of commercial complementarity with international capital, where local industrial companies would increasingly concentrate their accumulation on activities based on the trinomial of financialization, commercial representation and distribution of products of large local brands, and on a kind of introverted maquila (Morceiro 2018) based on the tropicalization of imported products in order to meet the requirements necessary to obtain local tax benefits and circumvent trade restrictions.

In terms of the sectoral dimension, medium-intensity technology sectors showed the smallest productivity losses, while low-intensity sectors showed the worst performance. Perhaps these sectors were more affected (especially between 2000 and 2010) by the substantial increase in productive integration between Brazil and China after the latter joined the WTO. On the other hand, the greater resilience of the medium

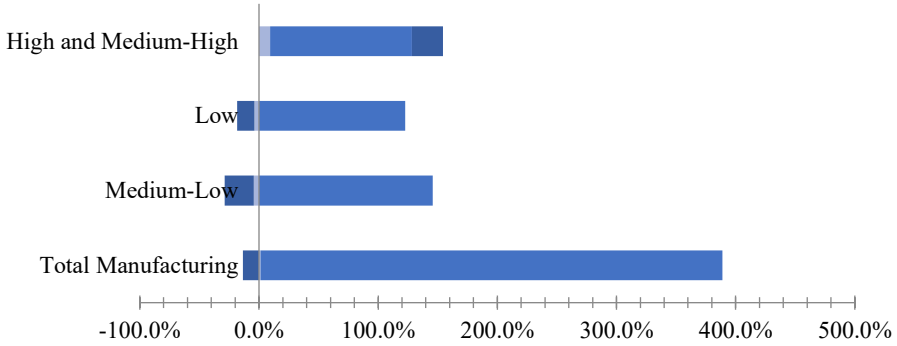
technological intensity sectors can be explained by the large representation of the oil and gas extraction sector, which saw exponential investment growth during this period (Bastos et al. 2015).

4.2 Manufacturing´s contribution to development in China

The growth dynamics of China's industrial productivity between 2000 and 2019 align closely with what classical authors (Hamilton 1791; List 1841; Rosenstein-Rodan 1943; Hirschman 1958; Furtado 1961; Gerschenkron 1962) and the empirical structural decomposition literature (Haraguchi 2015; McMillan and Rodrik 2011; OECD 1987; Timmer and De Vries 2009; De Vries et al. 2015) suggest for a virtuous development path. The same movement is also observed when analyzing the growth dynamics of industrial wages.

The first observation is that China's industrial productivity growth (357%) is the highest among the MICs over the period. This growth of about 7.3% per year even stands out among the other BRICS countries (Brazil with a decline of 15.6%, Russia with a growth of 243%, India with 33.6% and South Africa with 55.8%). The main component responsible for productivity growth was intra-sectoral at all different levels of technological intensity (Figure 3).

Fig. 3. Manufacturing productivity growth - structural decomposition according to tech intensity - China (2000 to 2019)



	Total Manufacturing	Medium-Low	Low	High and Medium-High
Structural change (static component)	1.21%	-4.3%	-3.8%	9.3%
Intra-sectoral component	387.75%	145.8%	122.7%	119.2%
Structural change (dynamic component)	-13.38%	-24.5%	-14.7%	25.8%

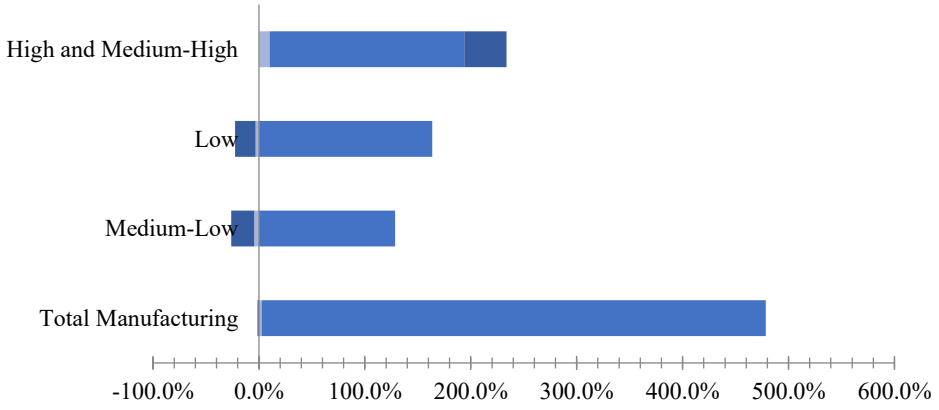
Source: Authors, based on Indstat-Unido, World Bank and IMF.

The dominance of this component can be explained by the intensity of the catching-up process of China's productive structure, which is materializing in manufacturing through the incorporation of technological progress into production processes, increased spending on R&D, and improved performance related to patenting and innovation, all of which contribute decisively to productivity growth (Mao et al. 2021).

For the high and medium-high tech sectors, the sum of the structural change components accounts for 22.5% of total productivity growth over the period, which means that around ¼ of this growth is explained by the reallocation of workers to activities with higher productivity levels and/or to activities with a productivity growth rate higher than the manufacturing average.

Following the logic of China's structural transformation model, the same outstanding pattern can be observed for industrial wages as for productivity. With a growth of 476% over the period (Figure 4), or more than 9% per year, China showed the best performance of all the MICs.

Fig. 4. Manufacturing mean salary growth - structural decomposition according to tech intensity - China (2000 to 2019)



	Total Manufacturing	Medium-Low	Low	High and Medium-High
Structural change (static component)	2.63%	-4.5%	-3.1%	10.2%
Intra-sectoral component	476.03%	128.6%	163.8%	183.6%
Structural change (dynamic component)	-1.43%	-21.6%	-19.6%	39.8%

Source: Authors, based on Indstat-Unido, World Bank and IMF.

Wage growth is evident across all levels of technological intensity, aligning with the broader transformation of China's productive structure. However, in the high and medium high-tech sectors, this growth is about 65% higher than in the medium low-tech sectors and 128% higher than in the low-tech sectors.

This movement could be understood as part of a broader process of avoiding the middle-income trap. This is because, on the one hand, the stronger growth of high and medium-high technology sectors would be associated with a greater representation of these sectors in the economy (as shown by the positive variations in the static and dynamic components of structural change), in parallel with the accumulation of technological and innovative capacities in these sectors (Lee 2019; Andreoni and Tregenna 2020).

On the other hand, we can see that the strategy of avoiding the middle-income trap is also present when we observe that the components of structural change are negative for the medium-low and low-tech sectors. In other words, although wages in these segments have increased due to the intra-sectoral component (which is also a virtuous

element in the development strategy of countries threatened by the middle-income trap), their representativeness in the economy has decreased. Thus, there is a negative contribution from the structural change components, as suggested by the policy guidelines aimed at avoiding the middle-income trap.

In other words, both movements would be in line with a reorientation of China's development strategy roughly since the Medium- and Long-term Science & Technology Plan (2006), and a subsequent implementation of a wide range of industrial policies such as the Strategic Emerging Industries Development Plan (2010), Made in China (2015), Innovation-driven Development Strategy (2016), among others. As suggested by Mao et. al. (2021), industrial and S&T policies have been a key driver behind China's economic miracle. The combination of these elements was based on structuring a top-down market and competition regulation logic, in which techno-nationalism configures a key vector to build productive and technological capacities in the Chinese economy (Chen and Naughton 2016; Naughton 2021).

4.2.1 Results discussion: Chinese industrial policy and manufacturing development strategy

In recent years, China has developed a "New National System", concentrating efforts and resources on key technological innovations and major industrial projects. This is a national development model that prioritizes key technological innovations and major industrial projects, driven by highly centralized policy implementation approaches and strategic optimizations of national resources (Arestis et al. 2021). It features government leadership (usually via industry guidance and support), strategic planning (encompassing five-year plans and medium- to long-term plans formulated by central and local governments), academia-industry-research collaboration (through national initiatives engaging universities and research institutes with enterprises), and significant national capital investments (such as the National Strategic Emerging Industries Development Fund). China's high-tech giants such as Huawei and ZTE in telecommunications equipment and BYD in new energy vehicles, are representative successful cases of this "New National System". This national development model fosters enterprise growth and expansion through diverse mechanisms, including market access, government procurement, financial support, and government collaboration, and provides crucial

assistance to businesses during economic crises. (Schaefer 2020; Kwan 2020; Yeung 2019). For example, Huawei, as the national pride of China, is often the preferred supplier for major communication projects by the government and state-owned enterprises, providing Huawei with a substantial domestic market base. Similarly, ZTE benefits from the backing of the Ministry of Science and Technology and local governments when it builds extensive network of R&D centers and international collaborative projects. Additionally, BYD partners with several provincial governments to advance electric buses and taxis, and receives substantial local fiscal subsidies and policy support

Complementarily, and also in line with the IDDS (Innovation Driven Development Strategy - 2012) guidelines, the static and dynamic structural change components are negative for the medium-low and low technological intensity sectors. This means that the representativeness of these sectors in total industrial employment decreased over the period. In other words, again in line with a virtuous circle of manufacturing's contribution to development, there has been productivity growth due to the intra-sectoral component even in the less technologically intensive sectors, but a reduction in the relative importance of these sectors in China's overall productive structure.

However, although it is possible to observe that manufacturing's contribution to development is moving in a direction that is seen as virtuous by the classic corollary of developmental policies (Johnson 1982; Wade 1990; Amsden 1989, 2001; Chang 1994; Arestis et al. 2021), it is worth noting that this process has some characteristics that are distinct from the broader logic of the Asian first-generation tigers.

This is because the coexistence of a movement of continued intense productivity growth (and also wages, as will be shown below) in the low and medium-low sectors, even in a scenario of gradual reduction of their representativeness in the local economy, reinforces the perception that maintaining China as the world's factory continues to be one of the constituent elements of the long-term objective of national rejuvenation.

It is also worth noting that this strong presence as the world's factory since the beginning of 2000 has occurred in parallel with the permanent transformation of local industry towards more technologically complex activities. This metamorphosis does not necessarily mean that, as happened in Japan, Korea and Taiwan, low-tech sectors would be replaced by medium- and high-tech ones, but that even in these less complex sectors

one could verify that, although manufacturing the same goods, there has been and increasing and steady process of technological sophistication of their features and production process.

Contrary to what a linear reading of the transition between different stages of development might suggest, the continued strength of manufacturing exports is not inconsistent with an ongoing movement to avoid the middle-income trap. As Diegues et al. (2023a) point out, there is a pervasive movement towards sophistication in China's production structure, even in the low- and medium-low-tech segments, which makes it possible to combine productivity and wage increases with maintaining international competitiveness (Arestis et al. 2021; Mao et al. 2021).

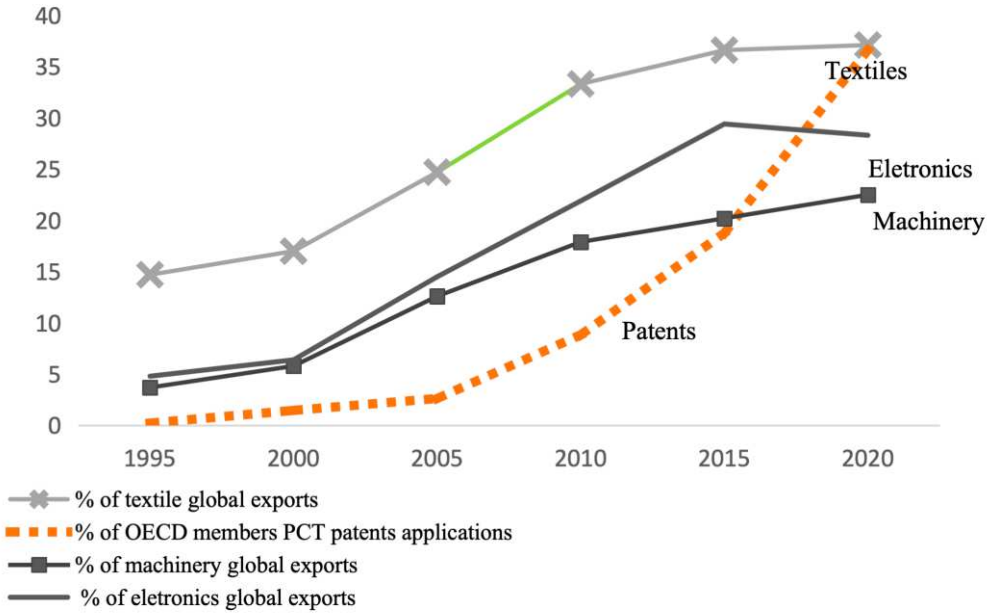
The logic of this process is based on the perception that China's productive, technological, regional, and social heterogeneity, coupled with its enormous geographic and population size, give the Chinese development process unique characteristics compared to those of the other Asian tigers. In this way, the authors suggest that this unique character would distance the Chinese strategy from an emulation of the historical experiences of countries such as South Korea and Taiwan under the flying geese paradigm (Akamatsu 1962; Palma 2009). This is because, in these experiences, the virtuous process of manufacturing's contribution to development was essentially characterized by specialization in activities of high technological complexity and the virtual elimination of medium- and low-technology products. Therefore, replicating this strategy has obvious limits in terms of universalizing, incorporating and extending the fruits of technological progress to the huge Chinese population.

Thus, according to Diegues et al. (2023a), the process of structural transformation of the Chinese economy would be accompanied by what the authors call the *"the coexistence of characteristics of different stages of development, which combine qualitatively distinct productive policies and institutions according to different regions of the country, sectors and technologies (as) the orientation of the Chinese economy toward an innovation-driven strategy does not necessarily eliminate the country's strength as the factory of the World including in low and medium-low tech industries"*

In empirical terms, this movement towards the coexistence of different stages of development in the production structure could be illustrated by the fact that, as shown in Figure 5, an increase in China's market share in world exports of electronics, machinery

and transport equipment does not go hand in hand with a decrease in the market share of labor-intensive sectors. This movement, in turn, is accompanied by an equally significant increase in Chinese patent applications under the PCT (Figure 5).

Fig. 5. Chinese Productive Indicators - Selected years - in %



Source: Atlas of Economic Complexity - Growth lab at Harvard University (% of exports) and OECD-Stats (% of patents).

Besides, China's informal institutional arrangements, exemplified by "'*Te Shi Te Ban*", are crucial in maintaining its status as the world's factory while advancing in the global value chain.

The concept of "*Te Shi Te Ban*" is actually a series of special dealings in the form of informal institutional arrangement, where local governments facilitate the growth of private businesses by helping them navigate through or bypass formal institutional barriers. Special dealings occur in various forms, such as breaking through regulatory constraints, offering land at preferential prices, easing credit constraints, blocking competitors' entry etc. (Li and Zhou 2005; Xu 2011; Hallward-Driemeier and Pritchett 2015; Jia et al. 2015; Bai et al. 2020)

"*Te Shi Te Ban*" is, to a great extent, a product of local governments competing in a GDP championship. The competitive dynamics among local governments to attract and support businesses, ensures that businesses across different regions have the

opportunity to grow and integrate into the global value chain, thus collectively raising China's position. More crucially, "*Te Shi Te Ban*" is usually extended to industries that have strategic importance for China's ascent in the value chain, such as technology and manufacturing, aligning closely with the national policy direction.

5 Concluding remarks: a comparative of manufacturing´s contribution to development in China and Brazil

In this paper, we analysed manufacturing's contribution to development in two of the leading economies of the Global South, China and Brazil, between 2000 and 2019, taking the main middle-income countries (MICs) as a comparative reference. This timeframe corresponds to the rise, consolidation and peak of global value chains (GVCs). Following a series of shocks that intensified after the pandemic crisis of 2020, these chains have increasingly undergone reorganisation. Since then, the factors shaping their organisation have gradually shifted from a predominant focus on economic efficiency towards greater resilience amid intensifying techno-nationalist disputes.

The decision to restrict the analysis to this period reflects the fact that Brazil and China pursued markedly different productive development strategies during the consolidation of GVCs. Thus, the responses of their domestic manufacturing structures were conditioned by the ways in which each country organised its integration into these chains.

On the one hand, China's strategy initially viewed the advance of globalisation and GVCs as an instrument for enabling domestic catching-up. This approach therefore focused on using GVCs to overcome certain gaps in the domestic productive structure, particularly those related to access to capital, international distribution and marketing channels, and productive learning. It is worth noting, however, that, at least since the 2006 Medium- and Long-Term Plan for Science and Technology Development (MLP), Chinese industrial and technological policy guidelines recognised that GVC participation would not automatically generate learning or functional and sectoral upgrading within these chains. On the contrary, avoiding functional lock-in in hierarchically subordinate positions would require a strategy to promote learning centred on a strong national innovation system.

In Brazil, by contrast, macroeconomic conditions regarding exchange rates,

interest rates and credit were incompatible with sustaining high investment rates over extended periods, preventing the promotion of a domestic process of structural transformation towards more sophisticated activities (Mantoan et al. 2021). In this context, integration into GVCs took an essentially defensive form, through growing imports of parts and components originating predominantly from Factory Asia.

It is worth emphasising, however, that this paper did not seek to analyse the impact of integration into GVCs on domestic productive structures. Rather, it sought to understand how the respective manufacturing sectors contributed to development amid a reorganisation of the global production paradigm, in which the connections between accumulation, investment and production were reconfigured both territorially and in terms of value creation and capture across the stages of manufacturing production. In short, the aim was to measure the extent to which domestic manufacturing sectors were able to reaffirm the classical association between structural transformation and development under these external conditions.

To this end, using shift-share decomposition techniques, we assessed manufacturing's contribution along two dimensions, productivity and average employee compensation, across sectors grouped by technological intensity.

The results support the paper's hypothesis that manufacturing's contribution to development is heterogeneous across countries and technological segments, rather than following a uniform pattern among MICs. Brazil recorded the weakest productivity performance among the 20 MICs with the largest manufacturing sectors, with a decline of 15.6% against an average growth of 107.7%. The decline was pervasive across all technological groups, concentrated in 2000–2010, and driven entirely by the intra-sectoral component. This points to a weakening of firm- and sector-level capabilities, including capital deepening, technological sophistication and cumulative learning, rather than to an unfavourable reallocation of labour. Wages did not fall, but their growth remained far below the MIC average and was relatively uniform across segments, including those with the sharpest productivity losses. Because this growth did not result from structural change towards more sophisticated activities, it appears to reflect sustained increases in the real minimum wage rather than a virtuous link between productivity and remuneration. China, in contrast, recorded the highest productivity growth among the MICs (357%) and the highest wage growth (476%). Intra-sectoral gains dominated at all technological levels,

while structural change made a substantial contribution in high- and medium-high-technology industries, accounting for 22.5% of their productivity growth over the period, with a stronger contribution after 2010. Wage gains were broad-based but disproportionately larger in higher-technology segments.

These findings contribute to the literature on premature deindustrialisation and the middle-income trap in two ways. First, they show that per capita income and the relative weight of manufacturing are insufficient to characterise manufacturing's contribution to development. Countries at similar income levels display very different intra-sectoral dynamics and different contributions of structural change, and these differences vary by technological intensity. Second, they suggest that, in the GVC era, the quality of manufacturing's contribution depends not only on preserving its share in output or employment but also, to a considerable extent, on the domestic accumulation of innovative capabilities and the ability to capture value from integration into global production networks.

For Brazil, overcoming the middle-income trap requires shifting competitive strategies away from cost reduction and tax incentives towards investment, technological learning and innovation, along the lines proposed by Lee (2013, 2019): building domestic capabilities, supporting larger firms to overcome size failures, and using GVCs as a vehicle for learning rather than for the mere assembly or adaptation of imported content. Infrastructure, skills formation, university–industry cooperation and macroeconomic coherence are enabling conditions for this shift (Suzigan and Furtado 2010; Albuquerque et al. 2017; Nassif et al. 2018; Mantoan et al. 2021). Brazil's natural-resource and agricultural base may offer opportunities in knowledge-intensive activities such as biotechnology and renewable energy. For China, as income rises, sustaining manufacturing's contribution will depend increasingly on innovation-driven productivity growth and on the quality of its innovation ecosystem.

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