

China's Growth Slowdown: A Macroeconomic Analysis

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Non-technical Summary

China's rapid catch-up growth since the late 1970s has slowed since the late 2000s. This report examines why this slowdown has occurred, drawing on macroeconomic theory and long-run empirical evidence, and considers what this shift means for China's future development and what policies should be implemented to boost long-run growth.

The theoretical framework applies the Solow model and its augmented version that includes human capital to understand long-run growth. This model explains how economies grow by accumulating physical capital, improving labour input and advancing technology and productivity. A key insight from this framework is that countries can grow quickly when they are still developing because they can adopt existing global technologies. However, as they become increasingly developed, further growth becomes harder, as capital investment faces diminishing returns. This means each additional unit of investment contributes less to output than before. At this point, long-term growth increasingly depends on improvements in productivity, rather than on expanding the scale of inputs alone. The theoretical framework also highlights the importance of labour quality, as changes in education, skills, working hours and size of the labour force can affect how much workers contribute to economic output. For China, these factors have become increasingly relevant as the population ages and the working-age share of the population declines.

To understand whether China's slowdown reflects short-term disruptions or a structural shift, the report uses a trend-extraction technique to separate the long-term growth component of Gross Domestic Product (GDP) from the short-term cyclical component. The report also applies growth accounting, to break down overall economic growth into contributions from capital accumulation, effective labour and productivity. By examining how each factor has contributed over time, it becomes possible to identify which parts of the economy have weakened and which have remained strong. The data used to inform this empirical analysis has been sourced from long-running international datasets that provide consistent measures of China's output, capital, labour force and human capital. The focus is on growth per worker, as this provides a clearer picture of underlying productivity without labour force changes affecting GDP trends.

The empirical results show a sustained, structural slowdown in China's underlying growth rate beginning in late 2007. While China's GDP has continued to grow, the pace of its growth has weakened. Growth accounting results explain why. Capital accumulation has remained a strong contributor to growth, continuing to raise capital per worker. However, the contribution of productivity to growth has declined significantly compared with earlier decades. Simultaneously, labour contributions have fallen, as China's working age population has begun to shrink and an ageing society has reduced the share of workers in the population. These findings align with theoretical predictions using the Solow model; as the economy develops and accumulates more capital, it becomes increasingly difficult to sustain high growth without stronger productivity improvements.

The following two policy recommendations are therefore made. First, increase effective labour participation, particularly by gradually raising the retirement age and improving healthcare for older workers. These measures would help offset the effects of population ageing by retaining experienced workers and ensuring they remain healthy and productive. Secondly, strengthen China's productivity growth by using a combined strategy of investing in Research and Development (R&D) to support technological innovation, and improving conditions for the diffusion of technology across all regions and firms. Enhancing skills, improving the business environment and allowing resources to move more easily to the most productive sectors would help ensure that innovations generated in leading industries also benefit the wider economy.

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Introduction

China's growth has been rapid and described by the World Bank as 'the fastest sustained expansion by a major economy in history' (Charlton, 2019). China's annual growth averaged 9.5% from 1979 until 2008 (IMF, 2025), far outstripping other economies, causing its GDP to double approximately every 8 years. However, since 2008, China's growth has slowed (Al-Haschimi, 2024). This report therefore uses macroeconomic theory and analysis to identify the drivers behind China's growth slowdown. This is achieved by applying the Solow-Swan and endogenous growth models within the theoretical framework, followed by the Hodrick-Prescott (HP) filter and growth accounting, within the empirical analysis section, to decompose structural drivers. The results are then used to inform two growth enhancing policy recommendations tailored to China.

Theoretical Framework – Solow Model

To analyse China's recent growth slowdown, we use the Solow-Swan model as the benchmark framework for long-run growth. The model is designed to identify the proximate drivers of output including capital accumulation, labour input, and Total Factor Productivity (TFP). The model is also designed to explain why countries can experience rapid catch-up growth and then converge to slower growth rates over time.

This framework can explain China's transition from decades of investment-led convergence to a more mature stage where sustaining growth depends increasingly on productivity and innovation (Zilbotti, 2017:943). Within the Solow-Swan model, with Harrod-neutral technological progress and assuming a standard Cobb-Douglas production function, output (Y) is produced using capital (K) and labour (L) and driven by the exogenous TFP (A).

$$Y = K^{\alpha}(AL)^{1-\alpha}, \quad 0 < \alpha < 1 \quad (1)$$

Here α is the output elasticity of capital, representing capital's share of national income. A is exogenous and captures the effects of innovation but also allocative efficiency, competition, and governance.

The key Solow mechanism is diminishing returns to capital, holding labour and TFP fixed, as the marginal product of capital falls as K increases. Therefore, capital deepening can generate rapid growth when the capital stock per effective worker (effective worker is AL , and becomes AhL once human capital is introduced in equation 9, TFP (A) scales the efficiency of each worker (L), so AL is the number of efficiency-adjusted workers) is low, but its contribution to growth diminishes when the capital stock per effective worker is high.

Capital grows according to equation 2, where s is the exogenous saving/investment rate increasing capital and δ is depreciation:

$$\dot{K} = sY - \delta K, \quad (2)$$

Labour grows exogenously at rate n and TFP at rate g :

$$\frac{\dot{L}}{L} = n, \quad (3) \quad \frac{\dot{A}}{A} = g \quad (4)$$

Both labour and TFP grow over time. Therefore, it is useful to express the economy in per effective worker terms. Workers become more productive as TFP improves, the relevant labour input effective labour.

Capital per effective worker (k) and output per effective worker (y) is defined by:

$$k \equiv \frac{K}{AL} \quad (5) \quad y \equiv \frac{Y}{AL} \quad (6)$$

When human capital is included (equation 9), we equivalently express variables per effective worker using AhL in place of AL .

Therefore, output per effective worker depends only on capital per effective worker: $y = k^\alpha$ (7)

This allows the focus to be on how capital accumulation affects output. Capital per effective worker increases when investment per effective worker is large enough to cover depreciation of existing capital, population growth and technology growth. A steady state occurs when capital per effective worker stops changing, where investment per effective worker exactly offsets depreciation and the growth of effective labour. At this point, output per effective worker is constant. Although a higher saving rate (s) raises steady state level of capital per effective worker (k^*), long-run growth in output per worker is determined by growth in TFP.

$$\dot{k} = 0 \rightarrow s(k^*)^\alpha = (\delta + n + g)k^* \quad (8)$$

However, output per effective worker may still grow over time because TFP continues to improve. Therefore, a higher saving or investment rate increases the level of output per worker but does not permanently increase the growth rate of output per worker unless TFP growth also rises.

To explain persistent income differences across countries, the model was augmented by Mankiw-Romer-Weil (MRW), which can be represented as an additional component of effective labour to include Human Capital (h). The production function becomes:

$$Y = K^\alpha (AhL)^{1-\alpha}, \quad 0 < \alpha < 1 \quad (9)$$

This extension highlights that investments in education and health raise the steady-state level of output per worker by improving labour quality and the economy's capacity to adopt and use technology, especially relevant for China as demographic tailwinds (favourable population trends, such as growing workforce and high birth rates) fade and production becomes more skill, and innovation-intensive. In our empirical analysis, we do not estimate a separate income share for human capital. Instead, consistent with the available factor-share data, human capital is treated as labour quality embedded in effective labour per worker, so its effect is captured through the effective labour term rather than as a separate factor share.

A key limitation of the Solow framework is that TFP growth is treated as exogenous, so the models do not explain why productivity growth accelerates or decelerates over time. This limitation becomes more important as economies close part of the gap to the world technological frontier. Distance-to-frontier perspectives emphasise that when an economy is far from the frontier, it can grow rapidly by accumulating capital and adopting existing technologies ("imitation" or diffusion). As it develops and moves closer to the frontier, the scope for growth from straightforward technology adoption narrows, and sustaining convergence increasingly requires frontier innovation, plus institutions that support experimentation, firm entry and exit and the efficient reallocation of resources toward more productive activities. This provides a complementary lens for interpreting China's recent stage of development. The growth model shifts from being primarily investment- and adoption-led growth, and towards being increasingly constrained by the pace of innovation and economy-wide diffusion, consistent with a reduced marginal impact of further capital deepening relative to earlier decades.

Guided by these frameworks, our empirical strategy uses Penn World Table (PWT) data to decompose China's output growth per worker into the contributions of capital deepening $\frac{K_t}{emp_t}$, effective labour per worker ($hc_t \times avh_t$), and the TFP residual, and to assess which components have weakened during the slowdown. The Solow framework predicts that as an economy matures, the growth contribution from capital deepening should diminish and sustained growth should depend increasingly on productivity. Accordingly, our empirical results focus on whether China's slowdown reflects weaker TFP performance, reduced returns to investment and slower capital deepening, and/or weaker effective labour dynamics.

Empirical Methodology

Hodrick-Prescott (HP) Filter

The HP filter is a technique used in macroeconomics to decompose a timeseries, such as GDP (y_t), into a long-run trend component (τ_t) and a short-run cyclical component (c_t) (Schüler, 2024:2). τ_t is purely statistical and should not be interpreted as potential output or a model-consistent steady state (Canova, 1998:475). This can be expressed using the equation:

$$y_t = \tau_t + c_t \quad (10)$$

To identify the long-run trend component (τ), the below HP filter equation is applied:

$$\min_{\tau} \left(\underbrace{\sum_{t=1}^T (y_t - \tau_t)^2}_{\text{1st part}} + \lambda \underbrace{\sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2}_{\text{2nd part}} \right) \quad (11)$$

This equation identifies the trend component (τ) by minimising the variance of the cyclical component (c) of the timeseries (y) to deliver a smooth trend line (τ), while penalising abrupt changes in the trend using a smoothing hyperparameter (λ). The first part therefore represents ‘goodness-of-fit’ and second ‘smoothness of the trend’.

The HP filter provides a descriptive decomposition that helps assess whether recent growth is unusually lower relative to past trends, but it cannot, by itself, distinguish structural from cyclical causes. Despite its limitations, the HP filter is a useful descriptive tool that complements the model-based growth accounting that follows.

Data

In the absence of real quarterly GDP, China’s quarterly nominal GDP (in millions, yuan renminbi) and quarterly total Consumer Price Indices (CPI; 2015=100) for China, as a deflator, were obtained from the OECD’s ‘Data Explorer’ for 1995Q1 to 2025Q3. Nominal GDP was deflated using the CPI to produce a real GDP series for filtering. The series was seasonally adjusted to account for seasonal patterns in China’s quarterly output.

Assumptions and Limitations

The smoothing parameter, λ , determines the extent to which sudden changes in the timeseries are filtered out by the trend component and is externally defined depending on the interval at which the timeseries is recorded. The higher its value, the smoother the extracted trend component (Schüler, 2024:2). As China’s GDP timeseries is quarterly, the standard value of 1,600 is used (ibid.). The choice of λ is conventional and not model-based, presenting an assumption, and an alternative value could yield different trend dynamics (Moura, 2024).

The HP filter has also been criticised for suffering from end-point bias, as the last point of the series can have an exaggerated impact on the trend (Bruchez, 2003:3). This means the estimated trend can shift as new data become available (ibid.). To test robustness, the Hamilton filter is also applied, as it uses a regression based detrending method that avoids an arbitrary smoothing parameter and reduces end-point bias.

Growth Accounting per worker

While the HP filter provides a descriptive account of aggregate output dynamics, we identify the proximate drivers of China’s slowdown using growth accounting on a per worker basis within an augmented Solow framework. Focusing on output per worker isolates changes in productivity and factor intensity from changes in overall employment, which is particularly important given China’s demographic transition and structural labour market changes. Growth accounting decomposes changes in output per worker into contributions from (i) capital deepening, (ii) changes in effective labour per worker, and (iii) a residual interpreted as TFP.

To align this framework with our empirical analysis in per-worker terms, we define output per worker and capital per worker using persons engaged (emp_t). Output per worker and capital per worker are defined as:

$$y_t^w \equiv \frac{Y_t}{emp_t} \quad (12) \quad k_t^w \equiv \frac{K_t}{emp_t} \quad (13)$$

Labour input may vary along both the extensive margin (employment) and the intensive and quality margins (hours worked and human capital). We therefore measure effective labour per worker as the product of the PWT human-capital index, hc_t , and average annual hours worked per worker, avh_t :

$$l_t^w \equiv hc_t \times avh_t \quad (14)$$

Aggregate output is assumed to be produced according to a Cobb-Douglas production function with effective labour and a potentially time-varying capital share α_t :

$$Y_t = A_t K_t^{\alpha_t} (hc_t H_t)^{1-\alpha_t} \quad (15)$$

where Y is real output, K_t is the physical capital stock, A_t captures TFP, and H_t is total hours worked, defined as:

$$H_t = emp_t \times avh_t \quad (16)$$

Dividing equation 15 by employment yields the per-worker production relationship:

$$\frac{Y_t}{emp_t} = A_t \left(\frac{K_t}{emp_t} \right)^{\alpha_t} (hc_t \cdot avh_t)^{1-\alpha_t} \quad (17)$$

Taking logs and applying a discrete Törnqvist/Divisia approximation gives the per-worker growth-accounting identity:

$$\Delta \ln y_t^w \approx \bar{\alpha}_t \Delta \ln k_t^w + (1 - \bar{\alpha}_t) \Delta \ln (hc_t \cdot avh_t) + \Delta \ln A_t \quad (18)$$

Where $\bar{\alpha}_t$ is the adjacent-period average capital share:

$$\bar{\alpha}_t \equiv \frac{1}{2} (\alpha_t + \alpha_{(t-1)}) \quad (19)$$

We implement time-varying factor shares using observed labour-income shares from the PWT; with labour share $labsh_t$, the implied capital share is:

$$\alpha_t = 1 - labsh_t \quad (20)$$

We report annual contributions in percentage points (pp) by scaling log changes by 100:

$$Capital\ deepening\ contribution_t = 100 \times \bar{\alpha}_t \Delta \ln k_t^w \quad (21)$$

$$Effective\ labour\ per\ worker\ contribution_t = 100 \times (1 - \bar{\alpha}_t) \Delta \ln (hc_t \cdot avh_t) \quad (22)$$

$$TFP(residual)_t = 100 \times [\Delta \ln y_t^w - \bar{\alpha}_t \Delta \ln k_t^w - (1 - \bar{\alpha}_t) \Delta \ln (hc_t \cdot avh_t)] \quad (23)$$

By construction, the TFP term is a residual capturing technological progress, efficiency improvements, changes in allocative efficiency, variation in factor utilisation not captured by hours worked, and measurement error. It should therefore be interpreted with caution but remains informative about the forces driving output per worker beyond measured inputs.

Data

We use PWT as it provides internally consistent annual measures of output, capital, labour, and human capital for China over the period 1952 to 2023. Output is measured as real GDP at constant national prices (rgdpna),

and physical capital is measured as the capital stock at constant national prices (rnna). National-price series are used to ensure consistency in within-country growth accounting.

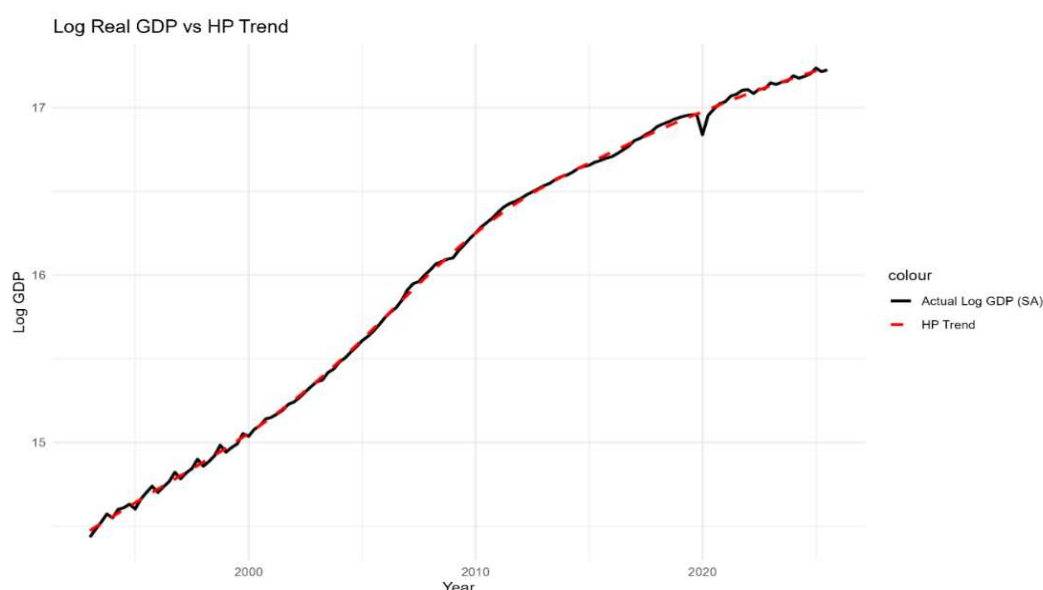
Labour input is measured as employment (emp). Growth accounting is conducted in per-worker terms, using output per worker ($\frac{Y_t}{emp_t}$) and capital per worker ($\frac{K_t}{emp_t}$). Labour quality is captured through effective labour per worker, defined as the product of the human capital index (hc) and average annual hours worked per worker (avh). This formulation incorporates both skill accumulation and changes in the intensive margin of labour supply without double-counting employment.

Labour's income share is taken from the PWT variable (labsh) and is used to infer the capital share in production. Because PWT does not provide a separate income share for human capital, human capital is treated as labour-augmenting, consistent with standard growth accounting practice. PWT is well suited to this analysis as it has a capital stock series, eliminating the need for a Perpetual Inventory Method, and expresses all variables in consistent prices and units over a long historical period.

Empirical Results

Figure 1 shows a structural slowdown in China's GDP. Figure 1 displays the HP filter applied to China's real quarterly GDP series to filter out its long-term trend level of GDP (red line). For the full composition, including the short-term business cycle (cyclical) component, see Annex 2.

Figure 1: Decomposition of China's real GDP using the HP Filter, 1995Q1 to 2025Q3.

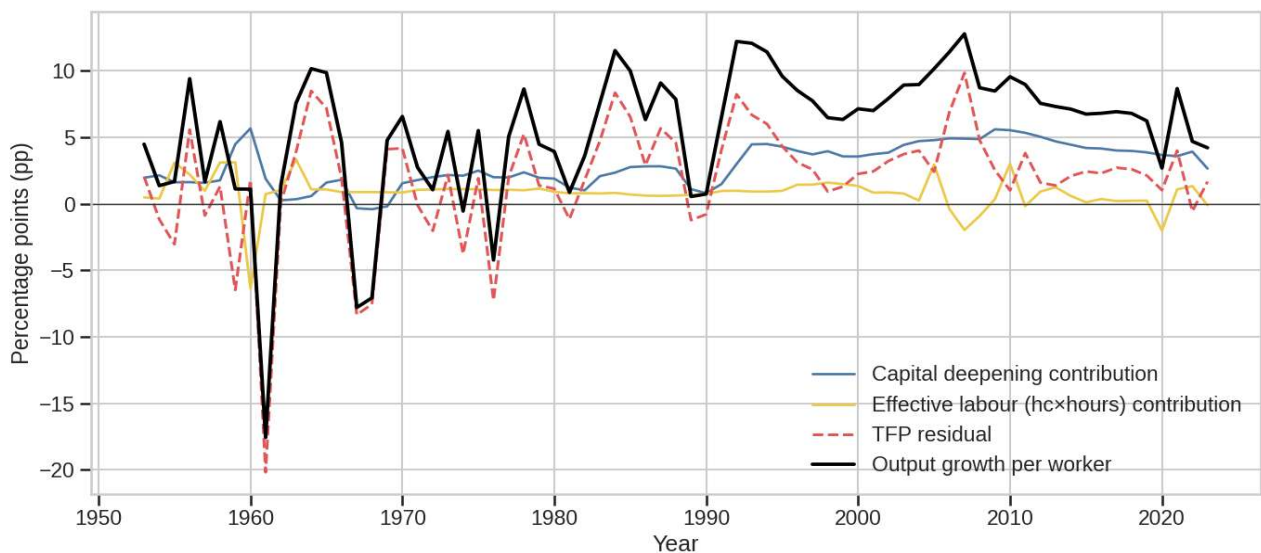


The HP filter trend line shows a continued growth in China's real GDP from 1995Q1 to 2025Q3. However, the rate of growth in the trend line has slowed since the late 2000s. Within Figure 1, the HP filter trend displays an increasing growth rate in China's real GDP, as the slope becomes progressively steeper, with the growth rate peaking in 2006. From 2007 onwards, the growth rate can be seen to slow, as the trend slope continues to flatten consistently up to 2025 Q3. The annualised trend growth rate fell from 14.4% in 2006 to 4.4% in 2024 (see Annex 1). The persistent reduction in the estimated trend growth is consistent with a sustained deceleration in underlying output, but by construction the HP/Hamilton filters do not identify causal sources; we therefore interpret this as a persistent deceleration rather than as definitive structural attribution. Findings from the Hamilton filter support a slowdown, but post-2020, the HP filter gives lower trend growth (5.0%), whilst the Hamilton Filter is more optimistic (7.5%) (see Annex 4). It is worth noting that, there have been international debates over the reliability of China's GDP data and so, this analysis may underestimate the true extent of China's current slowdown (Wu & Li, 2022).

Growth drivers

Figure 2 presents a growth-accounting decomposition of China's output growth per worker over 1952 to 2023. It shows the contributions of capital deepening (blue), effective labour (human capital*hours) per worker (yellow), and the TFP residual (red), alongside total output growth per worker (black line). Output growth per worker is highly volatile in early decades, with year-to-year fluctuations often mirrored in the TFP residual, while capital deepening provides a steadier positive contribution. Consistent with the macroeconomic context highlighted in Figure 1, output growth per worker shows a downward shift from the mid-2000s onwards. The sharp contraction between 1959-61 represents the Great Chinese Famine (Smil, 1999:1621).

Figure 2: Sources of China's economic growth per worker, 1952 to 2023



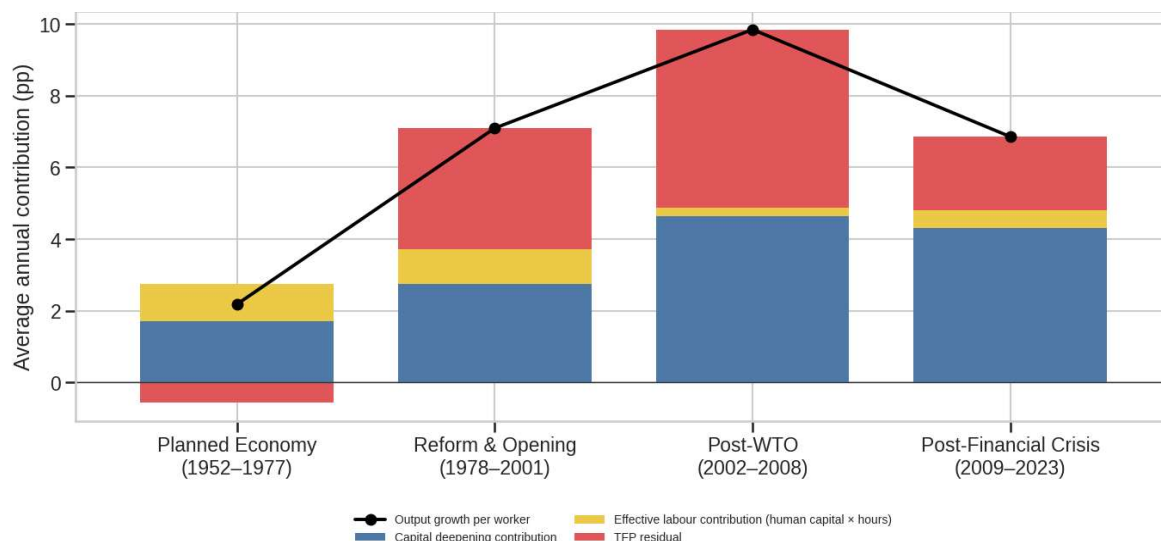
Furthermore, Figure 3 below summarises China's average annual output growth per worker across four historical eras (see Annex 4). Over the planned economy period (1952-1977), China recorded the lowest average growth in output per worker (2.18 pp). Growth in this era was driven primarily by factor accumulation, with capital deepening contributing 1.70 pp and effective labour contributing 1.05 pp, while the TFP residual was negative (-0.57 pp). The negative productivity residual is consistent with the view that planned economies often face weak incentives and resource misallocation, limiting efficiency gains even when inputs rise (Bajona, 2009:505).

As China transitioned towards market-oriented reforms during the reform and opening period (1978-2001), average output growth per worker increased sharply to 7.09 pp. This acceleration was driven by a substantial improvement in measured productivity, with the TFP residual contributing 3.38 pp, reflecting China's aim for efficiency and growth as a socialist market economy (Ray, 2002:3835). Contribution from capital deepening strengthened (2.75 pp) and a still-positive effective labour contribution (0.96 pp).

The period post China joining the World Trade Organisation (WTO) in 2001 represents China's peak growth period, with output growth per worker reaching its peak at 9.85 pp, as China's entry into the WTO fuelled an export-led boom (Zhao, 2023:235). TFP remained the largest contributor, with contributions increasing to 4.98 pp. While mechanisms such as competition and knowledge diffusion are plausible reasons, our aggregate accounting cannot apportion the residual across these channels; we therefore treat them as hypotheses consistent with the era. Capital contributions also further strengthened to 4.64 pp, as a greater reliance on capital accumulation occurred, causing it to become another important driver. Simultaneously, effective labour contributions became comparatively small (0.22 pp), reflecting an ageing workforce and demographic shifts (Liu & Hu, 2013:71).

Following the global financial crisis, average output growth per worker slowed to 6.85 pp in 2009-2023. The decomposition suggests this slowdown coincided with weaker productivity contributions, as TFP fell to 2.05 pp, while capital deepening remained large (4.31 pp) and effective labour stayed modest (0.49 pp). Overall, the era averages reinforce the shift away from labour-driven growth and towards a pattern where sustained per-worker growth increasingly depends on productivity performance and the efficiency of capital accumulation.

Figure 3: Average annual GDP growth by component and historical era, pp – per worker



Overall, the per-worker growth accounting results support a catch-up narrative in which China’s high growth prior to the global financial crisis reflected a combination of strong capital deepening and sizeable productivity gains, consistent with reforms and structural change (Lui, 2023). In our decomposition, output growth per worker peaks in the post-WTO era (2002-2008) at 9.85 pp, driven by capital deepening and a large TFP residual. Before slowing in 2009-2023 to 6.85 pp, as the TFP contribution falls despite still-large capital deepening, signalling reduced productivity and minimal labour contributions (Lui, 2015).

These empirical findings are consistent with the Solow framework. In the Solow model, economies that begin with a low capital-labour ratio can grow rapidly through capital deepening, but diminishing returns imply that, as capital per worker rises, sustaining high growth increasingly requires productivity (TFP) growth. Our decomposition is consistent with this mechanism, as output growth per worker is highest in the post-WTO era (2002-2008), when both capital deepening and the TFP residual make large contributions (4.64 pp and 4.98 pp), while the post-crisis era (2009-2023) shows slower growth alongside a notably weaker TFP contribution, even though capital deepening remains substantial. This pattern suggests that the slowdown is less about an abrupt collapse in factor accumulation but more about a shift toward the Solow “mature-growth” constraint where productivity becomes the binding margin, consistent with “distance-to-frontier” perspectives emphasising a transition from investment- and adoption-led growth toward innovation-led growth as economies develop.

However, the results do not imply that China has already reached an advanced-economy steady state. One simple benchmark is that China’s GDP per capita (PPP) is 27,105 (2024) versus 60,620 for the UK (2024) (World Bank, 2024b), indicating a large remaining income gap. The middle-income-trap literature notes that slowdowns often occur when countries approach approximately 25-30% of the global technology frontier, which is broadly where China is argued to sit in relative terms (Imam, 2005). In other words, China may be closer than before, but still, some distance from a high-income steady state. Quantifying “distance to steady state” would require additional modelling of savings, depreciation, population growth and trend productivity (or a structured cross-country frontier comparison), which is beyond the scope of this report.

External evidence suggests two main drivers of China's weaker TFP performance: increasing reliance on frontier innovation as China nears the technological frontier, and growing diffusion and reallocation frictions reflected in persistent productivity gaps across firms and regions. Although our decomposition cannot isolate these channels, this interpretation aligns with the World Bank (2019) and Brandt et al. (2020).

Policy Recommendations

Following theoretical and empirical discussions, we recommend that China adopts the following two policies:

1) Increase labour participation

This report recommends continuing the gradual increase in China's statutory retirement age, complemented by improved healthcare provision, to raise effective labour participation, given low effective labour contributions. A central factor behind China's low effective labour contributions is rapid population ageing. China's working-age population share declined from its peak of 74.5% in 2010 to 68.1% in 2022, while the old-age dependency ratio rose sharply over the same period (AMRO, 2024:8). Projections also suggest that the share of individuals aged over 60 will decline to approximately 40% by 2050, placing sustained downward pressure on labour supply and participation (Cao, 2020:3). These demographic trends reflect empirical results.

In response, China's statutory retirement-age reform represents a targeted and economically coherent intervention. China has recently adopted a decision to gradually raise statutory retirement ages over a 15-year period starting 1 January 2025, increasing the retirement age for men from 60 to 63, and for white-collar women from 55 to 58 and blue-collar from 50 to 55 (National People's Congress of the PRC, 2024; Xinhua, 2025). This phased approach aligns labour-market institutions with demographic realities, while limiting short-term adjustment costs. Simulation evidence indicates that delayed retirement can significantly offset demographic headwinds. Under delayed-retirement scenarios, effective labour input in 2050 is projected to be around 3% higher than in 2010, despite a large decline in the working-age population, largely due to increased hours worked (Cao, 2020:15). Complementary macroeconomic estimates suggest that raising the retirement age could temporarily increase annual GDP growth by up to 0.66 pp in the initial years of implementation, partially offsetting ageing-related growth losses (AMRO, 2024:22).

Retirement-age reform also operates through the human-capital channel emphasised in the augmented Solow framework. In this framework, investments in education and health raise the steady-state level of output per worker by increasing effective factor input and the economy's capacity to use technology. Educational expansion implies that future cohorts of older workers will be, on average, better educated than those retiring today. Delaying retirement, therefore, not only increases labour quantity, but also retains workers with higher levels of human capital, improving the quality of the effective labour force (Feng, 2019:33-52). However, realising these human-capital gains depends on older workers being sufficiently healthy to remain economically active. Evidence for China shows a strong relationship between health status and labour supply among older people, indicating that improved access to healthcare can help extend working lives (Giles et al., 2011). This interaction strengthens the case for retirement-age reform to address both quantity and quality dimensions.

Given the scope of this report, the policy discussion focuses on retirement-age reform complemented by improved healthcare. Other measures discussed in the literature, such as raising female labour-force participation, expanding access to affordable childcare and promoting flexible working arrangements, could further support labour supply and act as complements to retirement-age reform. A comprehensive assessment of these additional channels would enhance the policy framework but lies beyond the scope of this analysis.

2) Raising TFP through technological progress

Empirical results also indicated the need for improved technological progress. As TFP is measured as a residual, it reflects not only technological progress and within-firm efficiency improvements, but also reallocation effects, measurement error and any misspecification of the assumed production function. This reinforces the need for policies that target both frontier innovation and diffusion/reallocation, rather than treating TFP as a single causal mechanism. We therefore recommend that China adopts a combined strategy to raise TFP, these are: (i) sustaining frontier innovation by strengthening R&D investment in key innovation areas and accelerating economy-wide diffusion of existing technologies by raising absorptive capacity and (ii) improving conditions for technology spillovers and resource reallocation.

China's productivity challenge is increasingly uneven across sectors. On one hand, China is close to the global technological frontier in selected strategic industries. The World Bank (2019:22) frames China's transition as moving closer to the global technology frontier and emphasises that sustaining growth increasingly requires both diffusion of advanced technologies and "fostering discovery". In this context, the state should continue to selectively prioritise frontier innovation areas with large potential economy-wide spillovers, aligned with the objective of developing "new quality productive forces" and building a modernised industrial system. In practice, these priorities reflect those highlighted in the 15th Five-Year Plan Recommendations briefings, including strategic emerging clusters such as new energy, new materials, aerospace and the low-altitude economy, and "future industries" such as quantum technology, biomanufacturing, hydrogen energy and fusion energy, brain-computer interfaces, embodied intelligence and 6G (Xinhua, 2025).

The OECD similarly highlights intensifying strategic competition and the increasing importance of innovation policy in emerging technologies (OECD, 2023), while sector-specific evidence points to China's strong position in frontier-linked industries, such as electric vehicles (Wingender et al., 2024). The IEA (2025) reports that China produces over three-quarters of batteries sold globally. On the other hand, aggregate TFP growth has slowed, reflecting persistent productivity gaps across firms, regions and industries. The World Bank identifies two mechanisms for raising aggregate TFP: raising productive efficiency within firms and reallocating resources between firms through entry/exit and movement of resources (Brandt et al., 2020:8). This divergence suggests that future TFP growth will rely not only on frontier innovation, but increasingly on effective diffusion and adoption of existing technologies across the wider economy.

A core mechanism for strengthening TFP is increased investment in R&D, which raises productivity by expanding firms' innovative capacity and shifting the technological frontier. At the firm level, R&D facilitates the development of new products, processes and production techniques, enabling firms to generate more output from given inputs of capital and labour. At the aggregate level, these innovations translate into higher TFP through improved productive efficiency and empirical evidence supports this mechanism in the Chinese context. Using data on large and medium-sized industrial enterprises, Zhou and Xia (2010) find that average TFP growth since 2000 has been positive and mainly driven by technical progress, with R&D investment as the key driver.

However, R&D investment is most effective when complemented with mechanisms that facilitate the diffusion of new technologies. Technological spillovers, particularly through Foreign Direct Investment (FDI), play a central role in allowing innovations generated by frontier firms to raise productivity elsewhere. Foreign firms often introduce advanced technologies and managerial practices that can spill over to domestic firms through demonstration effects, labour mobility and supplier-buyer linkages within value chains. The effectiveness of these spillovers depends critically on absorptive capacity, particularly human capital and domestic R&D intensity. Huang et al. (2019:282) show that technology spillovers have statistically significant positive impacts on China's provincial TFP only once regions exceed key thresholds in education levels and R&D intensity. This

finding aligns closely with the augmented Solow framework, in which human capital enhances the effectiveness of technology adoption rather than acting as a direct driver of growth.

The interaction between technological progress and structural reform is particularly evident in China's manufacturing sector. Han (2023:5) provides empirical evidence that technological progress significantly raises manufacturing TFP, with this effect amplified when accompanied by structural reforms that improve marketisation, competition and innovation environment. This interaction illustrates that innovation-led productivity growth is most effective when supported by institutions that facilitate efficient resource allocation and technology diffusion.

Taken together, these findings imply that raising aggregate TFP requires both prioritising innovation where China is near the frontier and maximising spillover gains that diffuse across the wider economy. This is why a combined approach of higher R&D and stronger diffusion/reallocation directly targets the two channels identified by Brandt et al. (2020:8) to raise aggregate TFP, within-firm efficiency improvements through innovation/adoption and economy-wide reallocation via entry/exit. Frontier-focused R&D expands the pool of new technologies, while diffusion and absorptive-capacity measures determine whether non-frontier firms can adopt them. In parallel, reallocation mechanisms ensure that capital and labour move toward firms and sectors best able to use these technologies, allowing gains to appear in aggregate TFP.

It is worth noting that, this policy recommendation does have some limitations. First, because TFP is a residual, it bundles multiple influences (including reallocation and measurement error) and so, the decomposition cannot disentangle the precise contributions of innovation, diffusion and reallocation. Second, much of the supporting evidence is based on firm- or regional-level studies, meaning the size and speed of economy-wide spillovers may differ once general equilibrium effects and implementation constraints are considered. Third, spillover effects are conditional, as diffusion policies are less effective where absorptive capacity is low (Huang et al., 2019). Finally, while our recommendation targets both within-firm efficiency and between-firm reallocation, we do not model the broader complementary reforms that may be needed for diffusion and reallocation to operate effectively alongside higher R&D (Brandt et al., 2020).

Conclusion

In conclusion, this report examines the structural drivers behind China's long-run growth slowdown, using the augmented Solow framework and empirical evidence from trend and growth accounting decompositions. The trend-decomposition indicates a persistent deceleration in China's underlying GDP growth since the late 2000s, consistent with a structural slowdown. Growth accounting results support this, as despite capital deepening remaining robust, the contribution of TFP have weakened compared with earlier reform and post WTO periods. Effective labour input has also played only a modest role as demographic pressures have intensified. These findings reflect China's transition toward a stage of development in which diminishing returns to capital constrain the effectiveness of investment-led growth. Although China remains below the income levels of advanced economies, its narrowing distance to the global technological frontier reduces the scope for rapid growth through imitation and factor accumulation alone. Sustaining growth therefore depends increasingly on productivity improvement, through frontier innovation, technology diffusion and greater allocative efficiency. This structural transition therefore motivates the report's two policy recommendations. First, gradual retirement age reform, supported by improved healthcare provision, to counteract demographic headwinds, by increasing effective labour supply and retaining human capital among older cohorts. Secondly, strengthening TFP growth through a combined innovation and diffusion strategy that expands the technological frontier, while enabling adoption across firms and regions. Enhancing R&D capacity, absorptive capability and the reallocation mechanisms is therefore central to China's future growth potential.

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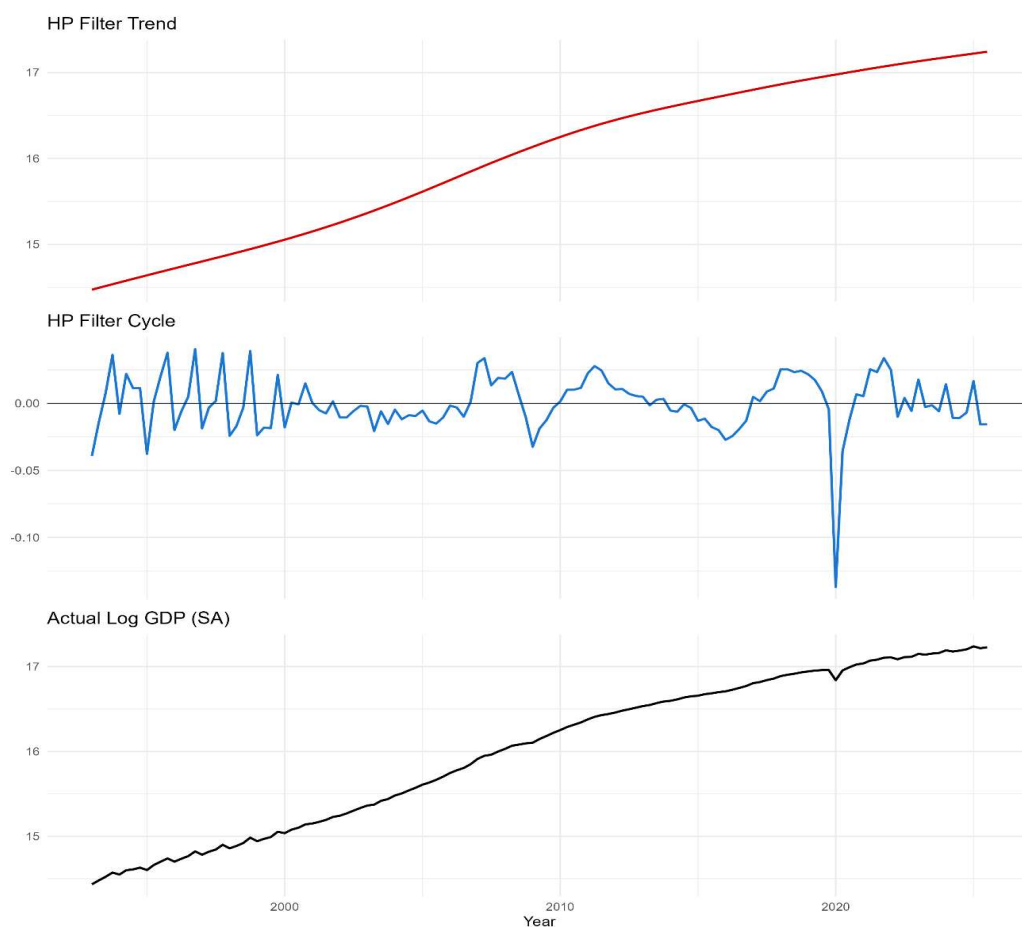
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Annex

Annex 1: Components and corresponding PWT variable(s)

Component	PWT Variable	Variable name
Y	rgdpna	Output-side real GDP at chained PPPs (in millions, 2021US\$)
K	rnna	Capital stock at constant 2021 national prices (in millions, 2021US\$)
Leff	emp*hc*avh	
H	hc	Human capital index, based on years of schooling and returns to education
L	emp*avh	Number of persons engaged (in millions) * Average annual hours worked by persons engaged

Annex 2: Decomposition of China's real GDP using the HP Filter, 1995Q1 to 2025Q3.

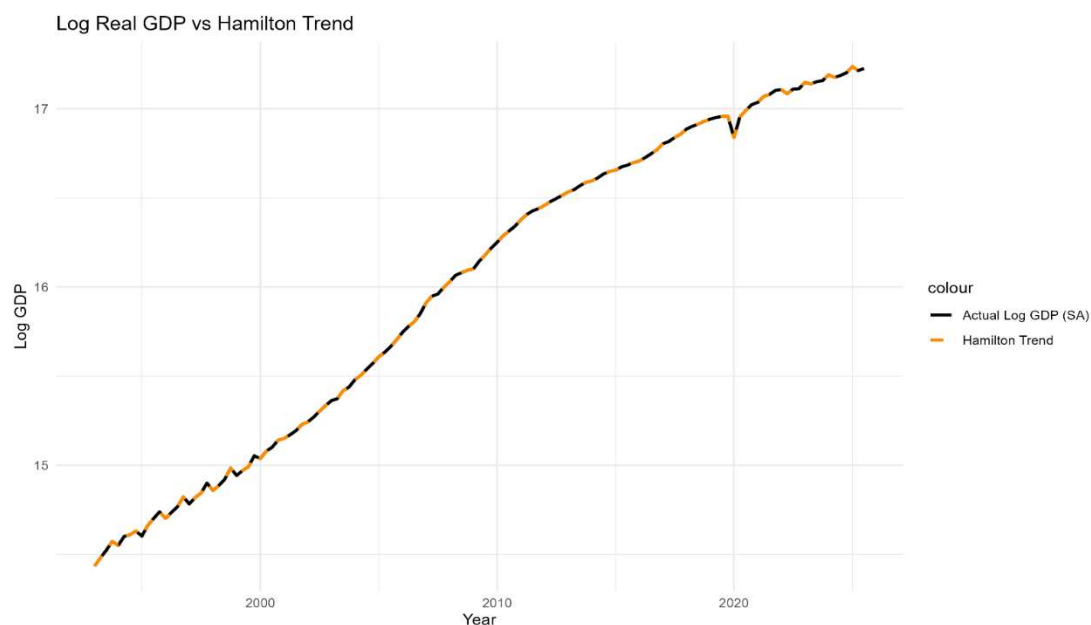


* Red=trend component; Blue=cyclical component, Black= GDP.

Annex 3: Annualised yearly HP filter trend growth

Period Years	Annualised Growth (%)
1996	9.2
1997	9.0
1998	9.0
1999	9.2
2000	9.8
2001	10.6
2002	11.5
2003	12.5
2004	13.5
2005	14.2
2006	14.4
2007	14.1
2008	13.3
2009	12.4
2010	11.4
2011	10.1
2012	8.8
2013	7.7
2014	7.1
2015	6.8
2016	6.7
2017	6.6
2018	6.2
2019	5.9
2020	5.6
2021	5.4
2022	5.0
2023	4.6
2024	4.4

Annex 4: Decomposition of China's real GDP using the Hamilton Filter, 1995Q1 to 2025Q3.



The Hamilton trend closely tracks the actual data because it defines the trend as a forecast based on 8-quarter lags rather than a smoothing exercise. For example, during the 2020 COVID-19 shock in China, this allowed the filter to adapt quickly to the structural change, treating the sudden contraction as a shift in the level of the series rather than a temporary deviation from a rigid, pre-existing path, like in the HP-filter.

Annex 5: Periodic Decomposition of Underlying GDP Growth (Hamilton Regression Approach)

Period	Trend Growth
1995-1999	9.4
2000-2004	11.3
2005-2009	13.0
2010-2014	8.3
2015-2019	6.2
2020-2024	7.5

Annex 6: Average annual output growth per worker by component and era (pp), China, 1952-2023

Era	Output growth per worker (pp)	Capital deepening contribution (pp)	Effective labour contribution (hc×hours) (pp)	TFP residual (pp)
Planned Economy (1952–1977)	2.18	1.70	1.05	-0.57
Reform & Opening (1978–2001)	7.09	2.75	0.96	3.38
Post-WTO (2002–2008)	9.85	4.64	0.22	4.98
Post-Financial Crisis (2009–2023)	6.85	4.31	0.49	2.05

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