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The Sustainability of China's Economic Growth in an Era of Global Turbulence

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Abstract

This article analyses the sustainability of China's economic growth in light of global challenges, focusing on macroeconomic changes in recent decades and their impact on the country's economy. The study covers the period 1962–2022 and uses data from various sources, including the World Bank, International Monetary Fund, Organisation for Economic Cooperation and Development, and national statistical data from the People's Republic of China. Correlation analysis methods are used to assess the impact of socio-economic indicators on economic growth, revealing significant correlations between gross domestic product and various indicators such as external debt, urbanisation, technological development, and the standard of living. The main conclusion of the analysis is that economic diversification and investment in high-tech industries are crucial for maintaining sustainable growth in China. The findings indicate the need for future research assessing the potential for reducing the environmental impact of industrialisation and improving social policies in a changing global economy.

Keywords: economic growth, macroeconomic changes, global challenges, turbulence, sustainability, correlation analysis, industrialisation, diversification, high-tech industries

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Устойчивость Экономического Роста Китая в Эпоху Глобальной Турбулентности

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Аннотация

Настоящая статья анализирует устойчивость экономического роста Китая в контексте глобальных вызовов, акцентируя внимание на макроэкономических изменениях последних десятилетий и их воздействии на экономику страны. Исследование охватывает период с 1962 по 2022 год. В статье анализируются данные Всемирного банка, МВФ, ОЭСР, а также национальных статистических данных КНР. Применены методы корреляционного анализа для оценки влияния социально-экономических показателей на экономический рост. Выявлены значимые корреляции между ВВП и такими показателями, как объем внешнего долга, уровень урбанизации, технологическое развитие и уровень жизни населения, а также с показателями внешней торговли и инвестиций. Подтверждено, что диверсификация экономики и инвестиции в высокотехнологичные отрасли имеют ключевое значение для поддержания устойчивого экономического роста. В заключении исследования подчеркивается необходимость дальнейших исследований для оценки потенциала снижения экологического воздействия индустриализации и улучшение социальной политики в условиях меняющейся глобальной экономической среды.

Ключевые слова: экономический рост, макроэкономические изменения, глобальные вызовы, турбулентность, устойчивость, корреляционный анализ, индустриализация, диверсификация, высокотехнологичные отрасли

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1. Introduction

This study of economic growth and development aims to analyse the stability and sustainability of a country's economic system. This involves examining the quantitative changes in an economy, such as an increase in the production and consumption of goods and services, which are measured by gross domestic product (GDP). Economic growth is based on the dynamics of GDP, as described by Chow and Li (2002) and Jones and Hameiri (2022). In the past half-century, China has shown exceptional economic growth, becoming the world's largest economy in terms of GDP at purchasing power parity (PPP), with more than 33 trillion USD in 2023. Such growth was stimulated by government investments in industry, accounting for about 40% of the country's GDP between 2000 and 2010. This was supported by active export activities and the strategic development of high-tech industries and infrastructure. However, since the 2010s, the global economy has faced new challenges, including financial crises, political upheavals, and pandemics. These have led to questions about the sustainability of China's economic growth (Carmody, Zajontz, and Reboledo, 2022; Repnikova, 2022).

The relevance of this research stems from the rapidly changing economic, social, and technological landscape of the global economy, particularly in light of technological advancements and geopolitical uncertainty. The onset of a period of global turbulence has necessitated adjustments to economic policies and strategies for many countries, including China, which is actively involved in international affairs and is a key player in global affairs. Despite China's significant influence, achieving sustainable economic growth in the country would require reviewing existing economic models and accounting for the trends towards a multipolar world order.

The purpose of this paper is to analyse the sustainability of China's economic growth, considering economic and political challenges, as well as macroeconomic factors modulating these challenges. We aim to understand the impact of global economic turbulence on the Chinese economy, and to identify the main factors that influence China's growth. Our study focuses on the Chinese economic system, including its various components, such as industrial production, agriculture, services, foreign trade, domestic consumption, investment, and public administration. We examine the factors and conditions that contribute to the sustainability of China's economic development.

2. Materials and Methods

2.1. Historical background

Since the establishment of the People's Republic of China in 1949, the country has been moving towards the implementation of socialist principles. This has led to intense socio-economic experimentation and significant fluctuations in its development, with periods of prosperity followed by a decline. During the "Great Leap Forward" period, China set ambitious goals to become a leading economy in a short period of time, but an ill-conceived policy led to an economic crisis. Similarly, the "Great Proletarian Cultural Revolution" caused dysfunction in the party-state apparatus, as described by Tanner (1999) and Heilmann (2008).

The deep economic crisis after the "Cultural Revolution" forced the Chinese government to search for ways to restore economic stability. Consequently, the government implemented effective measures to revive the country's economy. In 1979, a comprehensive economic reform plan was developed with the aim of achieving three main objectives: modernising and accelerating economic growth, expanding international relations, and maintaining political stability. Priority was given to accelerating economic development, focusing on expanding production capacity, strengthening national strength, and improving the living standards of citizens (Wu, 2005; Young, 1995).

The influential British historian Arnold Toynbee expressed the opinion that China could offer the world a "gift" that combined Western dynamism and traditional Chinese stability (Toynbee, 1934). These words proved to be prescient, particularly after Deng Xiaoping, the architect of modern China's economic reforms, formulated the phrase, "It doesn't matter what color a cat is, as long as it catches

mice” (Blue, 2000). Regarding Deng’s economic policies, it is clear that his desire for a practical and effective approach to economic management led China to succeed in the international arena. This allowed the country to become a leading global producer and exporter (Shirk, 1994).

According to Marxist-Leninist theory, there is a close relationship between the economic base and superstructure, such that changes in the former inevitably lead to alterations in the latter. In this regard, China has developed a unique economic system that has been recognised internationally as “reformed socialism” and domestically as a “middle way”. This system integrates certain aspects of capitalist and socialist systems to overcome stagnation and stimulate economic growth (Zweig, 2002; Roland, 2000). During the modernisation process, emphasis has been placed on accelerating economic development while assessing whether activities are in line with socialist ideals based on three key criteria: their ability to promote the development of productive forces, increase national strength, and improve the standard of living for the population (Naughton, 2007; Wu, 2005).

China’s reform programme was founded on three core principles: attracting investment, promoting exports, and utilising low-cost labour. Other aspects of the reform efforts included large-scale imports of technology, significant investments in the economy, active government involvement in economic activities, the establishment of special economic zones, and the preservation of a single-party system, which contributed to stability within the country (Ding and Tay, 2016).

The slowdown in China’s economic growth may be attributed to the transition from a deficit-focused economy to one with excess production. The country has shifted away from the strategy of extensive and extensive production towards a new model focused on the quality and efficiency of economic development. This transition is accompanied by large-scale economic reform efforts aimed at reducing reliance on exports and investments. Under the “quality” growth model, the primary indicator is not simply an increase in GDP but rather the level of employment among the population (Tian, 2019; Doshi, 2021).

China’s current economic transition is a structural transformation, with an industrial-oriented model giving way to a consumer-oriented model based on the growth of the service sector. In this context, a slowdown in GDP growth is not only unavoidable but also beneficial, as it represents a transition to more sustainable and balanced forms of economic growth (Balogh, 2017; Xiao et al., 2022). Table 1 presents a systematic overview of the key historical and economic events that have shaped China’s strategic trajectory.

Table 1. Key historical or economic milestones

| Year | Event | Economic Policy | Impact on Economy | Global Influence |
|-------|--------------------------------------------------|-------------------------|----------------------------------------------------------|----------------------------------------|
| 1949 | Establishment of the PRC | Land reform | Redistribution of land, increased agricultural output | Start of shift towards socialism |
| 1958 | Great leap forward | Collective farming | Economic downturn due to failed policies | Caused global concern regarding famine |
| 1966 | Cultural revolution | Political purge | Disruption of economy, decline in education and industry | Intensified isolation from the West |
| 1978 | Economic reforms initiated | Opening up and reform | Rapid industrial growth, improvement in living standards | Increased foreign investment and trade |
| 1990s | World Trade Organization membership preparations | Trade liberalisation | Expansion in manufacturing and exports | Strengthened global economic presence |
| 2001 | Entry into the WTO | Market opening policies | Boost in trade, access to international markets | Positioned as a major global trader |

| | | | | |
|-------|---------------------------|---------------------------|-----------------------------------------------------|------------------------------------------------|
| 2010s | Belt and Road Initiative | Infrastructure investment | Enhanced connectivity and influence in Asia, Africa | Extended China's geopolitical influence |
| 2020s | Dual circulation strategy | Focus on domestic market | Aims to reduce dependency on foreign markets | Strategic shift in response to global tensions |

2.2. Economic growth in the context of worldwide tendencies

China's economic performance stands out against the backdrop of global trends. Since the initiation of reforms in the 1970s based on the principles of market socialism, China has exhibited one of the most significant growth rates in the world. The degree of integration of the Chinese economy into international processes is unparalleled among most countries. This process was founded on a policy of openness and the attraction of foreign investment. Exports serve as the foundation for attracting the funds necessary for economic growth and modernisation, particularly in industries (Kaplan, 2021).

In 2001, China's accession to the World Trade Organization (WTO) significantly accelerated integration processes and opened access to new markets. China's share of global exports of goods increased from 1.9% in 2001 to 13.8% by 2020, consolidating its status as a major global trading power. However, researchers have noted potential challenges associated with this process, such as the volatility of the global economy under the influence of factors, including military conflicts and pandemics, which can lead to economic instability and turbulence. This turbulence can have a direct impact on China's economic growth, and to counteract these negative externalities, the Chinese government has implemented fiscal and monetary policies to compensate for potential losses. The correlation between public debt and economic cycles has been confirmed in practice (Yang et al., 2022), indicating the importance of these measures in maintaining stability and growth.

The progress of China's economic growth over the past decade is closely linked to the gradual development of the service sector. This has led to a shift towards the domestic market, stimulated by active consumer and investment demand. According to researchers, the current position of net exports of goods and services is not a significant factor in growth. Further, an analysis of China's GDP and foreign trade shows the resilience of the Chinese economy in response to fluctuations in trade volumes. It is reasonable to conclude that the export-driven development model has reached its limits. A new innovative development model will differ significantly from the approach of other industrialised countries, as it will be based on the large domestic market and internal growth factors in China. Innovation will replace export-oriented growth and capital accumulation as the primary drivers of economic growth. Current trends are aimed at promoting an intensive form of growth that will replace the extensive model. Factors such as domestic consumer demand, investment, and external exports will continue to contribute significantly to economic expansion (Potapov, 2023).

The increasing instability and turbulence within the context of global economic development and the disruption of previous trends in unipolar globalisation have led to the emergence of a new global economic order. Researchers have concluded that the focus of China's economic strategy has shifted towards domestic demand and consumption, a trend that intensified following the global economic crisis between 2007 and 2009. The key components of China's growth model include a low initial level of production, an extensive pool of labour resources in agriculture, foreign direct investment, efficient public administration, and the maintenance of control over key sectors of the economy, particularly the financial sector (Tenyakov and Amirhanova, 2023).

In response to the environmental challenges posed by rapid urbanisation and industrialisation in China, the country has implemented a sustainable development strategy. This strategy has made technological innovation an essential tool for achieving economic growth. Investments in science and technology by the government have led to the development of new technologies, including those that support sustainable development. The current socio-economic development in China is linked to the goal of

maintaining sustainability. Recent studies (Rudskaia et al., 2021; Cao et al., 2014; Qiu et al., 2020) have shown that innovative approaches to technology and sustainable development contribute to economic growth and help address the environmental challenges associated with rapid urbanisation and industrialisation.

Statistical data indicate that companies investing in green technologies enjoy significant economic benefits. For example, they experience a 15% increase in profitability and a 20% improvement in sustainability. This is due to increased demand for environmentally friendly products, reduced energy consumption costs, and compliance with environmental regulations. The active development of energy projects focusing on green energy helps reduce greenhouse gas emissions and creates new jobs, stimulating economic growth. New technologies allow for optimised production processes, increasing labour productivity and contributing to the sustainable growth and competitiveness of companies. As a result, the share of renewable energy in China's energy mix has increased from 20% in 2018 to 30% by 2023. China is transitioning from a high-growth model to a high-quality one, integrating sustainable practices into its economic, social, and environmental policies. This shift is leading to a reorientation of industry towards projects of a new quality, which aim to minimise negative impacts on the environment and society. Examples of such projects include the development of digital platforms for industry and digital infrastructure (Quan, 2018; Jia and Rodionov, 2022). The transition to high-quality growth requires technological innovation, but it also raises concerns about the risks associated with digitalisation and changes in production processes (Zaytsev et al., 2021; Feofilova et al., 2024).

Economic transformations have led to structural changes aimed at boosting domestic consumption and reducing reliance on exports, particularly in the technological sector. Policies to stimulate internal demand, improve working conditions, and increase wages have contributed to a rise in consumer spending. These developments are part of a broader restructuring of China's socio-economic system, driven by a new global economic landscape and the transition towards a model of high-quality growth (Lardy, 2019; Wang et al., 2015; Dmitriev et al., 2023). The new financial strategy has resulted in the adjustment of the economic model to better meet consumer demand. This has been largely driven by the re-examination of institutional aspects of economic security and the integration of sustainable development principles into these frameworks (Breslin, 2021).

Despite a significant amount of research on historical aspects and current trends in economic growth strategies in the context of global instability and the shift towards sustainability and the implementation of new strategies, there is still a need to develop new approaches and perspectives on development. An outdated understanding of economic models often prevents us from developing mechanisms to address threats to economic growth.

This study aims to address the gaps in the analysis of the sustainability of China's economic development. Table 2 presents the key events that have shaped the modern trajectory of the Chinese economy.

Table 2. The evolution of the Chinese economy in the context of global turbulence

| Year | Key Events | Economic Reforms | Impact on World Economy | Statistical Indicators |
|------|--------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 1978 | Beginning of Deng Xiaoping's reforms | Introduction of market mechanisms, opening up for foreign investment | Integration of China into the global economy | GDP increased by 10% over the decade, GDP per capita: USD 156 |
| 2001 | Entry into the WTO | Further trade liberalisation | Strengthening of China's position in the global export market | Share of global goods exports increased from 1.9% in 2001 to 13.8% in 2020, GDP per capita: USD 1,042 |

| | | | | |
|------|----------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 2008 | Global financial crisis | Stimulation of the domestic market | Stabilisation of global economic fluctuations by China | 9% increase in domestic consumption, increase in government spending to stimulate the economy |
| 2013 | Announcement of the Belt and Road Initiative | Expansion of international economic influence | Strengthening of trade and infrastructure connections | Overseas infrastructure investments doubled, GDP per capita: USD 9,607 |
| 2020 | Start of the COVID-19 pandemic | Enhancement of high technology and healthcare support | Acceleration of global digital transformation | GDP growth slowed but remained positive (2.3%), GDP per capita: USD 10,484 |
| 2022 | Global uncertainty, increased trade tensions | Strengthening of innovative policies, support for the domestic market | Continued growth despite global challenges | GDP growth of 5%, GDP per capita: USD 12,556, increase in the share of domestic consumption in GDP structure |

2.3. Methodological underpinnings of the analysis

To examine the sustainability of China's economic development in the face of global economic uncertainty, we conducted a correlational analysis of the association between economic expansion and key macroeconomic variables. Correlational analysis allows for the evaluation of the extent to which various economic, societal, and political transformations influence China's economic expansion. The analysis utilised the following methodologies and instruments:

- Software: Google Colaboratory.
- Programming language: Python.
- Data libraries: Pandas used for data processing, NumPy for numerical operations, and Matplotlib and Seaborn for data visualisation.
- Data sources: World Bank, International Monetary Fund, and OECD. National sources were also used: Chinese government publications, transcripts of speeches, development plans, and programs.

Stages of analysis:

1. Data were collected for the period 1962–2022 by importing them from the indicated sources. Table 3 shows the collected indicators for the key groups.

Table 3. Macroeconomic indicators by groups

| Economic indicators | Social indicators | Environmental indicators | Demographic indicators | Financial indicators |
|---------------------------------------------------------------------|-----------------------------------------|-------------------------------|-------------------------|-------------------------------------|
| Gross domestic product (GDP) (current US\$) | Births attended by skilled health staff | CO2 emissions | Net migration | External debt stocks |
| GDP growth (annual %) | Contraceptive prevalence | Annual freshwater withdrawals | Population density | Net official development assistance |
| Gross national income (GNI) per capita, Atlas method (current US\$) | Fertility rate | Forest area | Population growth | Poverty headcount ratio |
| GNI per capita, PPP (current international \$) | Immunisation, measles | Surface area | Urban population growth | Income share held by lowest 20% |

| | | | | |
|-------------------------------------------------|----------------------------------------|--|--|----------------------|
| Agriculture, forestry, and fishing, value added | Life expectancy at birth | | | Personal remittances |
| Gross capital formation | Mortality rate, under 5 | | | |
| Electric power consumption | Net migration | | | |
| Energy use | Personal remittances | | | |
| Exports of goods and services | Population density | | | |
| Imports of goods and services | Population growth | | | |
| Gross national income | Poverty headcount ratio | | | |
| Foreign direct investment | Prevalence of underweight | | | |
| High-technology exports | Primary completion rate | | | |
| Industry, value added | School enrolment (primary, secondary) | | | |
| Revenue, excluding grants | Urban population growth | | | |
| Tax revenue | Terrestrial and marine protected areas | | | |
| Total debt service (% of exports) | Time required to start a business | | | |
| Gross capital formation | Statistical Capacity Score | | | |

2. Correlation analysis. The use of statistical techniques to determine the association between macroeconomic variables and economic growth is referred to as correlation analysis. Specifically, the Pearson correlation coefficient (Equation 1) was employed to assess the strength and direction of the relationship between economic expansion and key macroeconomic factors. Before calculating the correlation coefficient, the data were cleaned and processed to eliminate errors, omissions, and anomalies. This involved applying linear interpolation to fill in missing values (Equation 2). The calculations were performed using Python programming language and the Pandas library.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}, \quad (1)$$

$$y = y_1 + \frac{(x - x_1)(y_2 - y_1)}{(x_2 - x_1)}, \quad (2)$$

where r is the correlation coefficient, n is the number of observations, x и y are the variables, and x_1, x_2, y_1 and y_2 are the data points for interpolation.

3. Interpretation of the results: Evaluation of the data obtained within the context of recent (2000-2022) and past (1964-2022) economic circumstances in China.

The findings of this study are expected to assist in identifying the correlation between macroeconomic variables and China's economic expansion, as well as in determining which factors have the most significant impact.

3. Results and Discussion

3.1 Correlation of economic indicators: 1962–2022

The correlation analysis was conducted for the period 1962–2022, with an emphasis on such important economic indicators as GDP (current US\$), GDP growth (annual %), GNI per capita, Atlas method (current US\$), and gross national income (GNI) per capita (PPP) (current international \$). The correlation results are presented in Table 4.

Table 4. Correlation coefficients for individual indicators (1962–2022)

| Indicator (1962–2022) | GDP (current US\$) | GDP growth (annual %) | GNI per capita, Atlas method (current US\$) | GNI per capita, PPP (current international \$) |
|-------------------------------------------------|--------------------|-----------------------|---------------------------------------------|------------------------------------------------|
| Agriculture, forestry, and fishing, value added | -0.730 | -0.155 | -0.732 | -0.841 |
| Annual freshwater withdrawals | 0.704 | -0.215 | 0.702 | 0.768 |
| Births attended by skilled health staff | 0.645 | -0.562 | 0.644 | 0.700 |
| CO2 emissions | 0.923 | -0.461 | 0.921 | 0.951 |
| Contraceptive prevalence | -0.508 | 0.154 | -0.506 | -0.521 |
| Electric power consumption | 0.939 | -0.155 | 0.938 | 0.953 |
| Energy use | 0.919 | -0.115 | 0.918 | 0.937 |
| Exports of goods and services | 0.493 | 0.199 | 0.484 | 0.114 |
| External debt stocks | 0.991 | -0.534 | 0.990 | 0.973 |
| Fertility rate | -0.466 | -0.094 | -0.462 | -0.430 |
| Foreign direct investment | 0.870 | -0.296 | 0.861 | 0.861 |
| Forest area | 0.930 | -0.501 | 0.929 | 0.961 |
| GNI, Atlas method (current US\$) | 0.999 | -0.178 | 1.000 | 0.991 |
| GNI, PPP (current international \$) | 0.993 | -0.589 | 0.994 | 1.000 |
| Gross capital formation | 0.620 | 0.307 | 0.632 | 0.693 |
| High-technology exports | -0.416 | 0.362 | -0.426 | -0.489 |
| Immunisation, measles | 0.699 | -0.467 | 0.697 | 0.789 |
| Imports of goods and services | 0.507 | 0.215 | 0.499 | 0.158 |
| Income share held by lowest 20% | -0.099 | -0.103 | -0.094 | -0.203 |
| Industry, value added | -0.108 | 0.416 | -0.135 | -0.681 |
| Life expectancy at birth | 0.625 | 0.305 | 0.691 | 0.926 |
| Mobile cellular subscriptions | 0.985 | -0.056 | 0.985 | 0.988 |
| Mortality rate, under 5 | -0.725 | 0.146 | -0.727 | -0.907 |
| Net migration | 0.067 | -0.191 | 0.078 | 0.765 |
| Net official development assistance | -0.742 | 0.487 | -0.742 | -0.893 |
| Personal remittances | 0.919 | -0.502 | 0.921 | 0.901 |
| Population density | 0.685 | 0.207 | 0.691 | 0.922 |

| | | | | |
|---------------------------------------------------|--------|--------|--------|--------|
| Population growth | -0.578 | 0.285 | -0.654 | -0.836 |
| Poverty headcount ratio (\$2.15/day) | -0.858 | 0.422 | -0.857 | -0.902 |
| Poverty headcount ratio (national poverty line) | -0.928 | 0.578 | -0.927 | -0.940 |
| Prevalence of underweight | -0.726 | 0.345 | -0.724 | -0.814 |
| Primary completion rate | 0.654 | -0.643 | 0.651 | 0.749 |
| Revenue, excluding grants | 0.629 | -0.398 | 0.637 | 0.609 |
| School enrolment, primary (% gross) | -0.721 | 0.285 | -0.721 | -0.906 |
| School enrolment, primary and secondary (% gross) | 0.718 | -0.139 | 0.716 | 0.793 |
| School enrolment, secondary (% gross) | 0.842 | -0.283 | 0.840 | 0.898 |
| Statistical Capacity Score | 0.921 | -0.821 | 0.926 | 0.903 |
| Surface area | -0.752 | -0.059 | -0.750 | -0.689 |
| Tax revenue | -0.625 | 0.486 | -0.637 | -0.633 |
| Terrestrial and marine protected areas | -0.485 | 0.149 | -0.439 | -0.424 |
| Time required to start a business | -0.888 | 0.511 | -0.888 | -0.866 |
| Total debt service (% of exports) | -0.288 | -0.201 | -0.283 | -0.319 |
| Urban population growth | -0.378 | 0.305 | -0.393 | -0.982 |

The purpose of this analysis is to determine the strength and direction of the relationships between economic growth indicators and various socio-economic factors over the entire observation period. It is worth noting that this type of analysis corresponds to most studies that include historical indicators in the analysis without separating modern economic policy from the previous one. To identify the most significant dependencies between the indicators, a selection of links with a correlation above 0.75 or below -0.75 was carried out.

A. GDP (current US\$). The dynamics of the indicator are shown in Figure 1.

A1. High correlation (over 75%) with:

- Electric power consumption (kWh per capita) (0.938677)
- Energy use (kg of oil equivalent per capita) (0.918928)
- External debt stocks, total (DOD, current US\$) (0.991004)
- Forest area (sq. km) (0.929715)
- Mobile cellular subscriptions (per 100 people) (0.985241)
- Personal remittances, received (current US\$) (0.919482)
- Statistical Capacity Score (Overall Average) (scale 0 - 100) (0.921255)

A2. Low correlation (less than 75%) with:

- Poverty headcount ratio at \$2.15 a day (2017 PPP) (% of population) (-0.857860)
- Poverty headcount ratio at national poverty lines (% of population) (-0.927616)
- Time required to start a business (days) (-0.888415)

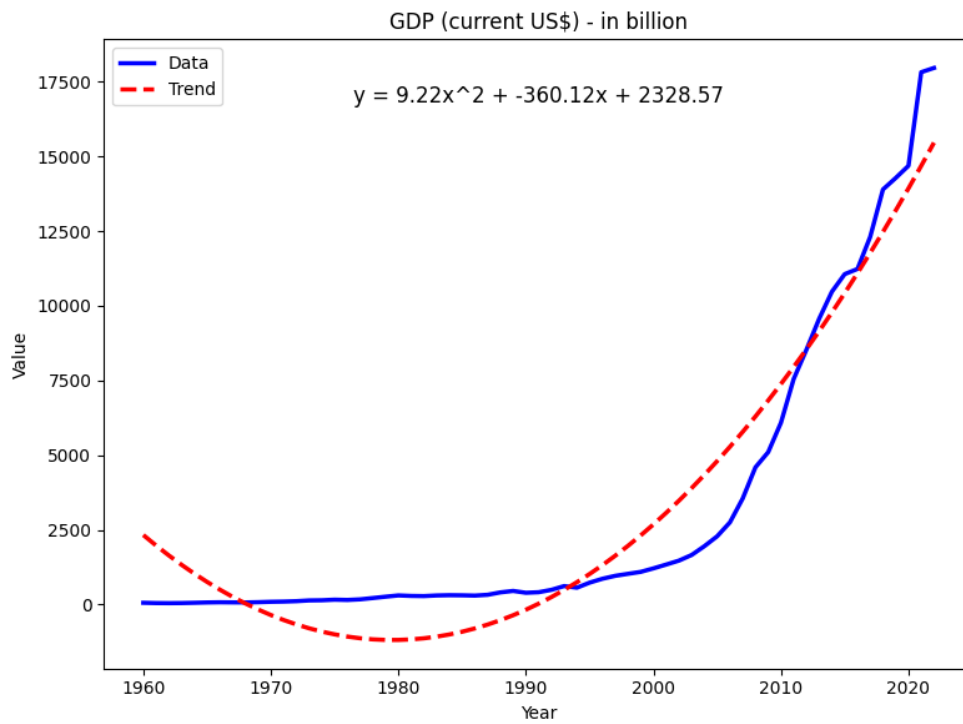


Figure 1. GDP dynamics (current US\$) and trend (polynomial)

B. GDP growth (annual %). The dynamics of the indicator are shown in Figure 2.

B1. High correlation (over 75%) with:

- Foreign direct investment, net inflows (0.870089)

B2. Low correlation (less than 75%) with:

- GNI per capita, Atlas method (current US\$) (-0.174645)
- GNI per capita, PPP (current international \$) (-0.582831)



Figure 2. GDP growth (annual %) and trend (polynomial)

3. C. GNI per capita, Atlas method (current US\$). The dynamics of the indicator are shown in Figure

C1. High correlation (over 75%) with:

- GDP (current US\$) (0.999424)
- GNI, Atlas method (current US\$) (0.999266)
- GNI, PPP (current international \$) (0.993947)
- Mobile cellular subscriptions (per 100 people) (0.985235)
- Personal remittances, received (current US\$) (0.920836)
- Population (people per sq. km of land area) (0.691338)
- Population, total (0.681870)
- Statistical Capacity Score (Overall Average) (scale 0 - 100) (0.925953)

C2. Low correlation (less than 75%) with:

- Poverty headcount ratio at \$2.15 a day (2017 PPP) (% of population) (-0.857482)
- Poverty headcount ratio at national poverty lines (% of population) (-0.927488)
- Urban population growth (annual %) (-0.982482)

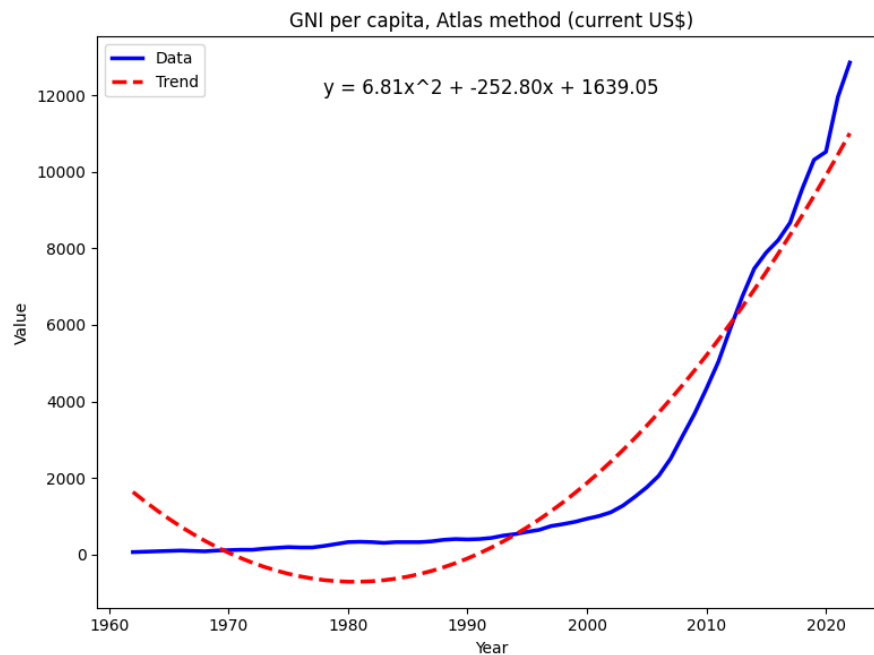


Figure 3. GNI per capita, Atlas method (current US\$), and trend (polynomial)

D. GNI per capita, PPP (current international US\$). The dynamics of the indicator are shown in Figure 4.

D1. High correlation (over 75%) with:

- GDP (current US\$) (0.992190)
- GNI, Atlas method (current US\$) (0.990669)
- GNI, PPP (current international \$) (0.999777)

- Mobile cellular subscriptions (per 100 people) (0.987961)
- Personal remittances, received (current US\$) (0.900863)
- Population density (people per sq. km of land area) (0.922084)
- Population, total (0.922016)
- Statistical Capacity Score (Overall Average) (scale 0 - 100) (0.902675)

D2. Low correlation (less than 75%) with:

- Poverty headcount ratio at \$2.15 a day (2017 PPP) (% of population) (-0.902480)
- Poverty headcount ratio at national poverty lines (% of population) (-0.940119)
- Urban population growth (annual %) (-0.982482)

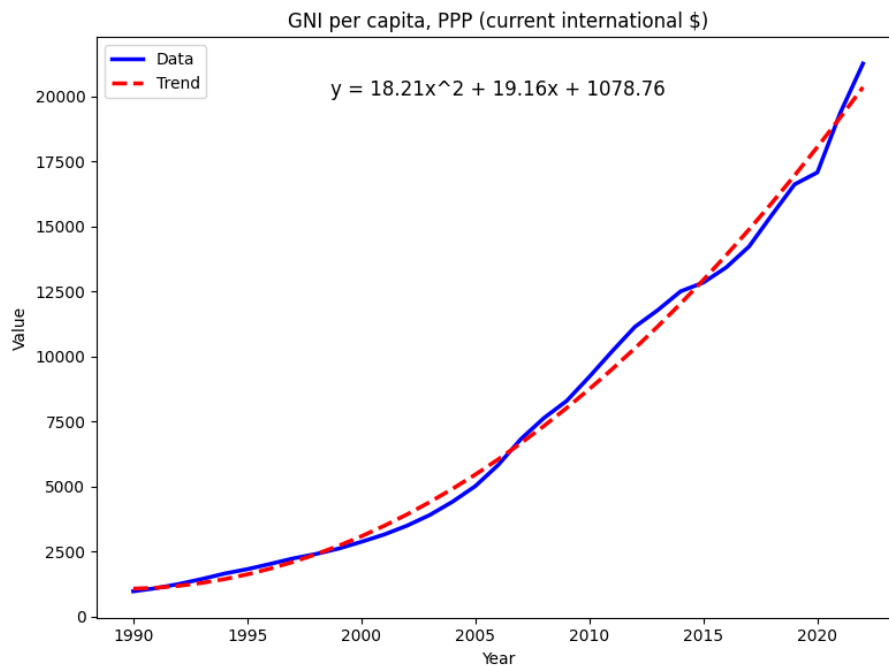


Figure 4. GNI per capita, PPP (current international US\$), and trend (polynomial)

Based on the high correlations and their interpretations, several conclusions can be drawn regarding the Chinese economy during the period 1962–2022.

1. Relationship between GDP, energy consumption, and external debt: The strong correlation between GDP and electricity consumption per capita, as well as with external debt, suggests that the energy sector and borrowing play a significant role in China's economic growth. This reflects the country's industrialisation, infrastructure development, and reliance on external financing to support its economy.

2. Importance of mobile communications and personal money transfers: The strong correlation between GDP and mobile phone subscriptions per capita, as well as personal money transfers, highlights the need for continued technological development and international financial integration for China's economic growth. This reflects a high level of digitalisation and involvement in global financial transactions. However, it also makes the country more vulnerable to threats to macroeconomic stability.

3. Strong connection between GNI and GDP: A strong relationship between GNI and GDP indicates that China's economic expansion is accompanied by rising per capita income. This suggests an increase in the prosperity and standard of living of the population.

4. Falling poverty and population growth: The low correlation between poverty and GDP indicates

that China's economic growth has been accompanied by a reduction in poverty. However, population growth has put pressure on the country's social infrastructure and resources.

5. External debt: The high correlation between external debt and GDP highlights the significant dependence of China's economy on external financing sources, emphasising the importance of effectively managing external debt and ensuring sustainable external financial flows for economic growth.

6. Technology and industry: The strong correlation between GDP and technological innovation in exports shows the success of China's technological development and the creation of a strong scientific and industrial foundation, which has contributed to export opportunities and created a competitive advantage in the global marketplace.

7. Stability and risk management: The low correlation between the labour cost index and GDP indicates potential risks in employment and instability in the labour market. This requires attention from the government to ensure the sustainability of the economy and social justice.

8. Environmental sustainability: The high correlation between forest area and GDP emphasises the importance of natural resource management and environmental protection for economic development. This also highlights the significance of environmentally sustainable practices in industry and agriculture.

9. International cooperation and investment: A significant correlation between FDI and GDP highlights the importance of international cooperation in attracting foreign investment. This can stimulate economic growth and help modernise industries.

The findings highlight the diverse aspects of China's economic growth and the need for a comprehensive approach to managing the economy. This approach should take into account various factors, such as technological innovation, social well-being, environmental protection, and international relations. It is also important to note that correlation cannot fully explain economic growth. Therefore, it is necessary to develop more complex models that take into account multiple dependencies.

3.2 Correlation of economic indicators: 2002–2022

We conducted a correlation analysis that used data from 2000 to 2022. The analysis focused on important economic indicators, such as GDP (in current US\$), GDP growth (in annual percentage), GNI per capita (Atlas method in current US\$), and GNI per capita PPP (in international \$). The results of the correlation are presented in Table 5.

Table 5. Correlation coefficients for individual indicators (2000–2022)

| Indicator (2000-2022) | GDP (current US\$) | GDP growth (annual %) | GNI per capita, Atlas method (current US\$) | GNI per capita, PPP (current international \$) |
|-------------------------------------------------|--------------------|-----------------------|---------------------------------------------|------------------------------------------------|
| Adolescent fertility rate | -0.147 | 0.260 | -0.147 | -0.128 |
| Agriculture, forestry, and fishing, value added | -0.904 | 0.504 | -0.902 | -0.922 |
| Annual freshwater withdrawals | 0.563 | -0.291 | 0.565 | 0.570 |
| Births attended by skilled health staff | 0.827 | -0.502 | 0.823 | 0.844 |
| CO2 emissions | 0.902 | -0.538 | 0.900 | 0.918 |
| Contraceptive prevalence | -0.628 | 0.200 | -0.625 | -0.671 |
| Electric power consumption | 0.914 | -0.589 | 0.914 | 0.919 |
| Energy use | 0.874 | -0.513 | 0.873 | 0.889 |
| Exports of goods and services | -0.624 | 0.820 | -0.630 | -0.567 |
| External debt stocks | 0.986 | -0.739 | 0.984 | 0.974 |

| | | | | |
|---------------------------------------------------|--------|--------|--------|--------|
| Fertility rate | -0.477 | 0.444 | -0.472 | -0.477 |
| Foreign direct investment | 0.743 | -0.325 | 0.724 | 0.747 |
| Forest area | 0.975 | -0.655 | 0.975 | 0.982 |
| Gross capital formation | 0.557 | -0.222 | 0.551 | 0.594 |
| High-technology exports | -0.416 | 0.362 | -0.426 | -0.489 |
| Immunisation, measles | 0.779 | -0.412 | 0.774 | 0.807 |
| Imports of goods and services | -0.654 | 0.803 | -0.660 | -0.608 |
| Income share held by lowest 20% | 0.818 | -0.743 | 0.828 | 0.794 |
| Industry, value added | -0.860 | 0.821 | -0.870 | -0.823 |
| Inflation, GDP deflator | -0.228 | 0.556 | -0.252 | -0.192 |
| Life expectancy at birth | 0.957 | -0.619 | 0.958 | 0.968 |
| Merchandise trade | -0.707 | 0.835 | -0.712 | -0.656 |
| Military expenditure | -0.797 | 0.388 | -0.784 | -0.817 |
| Mobile cellular subscriptions | 0.980 | -0.694 | 0.980 | 0.981 |
| Mortality rate, under 5 | -0.911 | 0.536 | -0.910 | -0.929 |
| Net migration | 0.738 | -0.562 | 0.736 | 0.735 |
| Net official development assistance | -0.864 | 0.660 | -0.863 | -0.841 |
| Personal remittances | 0.855 | -0.611 | 0.858 | 0.841 |
| Population density | 0.974 | -0.668 | 0.975 | 0.977 |
| Population growth | -0.733 | 0.458 | -0.731 | -0.769 |
| Poverty headcount ratio (\$2.15/day) | -0.914 | 0.681 | -0.915 | -0.912 |
| Poverty headcount ratio (national poverty line) | -0.928 | 0.578 | -0.927 | -0.940 |
| Prevalence of underweight | -0.827 | 0.427 | -0.827 | -0.852 |
| Primary completion rate | 0.526 | -0.643 | 0.520 | 0.511 |
| Revenue, excluding grants | 0.629 | -0.398 | 0.637 | 0.608 |
| School enrolment, primary (% gross) | -0.876 | 0.568 | -0.880 | -0.874 |
| School enrolment, primary and secondary (% gross) | 0.884 | -0.593 | 0.887 | 0.892 |
| School enrolment, secondary (% gross) | 0.832 | -0.481 | 0.829 | 0.853 |
| Statistical Capacity Score | 0.921 | -0.821 | 0.926 | 0.903 |
| Surface area | -0.630 | 0.221 | -0.630 | -0.670 |
| Tax revenue | -0.625 | 0.486 | -0.637 | -0.633 |
| Terrestrial and marine protected areas | -0.485 | 0.149 | -0.439 | -0.424 |
| Time required to start a business | -0.888 | 0.511 | -0.888 | -0.866 |
| Total debt service (% of exports) | 0.179 | -0.518 | 0.187 | 0.125 |
| Urban population growth | -0.978 | 0.714 | -0.978 | -0.984 |

The purpose of this analysis is to determine the strength and direction of the relationships between economic growth indicators and various socio-economic factors over the current observation period. This view highlights factors that are interrelated with economic growth. To identify the most significant dependencies between the indicators, a selection of links with a correlation above 0.75 or below -0.75 was carried out.

A. GDP (current US\$)

A1. High correlation (over 75%) with:

- External debt stocks (0.986)
- Mobile cellular subscriptions (0.980)
- Forest area (0.975)
- Population density (0.974)
- CO2 emissions (0.902)
- Electric power consumption (0.914)
- Life expectancy at birth (0.957)

A2. Low correlation (less than -75%) with:

- Poverty headcount ratio (national poverty line) (-0.928)
- Mortality rate, under 5 (-0.911)
- Agriculture, forestry, and fishing, value added (-0.904)
- Urban population growth (-0.978)

B. GDP growth (annual %)

B1. High correlation (over 75%) with:

- Exports of goods and services (0.820)
- Industry, value added (0.821)
- Merchandise trade (0.835)

B2. Low correlation (less than -75%) with:

- Statistical Capacity Score (-0.821)
- Electric power consumption (-0.589)

C. GNI per capita, Atlas method (current US\$).

C. High correlation (over 75%) with:

- GDP (current US\$) (0.984)

GNI, PPP (current international \$) (0.982)

Forest area (0.975)

Mobile cellular subscriptions (0.980)

C2. Low correlation (less than -75%) with:

- Poverty headcount ratio (national poverty line) (-0.927)

Urban population growth (-0.978)

D. GNI per capita, PPP (current international US\$)

D1. High correlation (over 75%) with:

- GDP (current US\$) (0.974)
- GNI, Atlas method (current US\$) (0.982)
- Population density (0.977)
- Life expectancy at birth (0.968)

D2. Low correlation (less than -75%) with:

- Poverty headcount ratio (national poverty line) (-0.940)
- Mortality rate, under 5 (-0.929)
- Urban population growth (-0.984)

These high correlations and their interpretation suggest several conclusions regarding the Chinese economy, taking into account modern development (since 2000).

1. External and internal factors stimulating the economy: The high correlation of GDP with the volume of external debts, the number of mobile subscriptions, and population density reflect China's integration into global markets and the focus of domestic development on technology and urbanisation.

2. Economic growth stimulated by trade and industry: The significant positive correlation of GDP growth with exports and industry highlights the export-oriented growth model and industrialisation as the main engines of economic expansion.

3. Socio-economic impact. Negative correlations of various economic indicators with poverty and mortality levels indicate that economic growth is associated with an improvement in living standards and health, although inequality problems continue to exist, as shown by negative correlations with urban population growth.

4. Technological and environmental considerations: The strong relationship between GDP and indicators such as CO₂ emissions and electricity consumption highlights the environmental impact of China's industrial growth. However, the correlation between mobile subscriptions and life expectancy demonstrates the positive effects of technological development and improved healthcare.

5. The need for sustainable and inclusive growth: Low correlations between GDP and poverty levels along the national poverty line, as well as high urban growth, indicate difficulties in ensuring a wide distribution of economic benefits among the population, which underlines the need for policies aimed at eliminating inequality and maintaining strategic sustainability.

6. The impact of globalisation: Globalisation plays a key role in shaping economic strategies, as indicated in the relationship between GDP and external debts and exports.

7. The importance of new technologies: The active introduction of mobile technologies and the increase in living space indicate technological progress that stimulates economic activity.

8. Problems of environmental sustainability: High levels of CO₂ emissions and energy consumption require a review in the direction of maintaining environmental sustainability.

9. Growth and inequality: Strong urbanisation and urban population growth in the context of a low correlation with an improvement in the standard of living of the population raise questions about social adaptation and the implementation of policies that promote an even distribution of economic benefits.

4. Conclusion

The study of China's economic sustainability in the context of global economic turbulence demonstrates that the country is successfully addressing the challenges of external instability through the diversification of its economy and strategic investment in high-tech sectors. Despite external pressures and

internal contradictions, China retains significant resources and potential for future growth. The correlation analyses identified several factors influencing economic stability, including the role of technology, international trade, foreign direct investment, and public policy. Key macroeconomic indicators, such as GDP, GNI per capita, and external debt, are closely linked to socio-economic factors. However, challenges remain, including managing external debts, reducing poverty, and addressing environmental issues, which require further analysis and tailored policies. To maintain sustainable economic growth, it is essential for China to continue implementing structural reforms and enhancing innovation efforts. Additionally, it is crucial to focus on the development of domestic markets and improving the living standards of the population, as these factors can serve as a foundation for long-term stability and prosperity. In light of the current global uncertainties and shifts in the international economic landscape, further research efforts should be directed towards assessing the effects of economic and political developments on China's economy, as well as identifying internal capacities for adapting to these changes.

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