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# Premature deindustrialization or reindustrialization

## The case of China's latecomer provinces

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Abstract

This study examines the occurrence of premature deindustrialization or reindustrialization in latecomer provinces in China, considering that China is a large country that produces manufactured products and has a series of related industrial policy practices. This study adopts the latecomer index to determine the occurrence of premature deindustrialization or reindustrialization, which is expressed by the downward or upward shift in the manufacturing–income relationship at a certain level of income. The results of our empirical analysis confirm the existence of premature deindustrialization in the Western economic zone of China. In the Eastern and Intermediate economic zones, the reindustrialization effect outperforms premature deindustrialization because of China's globalization and well-intended regional development policies.

## 1. Introduction

The topics of industrialization, deindustrialization, and reindustrialization cannot be ignored when creating policies and strategies for economic growth and development. The manufacturing sector is considered a country's growth engine, as verified by Kaldor's (1966, 1967) finding of a positive relationship between the growth of manufacturing output and the growth of gross domestic product (GDP), now known as Kaldor's law. Many empirical studies have indeed shown that the manufacturing sector is an engine of economic growth. Meanwhile, Rowthorn and Ramaswamy (1997) verified the "deindustrialization" phenomenon in most advanced countries, particularly in the United States (US), Europe, Japan, and the Four Tiger economies (i.e., Hong Kong, Singapore, South Korea, and Taiwan). This phenomenon has attracted a thought-provoking concern, as manufacturing employment ratios have dropped because of faster productivity growth in the manufacturing sector than in the services sector in high-income developed countries. In addition, Saeger (1997) confirmed that 23 Organization for Economic Co-operation and Development (OECD) countries have experienced lower manufacturing employment because of imports from the Global South between 1970 and 1990.

More recently, well-known economists and policy advisors have focused on the concept of "premature deindustrialization" in developing countries. Notably, Dasgupta and Singh (2007) and Rodrik (2016) stressed a quick transition into the service sector and the reduction or extinction of the manufacturing sector in developing countries. Developed countries, meanwhile, have already been experiencing this deindustrialization trend for a longer period. However, it has been labor productivity achievements, not prematurity, that has led to this structural shift from the secondary to the tertiary sector in developed countries. Accordingly, these movements resulted in employment losses but not output losses. However, this has not been the case for developing countries, which started on the path of transition since the 1980s and have experienced reduction in both their manufacturing share of output and employment.

Tregenna (2011, 2013) argued that reindustrialization could represent a sustained increase in both the share of manufacturing in total employment and in GDP. They also mentioned that reindustrialization is difficult to maintain and implement, albeit it is likely to be important for the long-term economic growth of a country. This implies the complexity of reindustrialization, and this understanding may be useful when looking at the situation of Asian developing countries; although there are trends toward reindustrialization in these countries, it remains that most of them continue to experience a lack of competitive and comparative advantages in the international market, as well as export marginalization, poverty, and debt

problems (UNCTAD, 2022a).[1]

Meanwhile, the industrialization outcome trends in current China are impressive compared to those in the rest of the world. Among the latecomer developing countries, China was one of the few to already have regions with heterogeneous characteristics—and different policy interventions in place for the economic transitions of these regions—even before the country became recognized by the World Bank as a middle-income country. The rise of China's manufacturing industry may also have unintentionally led to negative outcomes for the manufacturing sector of neighboring countries, which currently hold a low- or middle-income status. Bratton (2022) indeed remarked that China's rise in the manufacturing sector could affect the momentum of decline of the manufacturing sectors of other Asian countries, and lead these countries to move toward a greater reliance on the service sector more quickly than usual.

Accordingly, this study examines the occurrence of premature deindustrialization or reindustrialization with a focus on Chinese provinces from 1992 to 2020. Specifically, this study examines secondary sector (industry)[2] output based on data availability and the latecomer index, as represented by the ratio of a province's per capita gross regional product (GRP) relative to that of a benchmark province. The regional classification of the 31 provinces in China is shown in the Appendix. Beijing is selected as the benchmark province because it has the highest per-capita GRP at 2015 constant prices. The latecomer index allows for identifying the downward or upward shift of the manufacturing–income relationship, thereby suggesting the existence of premature deindustrialization or reindustrialization. The estimation methodology used in this study follows the propositions in the studies by Rodrik (2016) and Taguchi and Tsukada (2022). It also extends the findings of these previous studies by explaining the occurrence of reindustrialization or recovery from premature deindustrialization in case of an upward shift in the manufacturing–income relationship due to the government's industrial policy actions. This study also expands the past literature by focusing on latecomer provinces and on China after its entry into the World Trade Organization (WTO).

The remainder of this paper is organized as follows. Section 2 briefly describes China's economic growth and regional industrial development. Section 3 reviews the literature on premature deindustrialization and reindustrialization and clarifies the contributions of this study. Section 4 presents the framework of the econometric analysis with the methodology and

[1] See the following website: https://unctad.org/news/four-key-challenges-facing-least-developed-countries

[2] Secondary sector industries include mining and quarrying, manufacturing, production and supply of electricity, water and gas and construction. See the following website: http://www.stats.gov.cn/english/ClassificationsMethods/Definitions/200204/t20020419_72392.html

data, and discusses the empirical results. Finally, Section 5 summarizes and concludes the study.

## 2. China's economic growth and regional development policies since 1978

China's economic growth has gained a remarkable spot in the world since it started opening up its economy in the late 1970s and implemented a series of economic policies and strategic reforms under the leadership of Deng Xiaoping. Since then, China's global GDP contribution has been impressive. A 10%-GDP growth average over the last few decades has pulled more than 800 million people in China out of poverty and reduced the poverty head count ratio from 66.3% in 1990 to 0.1% in 2019. As a result of its effortful measures ever since 1978, China defeated its poverty trap and was promoted to a lower-middle-income country with a gross national income per capita of 1,760 USD in 2005; a decade later, in 2015, China was listed as an upper-middle-income country, with a gross national product per capita of 7,930 USD (World Bank, 2022).

Figure 1 shows the relationship between the share of the Chinese industry sector in the country's GDP and GDP per capita (at 2015 prices). While the GDP per capita grew from 7,387 yuan in 1992 to 63,427 yuan in 2020, the industry share in GDP showed an inverted-U shape, with a turning point being when China was promoted to a lower-middle-income country status in 2005, when the industry sector held a share of around 45% and 22,000 yuan in GDP per capita. Among the three economic zones of China shown in Figure 2, the real GRP per capita gap has been becoming narrower since the years 2005 and 2006. For instance, the real GRP per capita (at 2015 prices) of the Eastern zone in 2020 was 1.7 and 1.8 times higher than those of the Intermediate and Western zones, respectively.

As aforementioned, China's nationwide development is impressive, especially when compared with that of other countries in the world, and its economic structure appears to be approaching that of other industrialized countries. Its industrial transformation has followed the ordinary process of going from the primary sector to the tertiary sector after the secondary sector boom, which was accompanied by high labor productivity in the industry sector and technology-driven deindustrialization. However, not all the economic benefits of these changes have necessarily been delivered equally for provinces. For instance, Figure 3 shows the real GDP contributions of the three aforementioned economic zones to the total GDP of China, showing non-significant changes in real GDP contribution during 1995–2020. The Eastern zone has the highest GRP contribution, accounting for more than 54% of the total, whereas the GRP contributions of the Intermediate and Western zones remained at approximately 20%.

Regarding China's regional policies, the strategy implemented during the period of 1978–1992, including six dimensions,[3] was essential to smooth out the industrialization process at the regional level, and it was especially focused on the eastern coastal regions. No wonder coastal areas accounted for 84.7% of the total foreign investment in China from 1978–1995 (Song et al., 2019). The strategy of prioritizing the eastern coastal areas in the 1980s provided eastern Chinese provinces with first-mover advantages over provinces from other regions, creating large regional disparities in the early 1990s. Consequently, the Intermediate and Western zones were less prioritized by policies and lagged in development during this period. This has widened the regional development status and income gaps in China (Démurger, 2001; Fan and Sun, 2008; Fan et al., 2011; Zheng and Deng, 2013; Deng et al., 2015), leading many Chinese people from latecomer provinces to move to forerunner provinces as the latter offered higher wages, more employment opportunities, and more urbanization (UNFPA and UNICEF, 2018).

In the late 1990s, the Western and Intermediate zones started to receive more attention from the government through the coordination strategy for regional development, and a third "Go West" campaign was considered. Specifically, the Western development strategy (WDS) in 1999, the revitalization strategy of old industrial bases in the northeast region in 2003, and the strategy of promoting improvements in the central region in 2006 were all primarily focused on implementing development strategies coordinated at the regional level; these strategies targeted the provinces in the Intermediate and Western zones, which were lagging in comparison with those in the Eastern zone (The State Council, 2016, 2017; Deng et al., 2015). Before the economic system changes in 1978, two "Go West" campaigns had already been established for promoting regional development in China, namely a first wave in 1953–1962 and a second wave in 1964–1975. These two waves were partially successful, albeit more likely characterized by resource transfers from the eastern region to the other regions (Deng et al., 2015).

Most provinces in the Intermediate and Western zones of China own and produce natural resources and agricultural products, which they export at low prices to the eastern provinces that own and produce high-price value-added manufacturing goods. The provinces in the Intermediate and Western zones then import these high-price value-added products from provinces in the Eastern zone, thereby losing their regional competitiveness by being resource-

[3] The six dimensions are as follows: Implement Special Policies and Flexible Measures in Guangdong and Fujian Provinces; Establish Special Economic Zones; Open Up Coastal Cities; Open Up the Coastal Economic Open Zones; Establish Pudong New Area; Establish a Free Trade Zone in the Coastal Areas.

producing areas. If we consider this reality, one may imply that the Intermediate and Western zones have been paying taxes for ensuring the prosperity of the Eastern zone. Under the resource curse dilemma, the development of these resource-rich provinces has historically remained behind that of Eastern provinces (Song et al., 2019). The strategy of promoting the development of the central region in 2006 was initially focused on improving the regional industry, industrialization and urbanization, and ensuring its function of serving as a geographical linkage and transportation hub among the eastern and western region provinces (Song et al., 2019). The Chinese government planned to drive the growth of the central region from 2016 to 2020, and to allow for the region to establish itself as an advanced manufacturing center for the country with key areas of new urbanization, modern agriculture, and ecological civilization (The State Council, 2017).

These regional development policies have all been implemented in China, and the economic sizes of western and central region provinces rose remarkably 10 years after the launch of the WDS and the strategy focused on improving the central region. The achievements of the regional development strategies in stimulating domestic demand and investment were also remarkably effective despite the 2008 global financial crisis, especially in western region provinces; the growth rate of the Western zone[4] was the fastest among the three economic zones, and was even faster than that of the Eastern zone (Zheng and Deng, 2011; Deng et al., 2015). Thus, well-timed and -integrated regional development policies, especially the WDS, the improvement of the central region strategy, and the domestic demand stimulus strategy could be considered supportive development policies and strategies for reindustrialization in latecomer provinces and economic zones.

## 3. Literature Review and Study Contributions

This section reviews the literature regarding premature deindustrialization in developing countries based on multi-country analysis, regional multi-country analysis, specific-country analysis, and regional/provincial specific-country analysis, and the original works on premature deindustrialization by Dasgupta and Singh (2007) and Rodrik (2016). In addition, this section reviews some of the limited empirical literature on reindustrialization.

Dasgupta and Singh (2007) found that manufacturing is essential for economic growth in developing countries, as per Kaldor's law. They studied the relative importance of the

[4] The share of the nominal GDP of the Western zone in total GDP was around 20% in the 1980s, 17.09% from the early 1990s to 2003, it started to increase in 2004, and reached 18.6% in 2010. The GDP per capita of the Western zone increased faster after the WDS implementation (Deng et al., 2015).

manufacturing and service sectors in Latin America, Africa, East Asia, and India, and coined the process of deindustrialization experienced by developing countries as "premature deindustrialization." The term was used in the sense of a fall in the share of manufacturing employment with an increase in the share of the service sector that takes place at lower income levels (vs. when this happens in developed countries) in developing countries. For these cited authors, deindustrialization in developing countries takes place because they are technologically-driven toward this path and because of pathological reasons. Their empirical results show the pathological deindustrialization of Latin America and Africa, wherein economies have practiced import-substitution industrialization strategies and experienced a balance-of-payments problem in the long term. However, based on the experience of India's industrialization, they argued that the decline in manufacturing is not necessarily pathological, as India showed as a new engine of growth resulting from the information technology service sector. Similarly, knowledge-based industrialization in East Asia underwent technology-driven deindustrialization during its growth transition.

In a seminal work, Rodrik (2016) developed a refined concept and inference of premature deindustrialization by building a simple two-sector theoretical model encompassing the manufacturing and nonmanufacturing sectors. This cited study revealed that developing countries opening up their trades tend to be price-takers in the global market for manufacturing, and those who lack a strong comparative advantage in manufacturing must then become net importers of manufacturing because of the decline in the relative price of manufacturing and the rise of China. Together, these factors lead to deindustrialization in both employment and output, which is called **"*import deindustrialization***" in latecomer countries. The empirical estimation results for the posture of the cross countries and different country groups during the late 1940s to post 2010 presented that employment and output deindustrialization occurred in Latin American and African countries because these countries discovered their resources and experienced a rise in commodity prices. The findings also demonstrated that Asian countries sustained comparatively stronger advantages in manufacturing, and thus managed to avoid premature deindustrialization. Additionally, the results of the pre-and post-1990 estimations indicated that late industrializers reached their peak levels of industrialization (i.e., as measured by manufacturing employment and output shares) at lower income levels (i.e., around 40% of the level gained by early industrializers) when compared with early industrializers.

The "Technology Gaps" model constructed by Fujiwara and Matsuyama (2020), which extends the theoretical model of Rodrik (2016), describes premature deindustrialization by the heterogeneous capacity of countries to adopt frontier technology. Moreover, many empirical

studies have used Rodrik's (2016) theoretical model as a basis to identify the existence of premature deindustrialization in multiple and specific countries, and these studies are explored in the following paragraphs.

From the viewpoint of multi-country analyses and targeting non-OECD and OECD countries as samples, Sato and Kuwamori (2019) confirmed the existence of premature deindustrialization in non-OECD countries; specifically, the non-OECD countries' share of manufacturing employment and output peaked at lower income levels than the income levels of OECD countries when these factors peaked. Daymard (2020) advocated the occurrence of premature deindustrialization in Latin America and Africa from the viewpoint of manufacturing jobs. Nayyar et al. (2021) argued that premature deindustrialization matters in lower-income countries because the prospects for their service-led development are limited. Ravindran and Babu (2021) identified an increase in income inequality with premature deindustrialization, as workers are absorbed into low-productive and informal market services. Tregenna (2011) analyzed deindustrialization in developing countries by decomposing changes in the level and share of manufacturing employment in a cross-country case from 1985–2005; this cited author confirmed that "deindustrialization" in the analyzed countries could be associated with policy changes, such as trade and financial liberalization, that were not accompanied by structural changes.

Regarding regional multi-country analyses, Caldentey and Vemengo (2021) analyzed premature financialization in connection with the process of premature deindustrialization in Latin America. Ssozi and Howard (2018) discussed premature deindustrialization in Sub-Saharan Africa in relation to the low participation in global value chains. Taguchi and Tsukada (2022) presented the risk of premature deindustrialization, with a focus on developing Asian economies, by applying the latecomer index to demonstrate downward shifts in the latecomer countries' manufacturing–income relationships. They showed that the risk is higher for manufacturing trade-deficit countries and South Asian countries, and suggested the need for greater participation in global value chains to avoid premature deindustrialization.

There are very few empirical researches on specific country examinations of premature deindustrialization, with the scarce representatives having conducted regional panel analyses for premature deindustrialization (Andriyani and Irawan, 2018; Islami and Hastiadi, 2020; and Lar and Taguchi, 2022).

Empirical studies in the reindustrialization literature are also scant, and most of the related studies have focused on Europe's political interests following the global economic crisis of 2008. The European Commission (2012) supported the recovery of economic growth and jobs

by reversing the role of industry in Europe for the twenty-first century. Furthermore, the extant, and scarce, empirical studies on reindustrialization have used different perspectives for presenting the circumstances of reindustrialization. For instance, two studies reported growth in manufacturing productivity following reindustrialization (Tregenna, 2011; Capello and Cerisola, 2022). Tregenna (2011, 2013) verified that reindustrialization during 1990–2000 in some countries led to a continuous increase in both the share of manufacturing in total employment and the share of manufacturing in GDP. In the context of Western economies, Christopherson et al. (2014) investigated the potential and determining factors of a revival in manufacturing regions and the importance of industrial policies. Krawczyński et al. (2014) found that the Fourth Industrial Revolution could be a supporting factor for reindustrialization in European Union countries. Capello and Cerisola (2022) recently searched for regional reindustrialization patterns and productivity growth in the European region under a path-dependent theoretical framework. Their study discovered the occurrence of reindustrialization when the share of current manufacturing value added grew over time during 2000–2017. Meanwhile, few empirical researches have focused on reindustrialization in developing countries.

This study contributes to the literature in the following ways. First, this study targets China as a specific country using a regional/provincial panel analysis. In so doing, this research enriches the empirical evidence provided by specific-country studies. Specifically, this study used a two-step estimation procedure, as described herein: a fixed-effect panel estimation for 31 provinces to clarify the existence of premature deindustrialization in a nationwide provincial panel framework; a second estimation to verify premature deindustrialization in each economic zone of China (i.e., as per the official classification put forward by the National Statistics Bureau of China).

Second, following the methodology in the study by Taguchi and Tsukada (2022), this research applies the latecomer index to verify premature deindustrialization risk. Most previous empirical studies have concentrated on comparing industrialization peaks between developed and developing economies, and proven a lower peak at a lower-income stage in developing economies to be an index of premature deindustrialization. However, not all developing economies and local economies necessarily reach industrialization peaks. Considering this, the latecomer index allows for pinpointing downward shifts in the latecomers' manufacturing–income relationship, regardless of the existence of a peak in the manufacturing ratio. For economies that have not yet reached a peak, such downward shift suggests an upcoming peak at a lower manufacturing ratio and lower income stage. Thus, the latecomer index enables for

assessing the symptom and risk of premature deindustrialization. This study applies the latecomer index to the regional/provincial manufacturing-income analysis and contributes with a methodology for evaluating the performance of a country's industrial policies, and the degree of inclusive growth that these policies produce among provinces.

Third, the major contribution of this study lies in its examination of the "reindustrialization" effects of China as a manufacturing exporter undergoing globalization and the country's well-intentioned policy interventions. The majority of empirical analyses (Chaudhuri, 2015; Rodrik, 2016; Saeger, 1997; Taguchi and Tsukada, 2022) thus far have concentrated on the import deindustrialization under trade liberalization, including the import liberalization policies related to China's globalization. These policies accompanied the rise in imports from Asia, and China's entry into the WTO, which negatively impacted Asian countries' industrialization structure. Thus, the risk of premature deindustrialization in the context of China's WTO entry has become an important concern because many developing countries are facing the risk of premature deindustrialization because of the globalization effects related to the rise of China. China's re-engagement in manufacturing output due to its WTO entry might also promote reindustrialization in forerunner provinces and lessen the premature deindustrialization risk of latecomer provinces through export promotion and government policies to promote the manufacturing sector.

## 4. Econometric analysis: Methodology and data

This section presents the framework, methodology, and data concerning the econometric analysis, and discusses the empirical results.

### 4.1 Methodology

This study follows Rodrik's (2016) theoretical framework and empirical specifications. He constructed a two-sector theoretical model with manufacturing and nonmanufacturing sectors, and derived different outcomes for a closed economy in developed countries (exogenous in net manufacturing exports x and endogenous in manufacturing price $P_m$) and for a small open economy in developing countries (exogenous in $P_m$ and endogenous in x; namely, price takers in global manufacturing markets), as shown in Table 1.

This model explains premature deindustrialization in a developing country as a small open economy that liberalizes trade. Suppose that the global supply of manufacturing exceeds that of nonmanufacturing with the technological progress in manufacturing, and the relative price of manufactured goods declines ($P_m < 0$) for all countries under globalization. In this case, the

developing countries with less technological progress in manufacturing (the increase in $\theta_m - \theta_n$ is less than the decline in $P_m$) witness a decline in the manufacturing output and employment share. Then, only countries with a manufacturing productivity growth sufficient to offset the relative-price decline (i.e., those that have a comparative advantage in manufacturing) can avoid premature deindustrialization. Regarding the empirical specification, this study applies the equation with the inverted U-shaped manufacturing–income nexus proposed by Rodrik (2016), which controls for the effects of demographic and income trends using their quadratic terms.

At the same time, this study modifies Rodrik's specification by adopting the latecomer index, as proposed by Taguchi and Tsukada's (2022) study, to demonstrate the shifts in the latecomer provinces' manufacturing–income relationships and verify premature deindustrialization and reindustrialization, as follows:

$$\ln rivar_{it} = \theta_0 + \theta_1 \ln pop_{it} + \theta_2 (\ln pop_{it})^2 + \theta_3 \ln rgrpp_{it} + \theta_4 (\ln rgrpp_{it})^2 + \delta_1 lac_{it} + \delta_2 lac_{it}\, d02 + \delta_3 lac_{it}\, d09 + f_i + f_t + \varepsilon_{it} \quad (1)$$

where the subscripts "i" and "t" denote the province (among the 31 Chinese provinces) and year (1992–2020), respectively; *rivar* represents the industry sector output ratios to GRP in 2015 constant prices; *pop* and r*grpp* indicate the province's population size and GRP per capita in 2015 constant prices; *lac* denotes the latecomer index; *d*02, and *d09* represent time dummies for 2002–2020, and 2009–2020, respectively; $f_i$ and $f_t$ are a time-invariant region-specific fixed effect and a region-invariant time-specific fixed effect, respectively; $\varepsilon$ denotes a residual error term; $\theta_{0\ldots4}$ and $\delta_{1\ldots3}$ are estimated coefficients; *ln* shows a logarithm form.

The key variable in Equation (1) is the latecomer index (*lac*), proposed by Taguchi and Tsukada (2022) that examined premature deindustrialization risk in their cross-country panel analysis. In this study, the index is expressed as the ratio of the GRP per capita of a province to that of a benchmark province for each year. Beijing Province was selected as the benchmark province because it recorded the highest per capita GRP at 2015 constant prices. Thus, this index indicates the degree of delayed development of a province relative to Beijing. The significance and sign of the latecomer index coefficient ($\delta$) are critical for identifying premature deindustrialization risk and reindustrialization. Latecomer provinces are considered to be at risk of premature deindustrialization if the $\delta$ is significantly positive, as it reveals the linkage between a region's delayed development and its lower industrial output ratio. This relationship implies a risk of premature deindustrialization because it suggests that the province

would reach its industrial output ratio peak at a lower income level than Beijing. Conversely, if δ is significantly negative, latecomer provinces are expected to experience reindustrialization or recovery from deindustrialization. Figure 4 shows the occurrence of reindustrialization (dotted line B) and deindustrialization (solid black line A) in latecomer regions. Latecomer regions could also gain the A-1 position if the impacts of policy interventions could create recovery effects from deindustrialization.

Equation (1) also includes the cross terms of the latecomer index (*lac*) with the time dummies for 2002–2020 (*d*02) and 2009–2020 (*d*09). This is because the regional manufacturing activities related in this study to premature deindustrialization risks, reindustrialization, and recovery from industrialization also appear to have been affected by the following events. First, as a milestone achievement, China entries the WTO in 2001, and this affected its manufacturing sector because it led to massive outflows of domestic, lower-priced manufactured products. At the provincial level, this encouraged the expansion or involvement of regional value chains in the manufacturing sector in latecomer provinces. After a few months of accretion caused by the WTO entry, China's restructuring step, the so-called New Industrial Path (NIP),[5] stimulated its advanced industrialization by improving the technology level and resource efficiency of the country (UNCTAD, 2022b). Both happenings could significantly weaken the premature deindustrialization risk and promote reindustrialization in China.

Second, the global financial crisis of 2008 affected China's international trade sector, as the weak international market demand dampened the Chinese manufacturing sector. The provinces in the Eastern economic zone of China was significantly impacted, whereas those in the Intermediate and Western zones were relatively stable because they were underdeveloped in export-oriented industrialization compared with the Eastern zone (Song et al., 2019). Although China's merchandise exports dramatically dropped down by 18.3% in 2009, China's experience and management of the financial crisis provided remarkable evidence of its industrialization process (UNCTAD, 2022b). As soon as it started suffering from the impact of the 2008 global financial crisis, China started plans to encourage its domestic market demand and implement a financial stimulus plan, also called the Renminbi 4 trillion (approximately USD 570 billion) plan (Wong, 2011; Huang, 2018). The plan mainly focused on infrastructure

[5] The NIP encourages the adoption of information technology to advance industrialization by improving technology level, resource efficiency, and corporate profit. Since 2001, resources have been reallocated towards high-tech, information, equipment manufacturing, renewable energy, and other "strategic emerging" industries essential for China's digital transformation (UNCTAD, 2022b).

building and social welfare projects, such as projects related to low-income housing, rural infrastructure, water, electricity, transportation, environment, technological innovation, and rebuilding from several disasters. Soon after the 4 trillion plan, China's Industry Rejuvenation Plan (IRP) was formulated to protect 10 sectors: automobile, steel, shipbuilding, petrochemical, light industry, textile, non-ferrous metal, equipment manufacturing, electronic information, and modern logistics (UNCTAD, 2022b).

Therefore, the *d*02 and *d*09 time dummies account for the significant impacts of these events in the Chinese economy. The country's WTO entry and the effects of the NIP noticeably reduced the risk of premature deindustrialization in the country. However, regarding the *d*09 time dummy, it may be hard to define which event during this period had a stronger effect on the Chinese economy: the 2008 global financial crisis or the 4 trillion plan alongside the IRP. If the effect of the 2008 global financial crisis is stronger, the economy would suffer from a higher risk of premature deindustrialization. Meanwhile, if the effects of the two policy plans are stronger, there is the possibility of the occurrence of reindustrialization or recovery from deindustrialization.

Regarding GRP per capita, if the coefficients hold $\theta_3 > 0$ and $\theta_4 < 0$ at the conventionally significant level, the relationship between the provinces' industry output share and GRP per capita form an inverted U-shaped curve. Accordingly, Equation (1) contains the province-specific fixed effect, $f_i$, and the time-specific fixed effect, $f_t$, as control variables for the panel estimation. Each province is embedded with time-invariant factors, such as geography and resource endowments (not distributed randomly among the provinces), and the specific time effect is surrounded by province-invariant factors, such as changes in product factors and prices and technological improvements. The fixed effect variables absorb all these factors, including the unobservable ones, and help avoid biased estimations.

A panel dataset was then constructed with the 31 provinces for 1992–2020. The GDP deflator (at 2015 constant prices) data were retrieved from a World Bank dataset, and the remaining data for the estimation of Equation (1) were retrieved from the Office of the National Bureau of Statistics Stat (https://data.stats.gov.cn) and transformed into real terms (at 2015 constant prices). Descriptive statistics for the data are presented in Table 2.

### 4.2 Econometric analysis: results and discussions

Table 3 reports the nationwide panel analysis and its estimation results, with estimation (a) not having any cross terms with time dummies (i.e., *d*02 and *d*09), and estimations (b), (c),

and (d) having the cross terms with time dummies. Except for the estimation results of (d), the coefficients of GRP per capita satisfy $\theta_3 > 0$ and $\theta_4 < 0$ at the conventionally significant level, thereby showing the inverted U-shaped relationship between the provinces' industry output share and GRP per capita. The estimation results from (a) to (c) showcase significant coefficients with positive signs for the latecomer index, and significant coefficients with negative signs for its cross terms with the time dummies. As aforementioned, a positive latecomer index coefficient indicates the downward shift of the industry–income relationship and the existence of premature deindustrialization risk in the latecomer provinces.

In the estimation results of (b) and (c), the coefficients of the cross terms with time dummies are negative, implying that the China's entry into the WTO in 2001 and the NIP plan were influencing factors of the reindustrialization or recovery from deindustrialization in Chinese provinces. This conveys the impression that provinces are regaining the export reindustrialization route through the country's globalization and government policies. Moreover, while the effect of the 2008 global financial crisis may have depressed the manufacturing and secondary sector activities in latecomer provinces, its effect did not dominantly influence the effect of the two policy plans (i.e., 4 trillion plan and IRP), which contributed to the recovery from premature deindustrialization.

Regarding the estimation results of (d), it contains all the variables for the latecomer index, although the inverted-U curve is not very robust owing to the insignificant coefficient of the square of the real GRP per capita. The coefficients are significantly positive for the latecomer index and negative for their cross terms with $lac_{it}$ $d02$ and $lac_{it}$ $d09$. The magnitude of the coefficient of the cross term with $lac_{it}$ $d02$ is the largest, suggesting that China's WTO entry and the NIP plan are major contributing factors of reindustrialization and recovery from premature deindustrialization in latecomer provinces. Taguchi and Tsukada (2022) and Lar and Taguchi (2022) previously displayed downward shifts in latecomer countries' manufacturing–income relationship (premature deindustrialization) with progress in globalization, which included China's WTO entry. Therefore, the occurrence of reindustrialization in China's latecomer provinces is an innovative outcome that, thus far, had never been tested for a manufacturing-exporting country. Nevertheless, the positive coefficient of the latecomer index, representing premature deindustrialization, still presents a total effect.

Figure 5 depicts industry sector trends in each economic zone of China. It appears as an inverted U-shaped curve in the Intermediate and Western zones. However, the Intermediate zone reaches its peak in an inverted U-shape at a higher level of industry share than that of the Eastern zone. In the Western zone, the inverted U-shaped curve reaches a peak at a lower level

of industry share than that of the eastern zone.

In the estimation results of the Eastern economic zone, depicted from (a) to (d) in Table 4-1, there is no significant indication of the existence of premature deindustrialization because it consists of provinces that industrialized early on. Furthermore, the WTO entry and NIP plan favored the occurrence of reindustrialization in the Eastern zone.

For the estimation results of the Intermediate zone (Table 4-2), the coefficients of the cross terms with $lac_{it}$ $d09$ are significantly positive, implying that the 2008 global financial crisis had a dominant effect on the two Chinese policies (4 trillion plan and the IRP) and the existence of premature deindustrialization. However, the significantly negative coefficient of $lac_{it}$ $d02$ indicates that the WTO entry and China's NIP induced a reindustrialization effect.

The estimation results of the Western zone, shown from (a) to (c) in Table 4-3, demonstrate the significant and persistent existence of premature deindustrialization in latecomer provinces. However, the coefficients of the cross terms $lac_{it}$ $d02$ and $lac_{it}$ $d09$ are significantly negative, suggesting that the WTO entry and the NIP and the 4 trillion plan and the IRP favored the Western zone to reduce premature deindustrialization and recover from it. However, the total effects of the cross terms are lower than the deindustrialization effect, indicating that the Western zone still suffered from premature deindustrialization.

In summary, the Eastern zone did not experience premature deindustrialization during the sample period, whereas the Western zone did experience this phenomenon. This reflects China's unbalanced development policies and practices, which concentrated the resources in the eastern coastal area after its opening up. Our findings also confirm the reindustrialization effect, including the recovery from deindustrialization upon China's entry into the WTO and stemming from the country's regional development strategies, including the NIP, the 4 trillion plan, and the IRP. These findings are consistent with those of a study published by the UNCTAD (2022b), which noted that well-designed and effectively implemented industrial policies and strong state capabilities have played a vital role in China's industrialization process.

Researchers have emphasized that there are some supporting factors for recovering from premature deindustrialization and promoting reindustrialization, such as tax system changes, research and development project encouragement, and a favorable investment environment. Chivu et al. (2017) confirmed that the US federal government created new jobs in manufacturing, optimized tax systems, and stimulated investment and research to support reindustrialization and increase competitiveness. These cited authors also indicated that Romania is one of the less developed countries in the European Union, and that the country's reindustrialization depends on the following factors: technological transfer from advanced

European Union states; appropriate support from the government to change institutions; government support for developing an effective research and development plan; a favorable business environment. Thus, our findings provide supportive empirical evidence on how to protect late-industrialized countries from premature deindustrialization and to promote reindustrialization.

Both China's international trade policy liberalization and WTO entry definitely facilitated the growth of the domestic manufacturing sector during 2001–2004 (Chen, 2006). Similarly, the WTO (2011) reported that China's merchandise exports, manufacturing value-added, and inward flows of foreign direct investment skyrocketed after 2001. Additionally, since 2006, with the aim of enhancing the national competitiveness and the domestic research and development initiatives, the Chinese tax system has continuously improved for both domestic and foreign enterprises. Estimates from the International Labor Organization (2015) for China's sectoral employment ratio (in total employment) also revealed that the ratio of employment in the industry sector rose more than 22% after 2003 and reached more than 30% in 2013—that is, the highest ratio from 1992–2019. Thus, creating new manufacturing job opportunities has successfully supported the trend of reindustrialization or recovery from deindustrialization in latecomer region provinces.

## 5. Conclusion

The empirical results of this study demonstrate that the following could be promoting factors of reindustrialization and recovery from premature deindustrialization for latecomer provinces in China (i.e., mainly in the Eastern and Intermediate economic zones): China's domestic demand management policy interventions; coordination of regional development strategies; immediate policy implementation to respond to the negative shock of the 2008 global financial crisis. At the same time, the Western zone has not yet fully recovered from its premature deindustrialization. Therefore, western region provinces should be prioritized by the government and its industrial policies, so that these provinces can undergo inclusive growth.

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Table 1 The Effect of Shock on Manufacturing

| A. Closed Economy | | | |
|---|---|---|---|
| Effect on | Technology Shock $\theta_m$-$\theta_n$ >0 | Trade Shock $d_x$<0 | Domestic Demand Shock |
| *Employment share* | - | - | - |
| *Real Output Share* | + | - | - |
| B. Small Open Economy | | | |
| | Technology Shock $\theta_m$-$\theta_n$ >0 | Trade Shock $P_m$<0 | Domestic Demand Shock |
| *Employment share* | + | - | 0 |
| *Real Output Share* | + | - | 0 |

Notes: θm and θn : the productivity of manufacturing and non-manufacturing sectors, respectively :dx:net exports of manufactured goods ; and Pm: prices of manufactured goods

Source: Extracted from Rodrik (2016)

Table 2 Descriptive Statistics

| Variables | Dependent Variable | Explanatory Variables | | |
|---|---|---|---|---|
| | *rivar* (Real,%) | *pop* (10,000) | r*grpp* (Yuan) | *lac* |
| Observations | 899 | 899 | 899 | 899 |
| Mean | 42.03 | 4,204.80 | 29,378.82 | 0.382 |
| Median | 42.64 | 3,799 | 22,507.65 | 0.309 |
| Maximum | 61.96 | 12,601 | 147,848.2 | 1.313 |
| Minimum | 13.51 | 210.89 | 2,681.69 | 0.101 |
| Std. Dev. | 8.45 | 2,711.14 | 24,516.89 | 0.223 |

Source: National Bureau of Statistics Stat (https://data.stats.gov.cn)

Table 3 Estimation Result for 31 Provinces

| Estimation | | a | b | c | d |
|---|---|---|---|---|---|
| *Const.* | -12.592*** | -12.465*** | -8.894*** | -9.763*** | -6.051*** |
| | (-10.345) | (-10.507) | (-6.780) | (-7.953) | (-4.509) |
| ln *pop* | 0.605** | 0.911*** | 1.019*** | 0.928*** | 1.039*** |
| | (2.336) | (3.552) | (4.044) | (3.708) | (4.235) |
| $(\ln pop)^2$ | -0.021 | -0.036** | -0.044** | -0.031* | -0.039** |
| | (-1.183) | (-2.108) | (-2.540) | (-1.827) | (-2.314) |
| ln r*grpp* | 2.187*** | 2.108*** | 1.098*** | 1.498*** | 0.451* |
| | (13.728) | (13.541) | (4.781) | (8.431) | (1.862) |
| $(\ln rgrpp)^2$ | -0.089*** | -0.101*** | -0.037*** | -0.072*** | -0.006 |
| | (-10.784) | (-12.228) | (-2.770) | (-7.808) | (-0.434) |
| *lac* | | 0.920*** | 0.477*** | 1.009*** | 0.556*** |
| | | (6.922) | (3.098) | (7.518) | (3.705) |
| *lac*d*02 | | | -0.378*** | | -0.388*** |
| | | | (-5.887) | | (-6.195) |
| *lac*d*09 | | | | -0.319*** | -0.325*** |
| | | | | (-6.602) | (-6.879) |
| Provincial Fixed effect | YES | YES | YES | YES | YES |
| Period fixed effect | YES | YES | YES | YES | YES |
| Number of Provinces | 31 | 32 | 33 | 34 | 35 |
| Number of Observations | 899 | 900 | 901 | 902 | 903 |

*Note*. *, **, and *** denote the rejection of null hypothesis at 90%,95%, and 99% levels of significance respectively, t-statistics are in parentheses.

Sources: Authors' estimation

Table 4-1 Estimation Result for Eastern Economic Zone

| Estimation | | a | b | c | d |
|---|---|---|---|---|---|
| *Const.* | -3.425 | -2.459 | -0.396 | -1.578 | 1.297 |
| | (-1.362) | (-0.935) | (-0.149) | (-0.552) | (0.443) |
| ln *pop* | -1.913*** | -1.858*** | -1.739*** | -1.847*** | -1.711*** |
| | (-6.290) | (-6.053) | (-5.725) | (-6.005) | (-5.626) |
| $(\ln pop)^2$ | 0.106*** | 0.104*** | 0.096*** | 0.104*** | 0.096*** |
| | (5.532) | (5.369) | (5.038) | (5.365) | (5.016) |
| ln r*grpp* | 2.849*** | 2.706*** | 2.010*** | 2.529*** | 1.649*** |
| | (9.672) | (8.575) | (5.340) | (6.518) | (3.602) |
| $(\ln rgrpp)^2$ | -0.129*** | -0.128*** | -0.082*** | -0.120*** | -0.0649*** |
| | (-9.294) | (-9.213) | (-4.204) | (-6.973) | (-2.799) |
| *lac* | | 0.229 | -0.075 | 0.252 | -0.057 |
| | | (1.247) | (-0.369) | (1.3525) | (-0.282) |
| *lac*d*02 | | | -0.244** | | -0.262*** |
| | | | (-3.266) | | (-3.459) |
| *lac*d*09 | | | | -0.049 | -0.086 |
| | | | | (-0.785) | (-1.380) |
| Provincial Fixed effect | YES | YES | YES | YES | YES |
| Period Fixed effect | YES | YES | YES | YES | YES |
| Number of Provinces | 11 | 11 | 11 | 11 | 11 |
| Number of Observations | 319 | 319 | 319 | 319 | 319 |

*Note*. *, **, and *** denote the rejection of null hypothesis at 90%,95%, and 99% levels of significance respectively, t-statistics are in parentheses.

Sources: Authors' estimation

Table 4-2 Estimation Result for Intermediate Economic Zone

| Estimation | | a | b | c | d |
|---|---|---|---|---|---|
| *Const.* | 21.205*** | 23.825*** | 28.195*** | 26.008** | 29.597*** |
| | (2.721) | (2.718) | (3.365) | (3.014) | (3.568) |
| ln *pop* | -9.621*** | -10.323*** | -10.286*** | -11.052*** | -10.865*** |
| | (-6.176) | (-5.456) | (-5.721) | (-5.906) | (-6.066) |
| $(\ln pop)^2$ | 0.638*** | 0.681*** | 0.675*** | 0.715*** | 0.702*** |
| | (6.405) | (5.700) | (5.939) | (6.072) | (6.226) |
| ln r*grpp* | 2.982*** | 2.902*** | 1.669*** | 3.009*** | 1.844*** |
| | (7.231) | (6.741) | (3.484) | (7.100) | (3.857) |
| $(\ln grpp)^2$ | -0.115*** | -0.103*** | -0.016 | -0.096*** | -0.017 |
| | (-5.575) | (-3.679) | (-0.605) | (-3.479) | (-0.5484) |
| *lac* | | -0.568 | -1.778** | -1.294 | -2.262*** |
| | | (-0.656) | (-2.071) | (-1.467) | (-2.601) |
| *lac*d*02 | | | -0.380*** | | -0.352*** |
| | | | (-4.950) | | (-4.591) |
| *lac*d*09 | | | | 0.217*** | 0.171** |
| | | | | (3.083) | (2.520) |
| Provincial Fixed effect | YES | YES | YES | YES | YES |
| Period Fixed effect | YES | YES | YES | YES | YES |
| Number of Provinces | 9 | 9 | 9 | 9 | 9 |
| Number of Observations | 261 | 261 | 261 | 261 | 261 |

*Note*. *, **, and *** denote the rejection of null hypothesis at 90%,95%, and 99% levels of significance respectively, t-statistics are in parentheses.

Sources: Authors' estimation

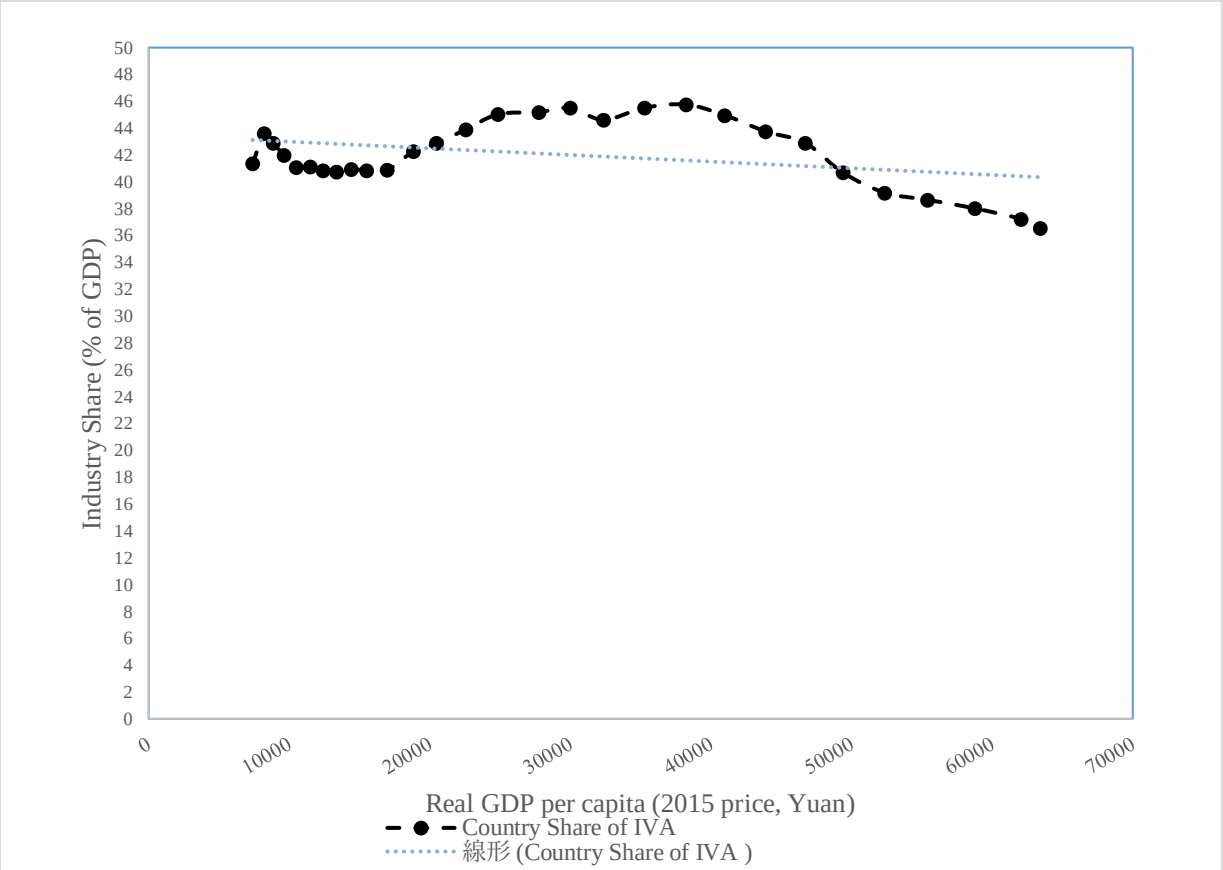
Table 4-3 Estimation Result for Western Economic Zone

| Estimation | | a | b | c | d |
|---|---|---|---|---|---|
| *Const.* | -22.572*** | -23.002*** | -19.052*** | -19.933*** | -15.669*** |
| | (-11.643) | (-13.471) | (-10.091) | (-11.045) | (-7.970) |
| ln *pop* | 6.092*** | 5.351*** | 5.449*** | 4.963*** | 5.049*** |
| | (12.051) | (11.854) | (12.389) | (11.069) | (11.612) |
| (ln *pop*)$^2$ | -0.449*** | -0.361*** | -0.369*** | -0.325*** | -0.332*** |
| | (-11.346) | (-10.039) | (-10.548) | (-9.039) | (-9.536) |
| ln r*grpp* | 1.227*** | 2.165*** | 1.034*** | 1.739*** | 0.538 |
| | (3.898) | (7.389) | (2.696) | (5.766) | (1.392) |
| (ln r*grpp*)$^2$ | -0.060*** | -0.159*** | -0.084*** | -0.139*** | -0.059** |
| | (-3.896) | (-9.451) | (-3.560) | (-8.166) | (-2.546) |
| *lac* | | 4.066*** | 3.215*** | 4.203*** | 3.321*** |
| | | (9.865) | (7.221) | (10.442) | (7.685) |
| *lac*d*02 | | | -0.395*** | | -0.413*** |
| | | | (-4.089) | | (-4.744) |
| *lac*d*09 | | | | -0.297*** | -0.310*** |
| | | | | (-4.371) | (-4.711) |
| Provincial Fixed effect | YES | YES | YES | YES | YES |
| Period Fixed effect | YES | YES | YES | YES | YES |
| Number of Provinces | 13 | 13 | 13 | 13 | 13 |
| Number of Observations | 377 | 377 | 377 | 377 | 377 |

*Note*. *, **, and *** denote the rejection of null hypothesis at 90%,95%, and 99% levels of significance respectively, t-statistics are in parentheses.

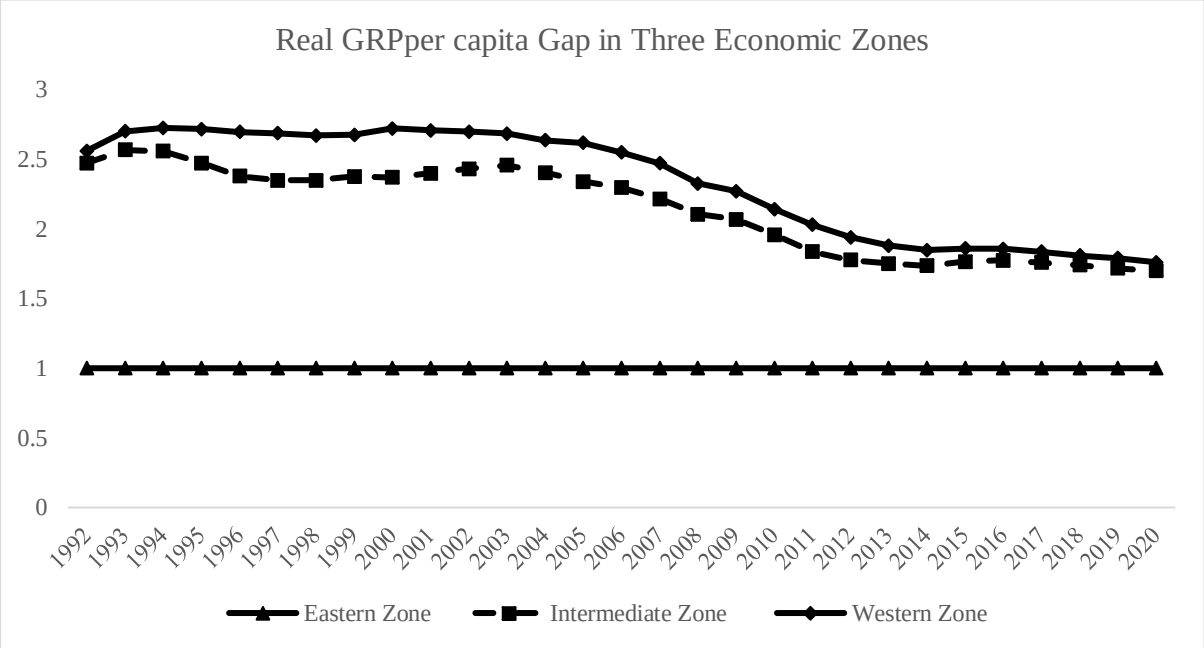
Sources: Authors' estimation

Figure 1 China's Share of Industry Value Added and Real GDP per capita



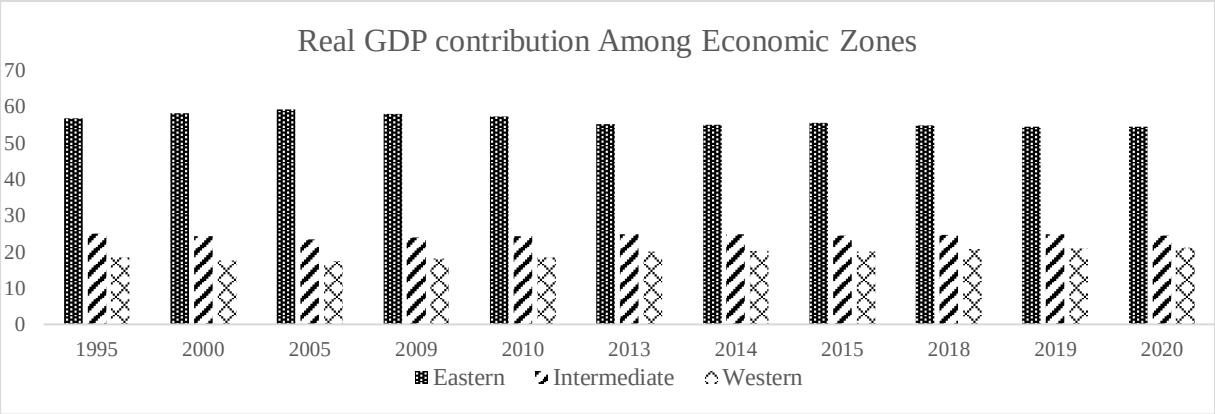

Source: National Bureau of Statistics Stat (https://data.stats.gov.cn)

Figure 2 Real GRP per capita in Three Economic Zones



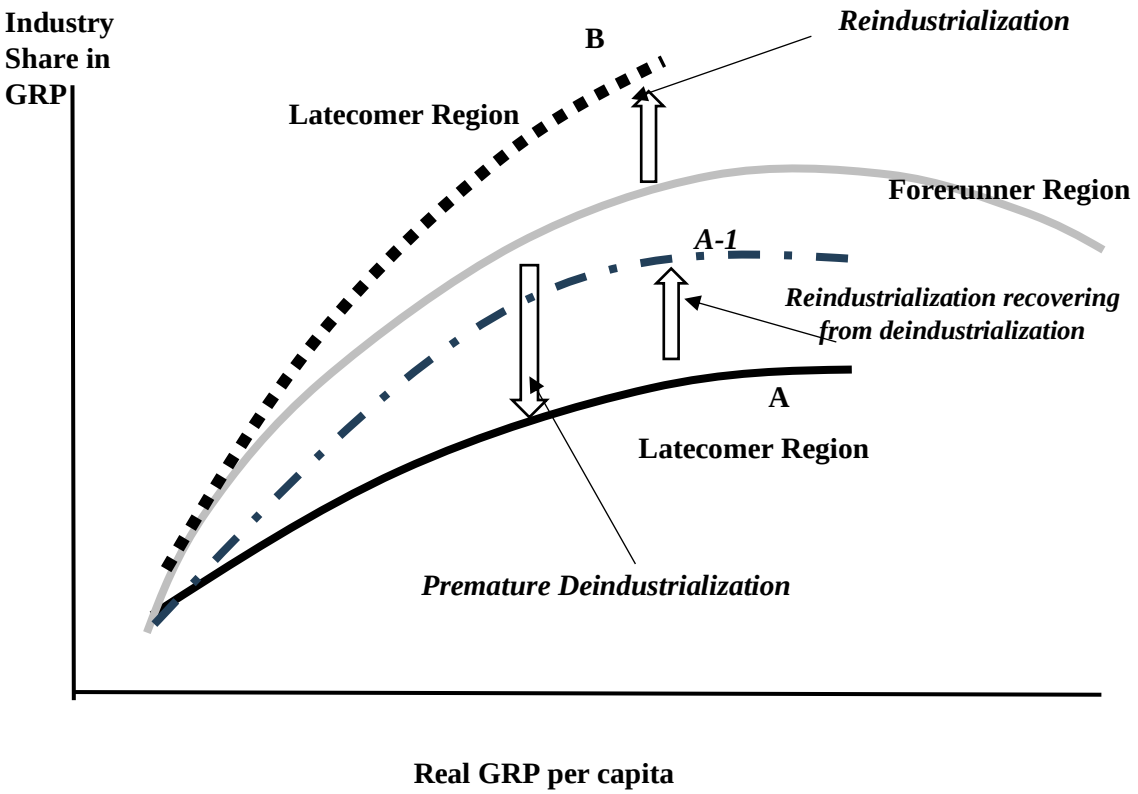

Source: National Bureau of Statistics Stat (https://data.stats.gov.cn)

Figure 3 Real GDP Contribution among Three Economic Zones 1995-2020



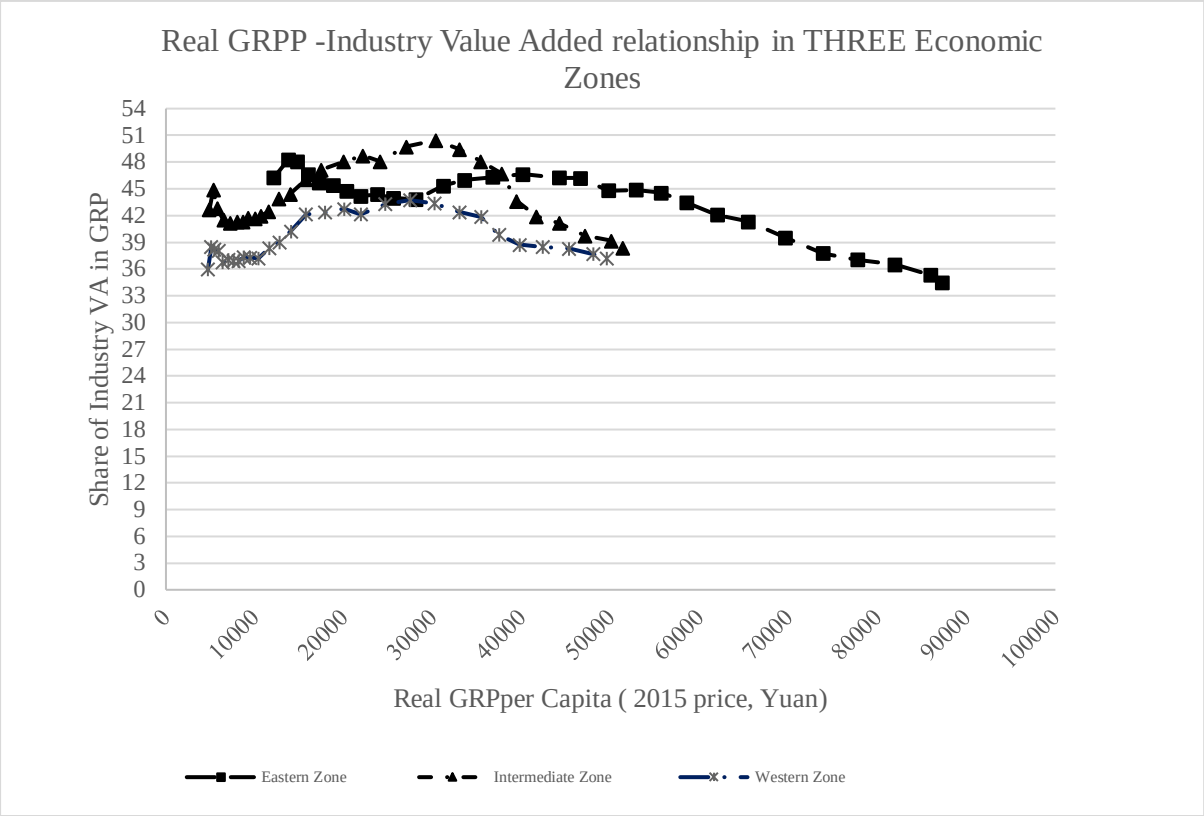

Source: National Bureau of Statistics Stat (https://data.stats.gov.cn)

Figure 4 Framework of Premature Deindustrialization, Reindustrialization, and Reindustrialization Recovering from Deindustrialization




Source: Authors' description

Figure 5 Secondary Sector Trend in Three Economic Zones, China




Sources: Authors' estimation

Appendix

China's Thirty-one provinces in Three Economic Zones

| Sr.No. | Eastern Zone | Intermediate Zone | Western Zone |
|---|---|---|---|
| 1 | Beijing | Anhui | Chongqing |
| 2 | Fujian | Heilongjiang | Gansu |
| 3 | Guangdong | Henan | Guangxi |
| 4 | Hainan | Hubei | Guizhou |
| 5 | Hebei | Hunan | Inner Mongolia |
| 6 | Jiangsu | Jiangxi | Ningxia |
| 7 | Liaoning | Jilin | Qinghai |
| 8 | Shandong | Shanxi | Shaanxi |
| 9 | Shanghai | | Sichuan |
| 10 | Tianjin | | Tibet |
| 11 | Zhejiang | | Xinjiang |
| 12 | | | Yunnan |
| | 11 | 8 | 12 |

Source: National Bureau of Statistics ( https://data.stats.gov.cn)

Map China's 31 Provinces and 3 Zones


Source: National Bureau of Statistics (https://data.stats.gov.cn)