China| A shift-share analysis of productivity growth

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1. Introduction

In the face of shifting demographics and evolving global trade dynamics, sustaining productivity growth has become the central pillar of China's long-term economic strategy. Recognizing this imperative, Chinese authorities have increasingly prioritized qualitative development, formally introducing the concept of "New Quality Productive Forces" to spearhead a systemic boost in social productivity.

This research note, by applying a shift-share analysis framework to China's census data, investigates the labor productivity changes in China over the decade spanning **2013 to 2023**. By comparing sectoral performance across different intervals, we attempt to identify the drivers behind productivity growth.

The rest of the note is structured as follows: section 2 reviews the recent debate about China's productivity slowdown; section 3 presents the results of our shift-share analysis applied to both the entire economy and the manufacturing sector; section 4 concludes with some policy suggestions.

2. The Debate on China's Productivity Slowdown

The long-term productivity trajectory of the Chinese economy remains a focal point of intense macroeconomic debate. Crucially, any analytical consensus regarding whether a genuine productivity slowdown has occurred is fundamentally intertwined with broader scholarly skepticism surrounding the veracity of China's official macroeconomic disclosures. Sceptics frequently target the conspicuous smoothness of headline metrics, such as real GDP growth and official employment rates, arguing that institutional political incentives to meet top-down targets can lead regional authorities to inflate or smooth data. This empirical friction intensified significantly in the aftermath of the COVID-19 pandemic. For instance, independent research institutions like the Rhodium Group utilized alternative data series to estimate that China's economy contracted in 2022 and expanded at a much slower rate in 2023 than official statistics indicate. Similarly, the Bank of Finland's Institute for Economies in Transition (BOFIT) constructed independent GDP indicators suggesting that China's real economic expansion ground to a near-halt during the 2022 lockdowns.

On the contrary, the latest iteration of the Penn World Table (PWT) marks a pivotal departure from its previously cautious stance, aligning instead with China's National Bureau of Statistics

(NBS). As the global benchmark dataset for evaluating cross-country living standards and structural productivity, the PWT had traditionally sided with critics of China's official data. Up to version 10.01, the dataset featured an adjusted GDP series for China developed by economist Harry Wu—a methodology that consistently yielded lower growth trajectories than official reports. Grounded in this Wu-adjusted baseline, earlier versions of the PWT depicted a sharp, aggressive deceleration in China's total factor productivity (TFP) between 2009 and 2019.

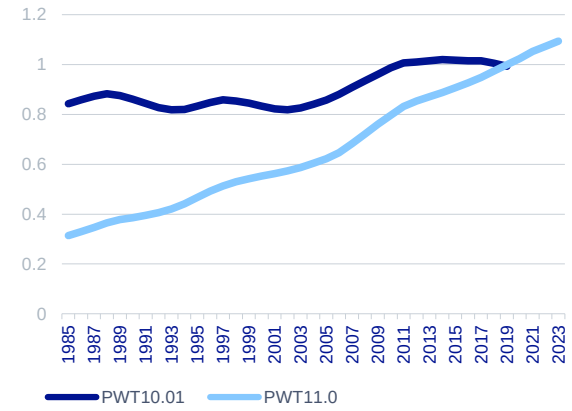
However, the publication of PWT version 11.0 shifted to using China's official National Accounts and GDP metrics as its primary input for estimating long-run productivity trends. To justify this pivot, the PWT recognized the systematic methodological improvements implemented by the NBS to elevate reporting standards, while identifying several structural flaws in the legacy Harry Wu methodology. Furthermore, the authors of the PWT noted that the overstatement of GDP growth is a widespread phenomenon across major emerging economies, finding no empirical basis to isolate or uniquely penalize China's reporting.

Under the new PWT 11.0 framework, China's productivity figures continue to reveal a decelerating structural trend, yet the gradient of this slowdown is far less severe than previously assumed. (Figure 1) This stark divergence is entirely an artifact of the baseline data series utilized across the two different versions of the dataset.

The PWT also estimated the dynamic trajectory of China's purchasing power parity (PPP)-based productivity relative to the United States. (Figure 2) The PWT 11.0 demonstrated that China's productivity convergence toward the US has persisted over the long run. Conversely, the Wu-adjusted data in PWT 10.01 implied that this catching-up process had actively reversed after 2018.

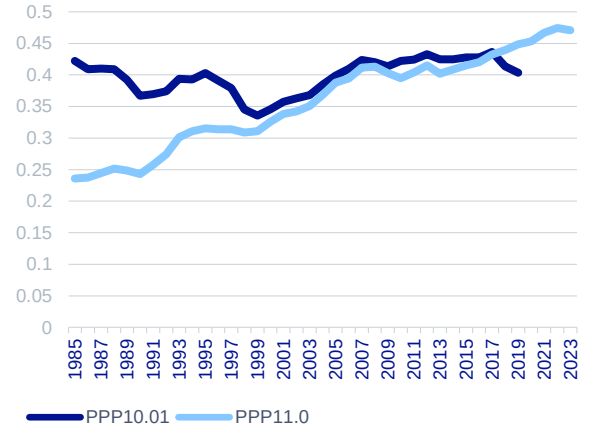
All in all, the precise magnitude and deceleration pace remain open to rigorous empirical debate. The following section leverages China's comprehensive economic census data to systematically examine the sector-level patterns of productivity changes.

FIGURE 1: TWO TFP ESTIMATES UNDER PWT (CONSTANT PRICE)



Source: The Penn World Table & BBVA Research

FIGURE 2: TWO TFP ESTIMATES UNDER PWT (PPP BASED AND US AS 1)



Source: The Penn World Table & BBVA Research

3. Shift-share Analysis of Labor Productivity Disclosing Structural Changes Bequeath Overall Resilience

We apply the shift-share analysis framework to examine China's productivity growth. Unlike the Total Factor Productivity (TFP) metric discussed in the preceding section, the focus here is strictly on labor productivity, defined as the output per worker across different economic sectors.

A couple of caveats must be noted: first, because our empirical dataset relies entirely on China's official statistical system, any inherent reporting or smoothing biases in the national accounts—as discussed in the preceding section—will inevitably carry over into our empirical findings; second, because our productivity metric measures labor productivity (output per capita) rather than multi-factor efficiency, these results do not capture the systemic capital overinvestment or its subsequent drag on Total Factor Productivity (TFP).

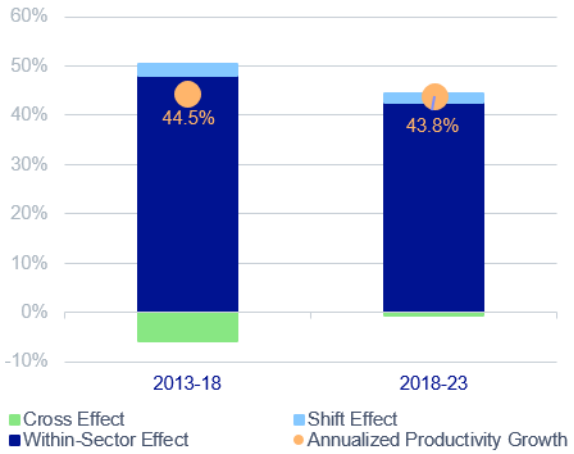
Shift-share analysis decomposes aggregate productivity growth into three distinct components:

- **The Within-Sector Effect:** This component calculates the sum of industry-level productivity growth rates, weighted by their initial output shares. It measures pure intra-industry efficiency gains—such as those driven by technological adoption or managerial improvements—that ultimately boost aggregate productivity.

- **The Shift Effect:** This captures the sum of sectoral employment growth rates, weighted by initial output shares, minus total employment growth. It measures the structural impact of labor reallocation based on baseline productivity levels. For instance, if workers migrate from low-productivity sectors (such as subsistence agriculture) to higher-productivity ones (such as modern manufacturing), this effect will be positive—even if neither sector experienced internal efficiency gains during the period.

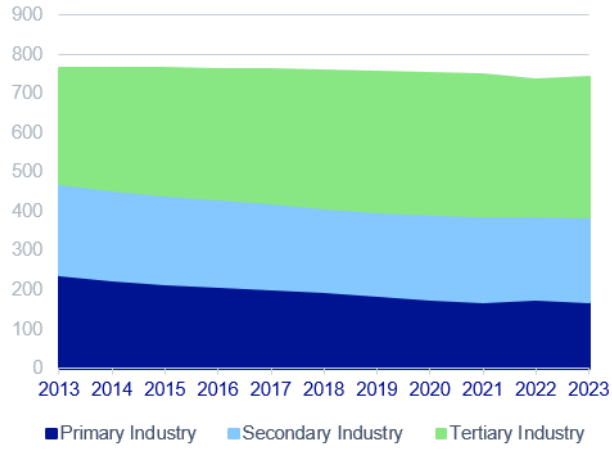
- **The Cross Effect:** Serving as the interaction residual of the decomposition, this component equals the product of the changes in sectoral productivity and the changes in labor inputs. It reveals whether labor is shifting toward sectors with accelerating productivity or those that are stagnating. A negative cross effect indicates that labor is migrating into sectors where productivity growth is slowing down. This structural burden is highly common in mature economies where employment shifts heavily toward service industries (such as healthcare or hospitality), which historically face steeper challenges in matching the high productivity growth rates of technology or manufacturing.

FIGURE 3: SHIFT-SHARE ANALYSIS OF TWO SUBPERIODS (2013-2018 AND 2018-2023)



Source: NBS & BBVA Research

FIGURE 4: EMPLOYMENT NUMBERS OF THREE INDUSTRIES



Source: NBS & BBVA Research

Utilizing the comprehensive census data from 2013, 2018, and 2023, we conduct a comparative analysis of China's labor productivity in two consecutive sub-periods: 2013–2018 and 2018–2023. (Figure 3) The aggregate economy is partitioned into 18 distinct sectors, matching the structure of national input-output tables. Notably, the aggregate employment softened from 762 million during 2013–2018 to 747 million during 2018–2023. (Figure 4).

The empirical results reveal below prominent trends in China's productivity dynamics:

- First, the slowdown in aggregate labor productivity growth between the two sub-periods is remarkably marginal. The overall productivity gain reached 44.5% during the 2013–2018 period and only softened slightly to 43.8% in 2018–2023. These findings corroborate the resilience of China’s productivity growth.

- Second, labor productivity growth in both sub-periods was predominantly driven by within-sector productivity improvements. It is in line with the historical findings of Molnar and Chalaux (2015) for the 2002–2011 period. The sustained strength of within-sector effects is partly attributable to China’s expanding investment in R&D. According to the NBS, China’s R&D expenditure as a percentage of GDP has steadily risen from 2.08% in 2013 to 2.65% in 2023, surpassing the EU’s average of 2.2%.

- Third, the structural **Shift Effect** (labor reallocation) accounted for a minor share of aggregate gains, contributing 2.3% in 2013–2018 and tapering to 1.7% in 2018–2023. This positive contribution demonstrates that structural labor reallocation persisted over the decade, with workers consistently moving toward higher-productivity activities.

- Fourth, the **Cross Effect** (interaction effect) improved substantially from -5.2% in 2013–2018 to -0.5% in 2018–2023. This contraction indicates that high-productivity sectors successfully continued to attract or retain labor during the second sub-period, effectively neutralizing previous negative structural drag.

Structural changes indicate the maturing of China's economy

The sectoral contributions detailed in Table 1 highlight profound structural shifts in the aggregate Within-Sector Effects. Most notably, the manufacturing sector's contribution to total within-sector gains was cut in half, dropping from 17.4% in the first sub-period to 8.5% in the second. In relative terms, manufacturing accounted for more than one-third of aggregate within-sector growth during 2013–2018, but this share contracted to less than one-fifth during 2018–2023. Conversely, this stark deceleration in the manufacturing sector's contribution mechanically implies an expanding role for other sectors of the economy.

TABLE 1: WITHIN-SECTOR EFFECTS BY INDUSTRY

Industry	Code	2013-18	2018-23
Agriculture, Forestry, Animal Husbandry and Fishery	A	7.2%	6.2%
Mining	B	4.2%	3.7%
Manufacturing	C	17.4%	8.5%
Electricity, Heat, Gas and Water	D	1.8%	0.8%
Construction	E	1.5%	3.0%
Wholesale and Retail Trades	F	0.8%	1.7%
Transport, Storage and Post	G	5.2%	1.4%
Hotels and Catering Services	H	-0.2%	0.5%
Software and Information Technology Services	I	1.1%	2.0%
Real Estate	K	0.7%	2.7%
Leasing and Business Services	L	0.1%	0.9%
Scientific Research and Technical Services	M	0.7%	1.3%
Water Conservancy, Environment and Public Facilities	N	0.0%	0.2%
Other Services	O	-0.2%	1.1%
Education	P	0.9%	1.3%
Health and Social Work	Q	0.2%	1.2%
Culture, Sports and Entertainment	R	0.2%	0.1%
Public Management (Including Finance)	S	6.4%	5.9%

Source: NBS & BBVA Research

To better understand these dynamics, we categorize the 18 sectors into a 2x2 matrix based on two criteria: the acceleration or deceleration of labor productivity growth between the two sub-periods, and the net change in employment shares between 2018 and 2023. This classification yields four distinct quadrants, as mapped out in Figure 5:

- **Quadrant I (Booming Sectors):** The industries in this quadrant achieved accelerated labor productivity growth during the 2018–2023 period relative to 2013–2018, while simultaneously attracting net labor inflows.
- **Quadrant II (Mature Sectors):** These industries experienced a slowdown in productivity growth during the 2018–2023 period compared to the preceding five years, yet they continued to register net labor inflows. This continued expansion of their workforce may be attributed to their high absolute productivity levels or lower

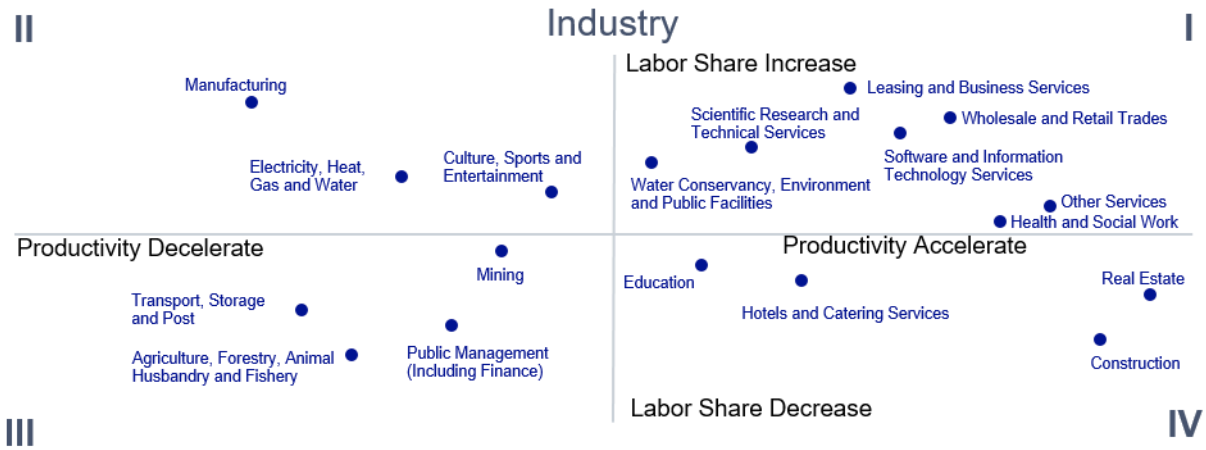
entry barriers. Notably, the manufacturing sector falls within this quadrant.

- **Quadrant III (Consolidating Sectors):** Sectors in this quadrant are characterized by both decelerating productivity growth and a shrinking share of total employment. A prominent example is the agriculture, forestry, animal husbandry, and fishery sector, which continues to shed labor to the rest of the economy.

- **Quadrant IV (Restructuring Sectors):** The industries here achieved accelerated productivity growth, but at the expense of a contracting labor share. Notably, every sector in this quadrant was subject to severe external shocks between 2018 and 2023. For instance, regulatory policy shifts in 2021 imposed stringent constraints on the education and real estate sectors, which subsequently dragged down the tightly interconnected construction sector. Similarly, the shock to the hotel and catering services industry stemmed from the COVID-19 pandemic; widespread domestic pandemic containment measures and mobility restrictions severely constrained the sector until the full economic reopening in 2023. These patterns suggest that these sectors might get hit by unexpected external shocks while they are experiencing high-productivity growth.

As illustrated in Figure 5, the labor productivity slowdown observed within the manufacturing sector during the 2018–2023 period was largely offset by a cluster of booming industries, including Leasing and Business Services, Wholesale and Retail Trades, Software and information Technology Services, Scientific Research and Technical Services, Water Conservancy, Environment and Public Facilities, Health and Social Work as well as Other Services. These expansionary sectors achieved accelerated productivity growth relative to the preceding 2013–2018 observation window. Notably, all these booming, high-performance industries belong to the service sector. This structural shift represents a successful rebalancing toward a service-driven economy, a developmental milestone that typically characterizes China's transition into an upper-middle-income country.

FIGURE 5: DISTRIBUTION OF SECTORS IN A MATRIX OF PRODUCTIVITY AND LABOR SHARE CHANGES

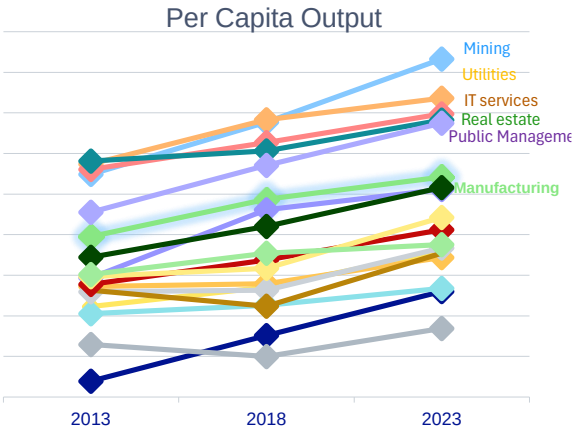


Source: NBS & BBVA Research

Inside the manufacturing sector

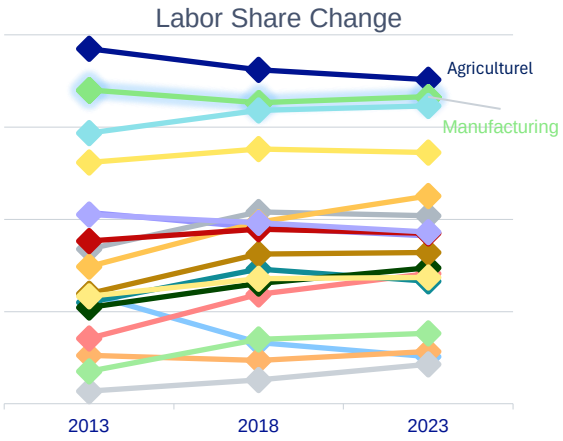
Figures 6 and 7 disclose more characteristics of the manufacturing during the observation window. Despite experiencing a growth slowdown during the 2018–2023 sub-period, the absolute level of per capita output in manufacturing remained higher than in most other industries. The only notable exceptions were capital- or knowledge-intensive sectors, including mining, utilities (electricity, heat, gas, and water), software and information technology, real estate, and public management (which includes finance). (Figure 6) Concurrently, the manufacturing sector retained its position as the second-largest employer in the economy, trailing only agriculture, forestry, animal husbandry, and fishery. Interestingly, manufacturing's share of total labor contracted during the 2013–2018 period but experienced a partial rebound between 2018 and 2023. (Figure 7).

FIGURE 6:ABSOLUTE LEVEL OF PER CAPITA OUTPUT ACROSS SECTORS



Source: NBS & BBVA Research

FIGURE 7 LABOR SHARE ACROSS SECTORS IN THE ECONOMY



Source: NBS & BBVA Research

The granularity of the Census data enables a more detailed examination of the manufacturing sector. We first disaggregate the broader manufacturing industry into 31 distinct subsectors and map them onto the same four-quadrant matrix utilized for the macro-level sectors (Figure 7).

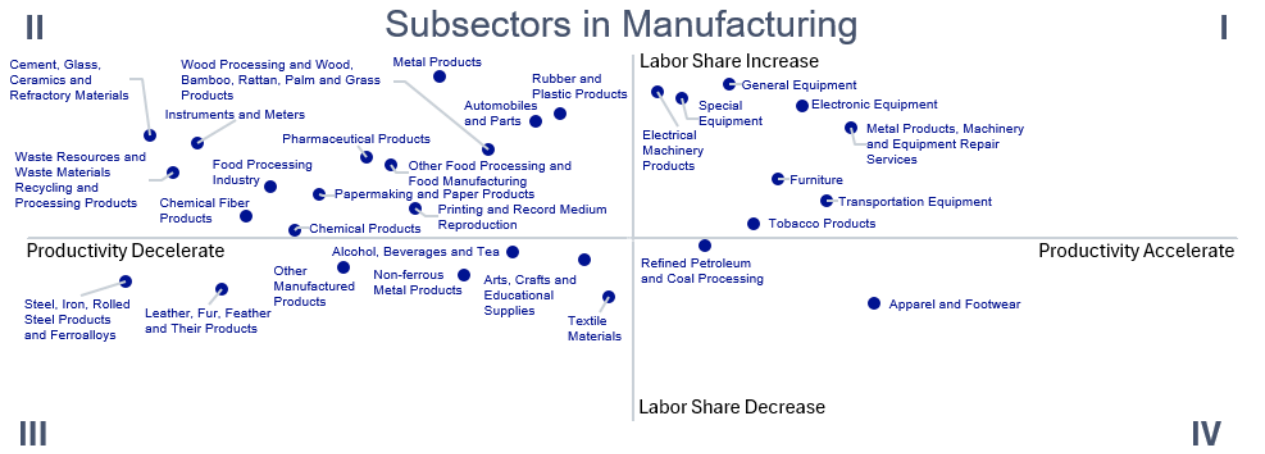
Performance across these manufacturing subsectors exhibits significant heterogeneity. While a cluster of booming subsectors experienced simultaneous productivity gains and labor share expansion, only 8 of the 31 subsectors fall into this category. Additionally, two subsectors achieved productivity growth at the cost of a shrinking labor share. We attribute this divergence to severe external shocks encountered between 2018 and 2023: the Refined Petroleum and Coal Processing subsector faced mounting structural pressure from the global push toward sustainability, while the Apparel and Footwear subsector bore the brunt of rising global protectionism, symbolized by the onset of the US-China trade war in 2018.

The remaining 21 subsectors experienced a deceleration in productivity growth during the 2018–2023 period, largely explaining the general productivity slowdown observed within the

broader manufacturing sector. These subsectors include traditional heavy industries (such as Steel, Metal Products, Cement etc.) as well as some labor-intensive ones (such as Textile, Leather & Fur, Food Processing etc.)

Ultimately, although a select group of booming subsectors successfully attracted labor inflows through productivity advancements, most subsectors appear to be mature or consolidating, thereby acting as a structural drag on aggregate manufacturing productivity gains.

FIGURE 8: DISTRIBUTION OF SUBSECTORS OF MANUFACTURING SECTOR IN A MATRIX OF PRODUCTIVITY AND LABOR SHARE CHANGES



Source: NBS & BBVA Research

4. Conclusions and Policy Suggestions

Applying a shift-share decomposition framework, we examine the dynamics of China's labor productivity—measured as real output per capita—over the 2013–2023 decade. Our empirical findings indicate that most of the aggregate productivity growth during this period was driven by **within-sector effects** (intra-industry efficiency gains), whereas structural labor reallocation (the **shift effect**) played a smaller but consistently positive role. Crucially, the manufacturing sector experienced a pronounced productivity deceleration in the latter half of the decade (2018–2023). However, its negative drag on aggregate productivity was largely neutralized by a cluster of booming, high-productivity service industries. It explains how China maintained a relatively robust rate of GDP growth even as its macroeconomic engine shifted toward the service sector.

At a more granular level, the 31 subsectors within manufacturing exhibit profound performance heterogeneity. Only 8 of these 31 subsectors achieved simultaneous productivity gains and labor share expansion during the 2018–2023 period. In contrast, 21 subsectors experienced a marked deceleration in productivity growth, contributing to the broader manufacturing slowdown. These findings suggest that Chinese policymakers cannot afford complacency regarding the industrial base. While a number of high-profile emerging industries—such as electric vehicles (EVs), shipbuilding, lithium-ion batteries, photovoltaic

systems, and LED technologies—demonstrate formidable international competitiveness, the underlying trend of productivity deceleration is actually broad-based across the vast majority of the manufacturing sector.

Several policy implications can be drawn from our findings regarding China's labor productivity over the 2013–2023 decade.

First, the authorities should maintain the intensity of R&D expenditure to facilitate efficiency gains across diverse sectors. Innovation and technological progress are critical to driving productivity and aggregate output as China's demographic dividend begins to diminish.

Second, policymakers should strive to dismantle unnecessary barriers that impede the mobility of capital and labor toward high-productivity sectors. Eliminating these friction points will optimize the structural shift effect and bolster aggregate productivity growth. Crucially, several sectors in our analysis exhibit a combination of rapid productivity gains alongside pronounced labor outflows. Our analysis suggests that some of these trends are tied to unintended structural frictions from regulatory shifts—such as the rapid restructuring of the private tutoring and education sector—or poorly timed interventions in the real estate and construction sectors. Suboptimal policy reactions risk choking off productivity gains and deterring necessary labor inflows.

Third, the government must pay closer attention to the potential role of the ongoing AI revolution in reshaping both sectoral and aggregate productivity. A well-designed "AI+" strategy could reinvigorate mature or consolidating sectors, effectively reaccelerating their productivity trajectories.

Appendix: Shift-Share Analysis

Shift-share analysis is a powerful decomposition technique used by economists to isolate the underlying driving forces of an economy's aggregate labor productivity growth. This framework peels back macroeconomic layers by decomposing aggregate growth into three distinct components: the Within-Sector Effect, the Shift Effect, and the Cross Effect.

For each individual industry i , labor productivity (LP_i) is defined as output (Y) divided by labor input (L). Then growth of labor productivity can be decomposed as below:

$$\Delta LP/LP_{t-1} = \Sigma (L_{i,t-1}/L_{t-1}) * (\Delta LP_{i,t} /LP_{i,t-1}) + \Sigma (LP_{i,t-1}/LP_{t-1}) * (L_{i,t}/L_t - L_{i,t-1}/L_{t-1}) + \Sigma (\Delta LP_{i,t}/LP_{t-1}) * \Delta(L_{i,t}/L_t)$$

The first component is the Within-Sector Effect, which calculates the sum of industry-level productivity growth rates, weighted by their initial output shares. It measures pure intra-industry efficiency gains—such as those driven by technological adoption or managerial improvements—that ultimately boost aggregate productivity.

The second component is the Shift Effect, which captures the sum of sectoral employment growth rates, weighted by initial output shares, minus total employment growth. It measures

the structural impact of labor reallocation based on baseline productivity levels. For instance, if workers migrate from low-productivity sectors (such as subsistence agriculture) to higher-productivity ones (such as modern manufacturing), this effect will be positive—even if neither sector experienced internal efficiency gains during the period.

The third component is the Cross Effect, which serves as the interaction residual of the decomposition, this component equals the product of the changes in sectoral productivity and the changes in labor inputs. It reveals whether labor is shifting toward sectors with accelerating productivity or those that are stagnating. A negative cross effect indicates that labor is migrating into sectors where productivity growth is slowing down. This structural burden is highly common in mature economies where employment shifts heavily toward service industries (such as healthcare or hospitality).

Conducting this analysis requires comprehensive, sector-specific labor input data. We extract these inputs from China's Economic Census, which has been conducted every five years since 2004. To capture the most recent economic developments, this study utilizes data from the 2013, 2018, and 2023 census waves. Additionally, we use officially reported annual employment statistics to calibrate and ensure the consistency of total employment figures across these three benchmark years.

Because the Economic Census provides sector-level financial indicators rather than direct sectoral output figures, we utilize China's official Input-Output (I-O) tables as our primary source for by-sector output data. All output data have been deflated using relevant sector-specific price indices to ensure the values are evaluated in real terms.

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