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Original Paper

Study on Urban-Rural Income Inequality in China

—Based on VAR Model

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Abstract

Wealth disparity is a complex issue that has plagued the world for many years. China's economic development has achieved world-renowned results during the last 40 years. Over that time, the country has risen from extreme poverty to the world's second-largest economy. Nevertheless, the significant wealth inequality accompanying it has also caused great concern. At the start of China's reform and opening-up period, government officials tacitly approved of this uneven development and made plans to "drive the rich first to the rich later" in pursuit of economic development. Economic development aims to achieve shared prosperity, not to deprive the relatively poor of wealth. As a result, wealth disparity in China must be addressed. Based on the Kuznets hypothesis, the theory of urban-rural dual structure, and the current situation in China, this paper has evaluated the current wealth gap in China. Since 1978, Chinese households' wealth accumulation has come from the income gap. Private property was not allowed to exist during China's planned economy period (1949-1977). After the reform and opening up period (After 1978), income disparities between various industrial sectors led to an initial round of wealth accumulation for many Chinese citizens. The industrialisation process and urbanisation rate significantly impacted China's economic modernisation and growth. Therefore, this paper has analysed the effects of several factors on income disparity in China. The examined factors were; economic development, the urbanisation rate, and the industrialisation process. Based on the theoretical analysis, this paper selected time series data from 1978 to 2021, including; per capita GDP, the per capita disposable income of urban and rural residents, the urban population to total population ratio, and industry contribution to the GDP. First, an analysis of the impact of economic development on income inequality was conducted using a static model. Then, a VAR model was built through ADF and PP testing, and an impulse response and variance analysis were conducted to explain the impact of

various factors on the change rate of income inequality. The study results indicated that (1) Economic development has resulted in a significant increase in the income of urban and rural residents. However, urban residents have benefited more. Simultaneously, the income gap between urban and rural areas has grown significantly alongside economic expansion. (2) Urbanisation showed little effect on the income gap in the short term; however, it increased it in the long term. (3) Industrialisation reduced the short- and long-term income gap while increasing urbanisation.

Keywords

Urban-rural income gap, Urbanization rate, Degree of industrialization, VAR model

1. Introduction

1.1 Background of the Problem

Four decades of reform and opening-up have resulted in remarkable economic development in China, from extreme poverty to eradicating absolute poverty. Nonetheless, as a corollary, economic development has inevitably resulted in inequality. In recent years, people from all walks of life have gradually come to terms with this outcome, and some have even suggested that inequality spurs economic growth (Xie & Zhou, 2014). Since the 1990s, the gap between the rich and poor in China has been growing. According to the World Inequality Report China 2022, the average wealth of China's bottom 50%, the middle 40%, and the top 10% of citizens was US$55,270, US$280,500, and US$2,943,907, respectively. Thus, the average wealth of the top 10% of citizens was fifty times greater than that of the bottom 50%.

As depicted in Figure 1, the wealthiest 10% of Chinese citizens own nearly 70% of the country's total wealth in 2021.

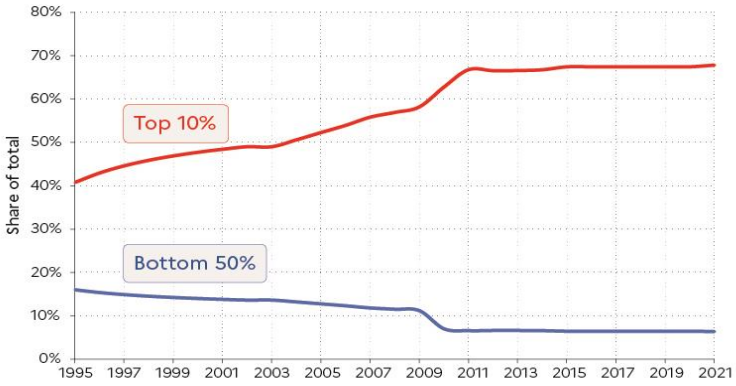

Figure 1. Top 10% vs. Bottom 50%

Source: World Inequality Report 2022

According to the relative poverty perception system, the rise in inequality in China has undermined efforts to reduce poverty (Fang & Zhang, 2021). Renowned scholar Peter Townsend defined relative

poverty as a relative deprivation-based concept. In addition, the primary connotation of relative poverty is an imbalance in income and distribution. When the income gap widens, more individuals experience deprivation and become "relatively poor." In contrast, more individuals can escape poverty when the income gap narrows. Therefore, the level of socioeconomic development is strongly related to the existence of relative poverty.

Townsend (1979) stated that poverty could be eradicated, but inequality might remain. China is currently in this situation. In China, as socialism with Chinese characteristics enters a new era, the leading social contradiction has shifted to people's growing desire for a better life versus unbalanced and inadequate development. This situation should be compared to the "contradiction between the growing material and cultural needs of the people and backward social production" in the early stages of the reform and opening-up period. The new contradiction demonstrates that China has successfully overcome absolute poverty by meeting its citizen's basic survival and living needs.

China, as the world's largest developing economy and emerging market, faces the challenge of regional poverty due to unbalanced and inadequate growth and development and cannot avoid the chronic problem of poverty among vulnerable groups due to market failures and inequality. Consequently, the issue of poverty in China is primarily the result of the overlapping resonance of insufficient growth, development imbalances, and economic inequality. This study should focus on relative poverty and wealth inequality to address China's poverty issue. Adelman and Morris argued that equitable growth depended on ensuring that as many people as possible had access to capital and educational resources. This outcome should be achieved via the redistribution of land ownership and accelerated industrialisation based on human resource-intensive technologies (Hartmann et al., 2017). In the early stages of economic development, economic growth requires the accumulation of income and capital by the wealthy. When a certain level of development has been reached, the income of the poor should be increased by increasing productive employment for low-income groups, thereby reducing income and wealth disparities. In addition, the factors affecting income quality are diverse, including; political systems and historical trajectories, factor endowments, geographical conditions, and technological change. The remainder of the paper focuses on these four aspects.

First, regarding its historical trajectory and political system, China has exhibited a high degree of income inequality, primarily due to structural forces within the country's political system (Xie & Zhou, 2014). Before the reform and opening-up period, China's economy was a closed, low-income, planned economy. At that time, productivity was low, poverty was high, and many things needed to be done to achieve prosperity. Under these conditions, China had a planned economy where the government directly allocated all resources and the public, and the state-owned economy had the sole voice (Lin, 2021). No significant private property was permitted anywhere in the country (Xie et al., 2009). All production and means of subsistence were produced collectively and distributed uniformly. Thus, the rate of inequality was low during this period. This era was known as the "mess-together" period. Even though China's planned economy achieved the desired "equity," economic growth was inadequate. The

country remained in extreme capital deficiency, and the populace was stuck in a "poverty trap." This shared national poverty contradicted the Marxist-communist ideal of shared prosperity. Individually, the demand-based distribution did not encourage workers to perform more work for additional compensation.

In the context of the collaborative economy, numerous experts have repeatedly attempted to find a way out of the vicious cycle of "unification leads to death and release leads to chaos," but without success. In 1978 Deng Xiaoping proposed "allowing some; regions, enterprises, workers, and peasants to become wealthy first". China commenced its transition from a planned to a market economy. Additionally, the method of income distribution was changed from demand-based distribution to labour-based distribution.

The change in distribution strategy significantly increased the vitality of production. Workers were able to earn more money by providing more labour. Labour-based distribution differentiated the labour that workers could provide. Mental and skilled labour, for instance, would earn a greater wage. On the other hand, physical labour and unskilled worker would be paid relatively low. As a result of the increasing disparities in labour income, Chinese citizens gradually began to accumulate wealth.

Consequently, the gap between the rich and the poor has continued to grow. As depicted in Figure 2, the income gap between the top 20% and bottom 20% of citizens in China has remained persistently large. Therefore, studying wealth inequality in China, particularly the wealth gap after the reform and opening up period, is a study of the population's income gap.

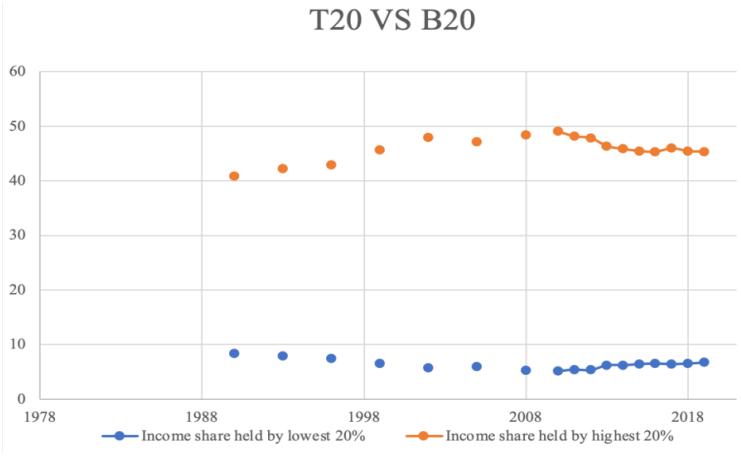

Figure 2. Income Share Held by the Lowest 20% and Highest 20% in China

Source: NBSC

China is a vast nation, but its population is very unequally distributed. It is acknowledged that China's geographical conditions and factor endowments vary considerably between its eastern and western regions. Famous geographer Hu Huanyong specifically drew a line from Heihe City, Heilongjiang Province, to Tengchong, Yunnan Province, denoting two halves of the country. Interestingly, 57% of

China's landmass is west of this line but contains only 6% of the population, while 43% of the country's landmass is east of this line and contains 94% of the population. The relevance of the labour force to economic development is self-explanatory. Significantly, China had a comparative advantage in labour-intensive industries. The unequal population distribution also reflects the disparity in factor endowments between China's geographic regions.

Furthermore, geographical differences have been reflected in trade. China's coastal regions offer convenient shipping, and low freight costs, giving access to abundant international and domestic commerce. Consequently, coastal regions have been more likely to contain industrial clusters and higher levels of economic activity. In contrast, inland regions are less accessible, and freight costs are generally higher, except for areas neighbouring the Yangtze River. Poor trade flows and small, dispersed industries have resulted from the lack of transportation in inland regions.

Consequently, the economic growth of inland regions has been less dynamic than that of coastal regions. Environmental and other factors are also a consideration. Northern and Northeast China has a temperate monsoon climate with long and cold winters. This area forms China's principal wheat and corn cultivation area. In contrast, Northwest China has a relatively dry temperate continental climate and is the country's main area for animal husbandry. Qinghai-Tibet is a unique mountainous plateau climate dominated by plateau life forms. Geographical conditions and factor endowments have caused a gradual divergence and chasm between China's urban and rural industries.

Lastly, the present study reviewed technological development. Zhang (1949) proposed that industrialisation was a process in which a sequence of essential production functions or combinations of production factors underwent continuous breakthrough changes or transformations from lower to higher levels. A nation's industrialisation is a process of technologically driven economic expansion. Therefore, China's transformation from an agricultural to an industrial nation has been a technologically driven process of economic growth. According to Huang (2006), urbanisation and industrialisation are mutually reinforcing. During the initial phases of industrialisation, it frequently drives urbanisation.

In contrast, urbanisation pushes industrialisation in the middle and late stages. Since the reform and opening up period, China's rate of industrialisation has been extraordinary. China has evolved from a predominantly agricultural nation to the most industrialised nation in the world. China's industrialisation entered the late industrialisation stage after 2011 (Huang, 2018). The graph below (see Figure 3) depicts the evolution of the composition of China's three industries contributing to its gross domestic product. China initiated rapid industrialisation after 1984. As shown in the graph, the proportion of primary industry began a process of continuous structural upgrading by decreasing. Over a decade, the share of primary industry fell from 32.8% in 1982 to 19.5% in 1994, a decline of 13.3 percentage points. The proportion of secondary industry in China's GDP has grown steadily, while the proportion of tertiary industry has grown more rapidly.

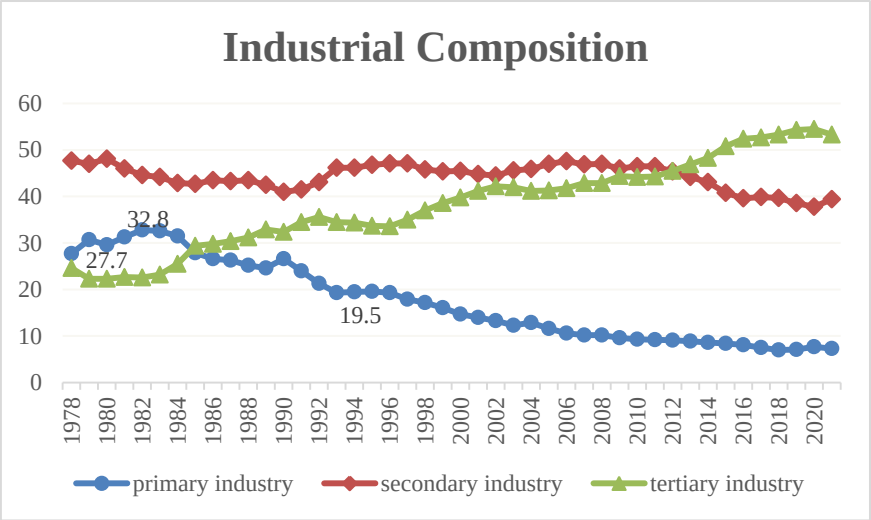

Figure 3. Industrial Composition

Source: NBSC

In China, the disparity between the rich and the poor has manifested itself in three ways. First, the income gap between urban and rural areas has widened because of urban and rural areas divergent development strategies. Additionally, industrialisation and urbanisation have increased the loss of active rural labour force. Due to the disparity between urban and rural social security systems, secondary distribution has widened the gap between urban and rural areas. Second has been the disparity in regional income distribution. Due to factors including; factor endowments, geographic location, population quality, productivity levels, and national policies and measures, the economic development of eastern, central, and western China has been highly disparate. Over recent years, the development disparities between China's north and south have become more pronounced. The third factor is the income gap between social classes. There has been a significant income gap between social classes due to; industrialisation, development, scientific and technological advancement, and unequal opportunities. The Matthew effect of "the poor getting poorer and the rich getting richer" has intensified social stratification.

1.2 Research Questions

Based on the previous analysis, this paper argued that since the reform and opening up period, the wealth gap in China had been primarily caused by the income gap. Much of the existing literature (North & Thomas, 1973; Zhang, 2016; Xie & Zhou, 2014; Sun et al., 2021) has suggested that economic growth is associated with higher income growth, thereby enhancing social welfare. Since 1980, however, China's economic growth has increased exponentially (from US$15 billion in 1978 to US$17,733 billion in 2021, as measured by the GDP in current dollars). The income gap in China has also increased from US$209 in 1978 to US$28,481 in 2021. Focusing solely on economic growth may jeopardise social welfare if the income gap grows. Therefore, identifying the causes of the disparity in China's income distribution is crucial.

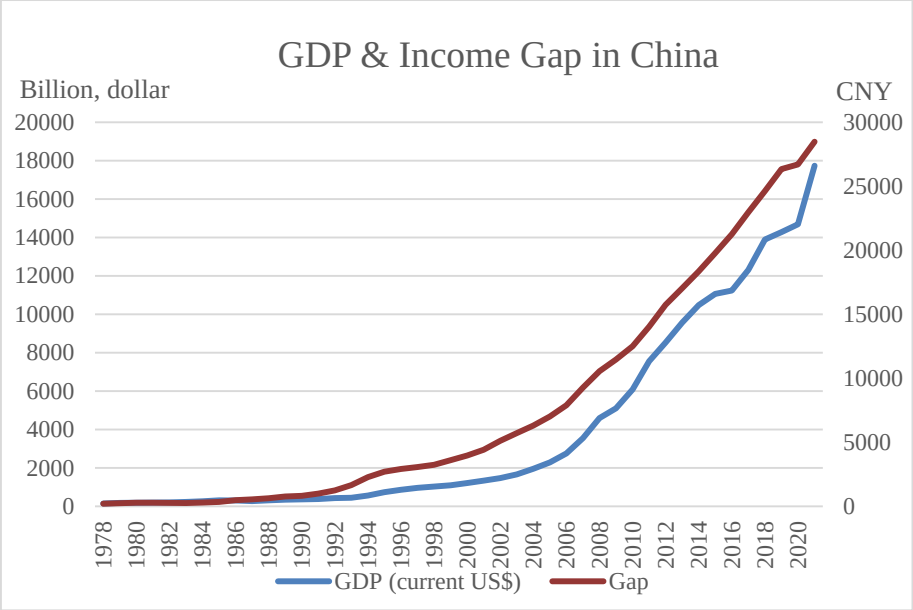

Figure 4. GDP & Income Gap in China

Source: NBSC

Although wealth gaps have been unavoidable due to rapid economic development, globalisation has resulted in varying degrees of wealth gap performance in different nations. Nevertheless, China's wealth gap problem is complex and globally prominent, with China's Gini index frequently approaching the warning line. The National Bureau of Statistics of China (NBSC) has published national income Gini coefficient data ranging from 0.473 to 0.491 from 2003 to 2012. The Gini coefficient of the national income gap in 2020 calculated by the China Household Finance Survey of the Southwest University of Finance and Economics based on its household survey has been calculated by civil society organisations to be as high as 0.61.

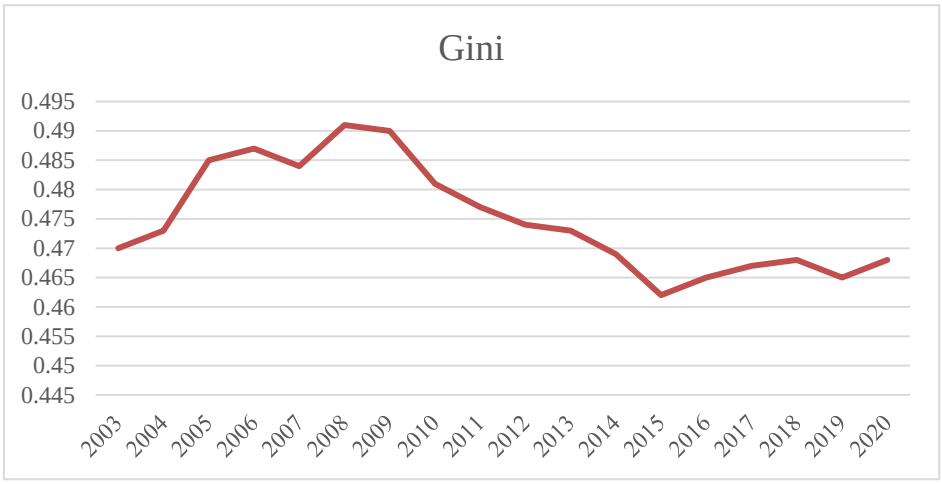

Figure 5. Gini Index in China

Source: NBSC

According to the above analysis, this study identified three influential factors of income inequality: economic development, urbanisation, and industrialisation. Based on this, this study analysed the issues related to economic development and income inequality in China using data covering more than four decades since the reform and opening-up period commenced. The research questions raised are as follows:

i. Does economic development deepen income inequality in China?

ii. Does urbanisation increase income disparities in China?

iii. What effect does industrialisation have on income disparity?

1.3 Research Significance

(a) Theoretical significance

Since the introduction of the inverted U-shaped hypothesis by Kuznets and Lewis's urban-rural dualism model, numerous scholars have investigated these concepts in the Chinese context with varying results. The current study has examined economic growth, urbanisation, and industrialisation's effects on income disparity through quantitative analysis. Different explanatory variables, period selections, and data types could substantially affect the outcomes. Consequently, this paper has adapted these two theories to the Chinese context from various perspectives to bolster the realism of these two theories.

(b) Practical significance

China vowed to eradicate absolute poverty by 2020, a problem that has plagued the country for millennia as the nation enters a new phase of rural revitalisation growth. The Fourth Plenary Session of the 19th CPC Central Committee (2019) emphasised "consolidating the results of poverty eradication and establishing a long-term mechanism for solving relative poverty," indicating that the emphasis of China's future poverty alleviation efforts would shift from absolute to relative poverty. Consequently, additional objectives were included to reduce relative poverty and close the gap between urban and rural areas. However, the path to resolving the issue of relative poverty is lengthy and cannot be completed in a single step. In practice, narrowing the gap between the rich and the poor is much more challenging in reality than in theory.

In addition, China's experience over the past four decades, from extreme capital shortages to eradicating absolute poverty, offers valuable lessons for the rest of the world in reducing poverty. In the 1980s, China was one of the world's poorest nations. After forty years of reform and opening up, more than 700 million Chinese have been lifted out of poverty, contributing to more than 70 per cent of the global reduction in poverty (Lin, 2018). This result has highlighted the unique advantages of the "Chinese system" in the global anti-poverty movement and provided Chinese ideas for global poverty reduction. Consequently, in the new era in which China begins to implement its rural revitalisation strategy, it is pertinent to reexamine the urban-rural income gap in China and investigate possible means of narrowing the gap between the rich and the poor.

2. Literature Review

This article has examined existing research on income inequality in China. China's economy and society have undergone numerous institutional changes, and the key to economic growth has been effective economic organisation (North & Thomas, 1973). There is no doubt that 1978 marked a significant turning point in China's economic development. Initiated by economic reform and opening-up policies, China's structural changes ushered in a period of sustained and rapid economic growth (Zhang, 2016). This year marked the beginning of China's rural production system's innovation and the rapid growth of farmers' incomes. It was also the year China joined the globalisation movement and became the world's factory. Urban economic reforms, including reforms of state-owned enterprises and fiscal and financial systems, dominated the 1990s. Rural taxes and fees were reformed to reduce regional economic disparities beginning in the 21st century. Concurrently, many policies were implemented to foster economic growth in the central and western regions. Reform and opening-up policies have gradually helped Chinese citizens escape absolute poverty over the past forty years. However, rapid economic development in China over the past few decades has been accompanied by a rapid increase in income inequality, which reached high levels around 2010 (Xie & Zhou, 2014; Sun et al., 2021). To some extent, the rise in income inequality has been both an inevitable consequence of economic development and a necessary driver of economic development. As predicted by Deng Xiaoping in 1978, the disparity between the rich and the poor is an inevitable consequence of uneven development and a fundamental obstacle to be overcome when moderate prosperity is achieved globally. China declared the end of absolute poverty and the attainment of total moderate prosperity in 2021, followed by the development of goals for rural revitalisation. Therefore, studying the high level of urban-rural income disparity and its causes in China and exploring potential solutions has provided China with excellent guidance for achieving its new era goal of shared prosperity.

Urban-rural wealth disparity accounts for a significant portion of China's overall inequality (Hussain et al., 1994; Lin et al., 2004; Lu & Chen, 2006; Wan et al., 2006; Xie & Zhou, 2014; Chen et al., 2016; Cheng & Wu, 2016; Lu et al., 2019; Yang et al., 2021). The theory of binary economic structure is foundational for analysing the urban-rural income gap. Lewis (1954) noted that developing nations coexisted with rural agriculture dominated by traditional production methods and a modern urban sector dominated by modern manufacturing, i.e., a dichotomy between traditional and contemporary economies. H. Fei and G. Ranis (1964) modified the assumptions of Lewis's model by refining the dual economic structure by considering the balanced growth of the agricultural and industrial sectors. These studies evolved into the dualistic economic development concept with surplus labour transfer. The origins of the urban-rural divide in China, according to Yang (2002), can be traced back to the development strategies of the planning era (the 1950s-1970s) (Cheng & Wu, 2016). At that time, traditional production methods dominated Chinese agriculture (Gustafsson et al., 2010), and productivity levels were low. The nation did not make significant efforts to develop manufacturing in the cities until 1978. Since that time, agricultural productivity has declined. Simultaneously, the urban

capital intensity increased, and labour productivity in the industrial sector flourished. During this time, active agricultural labour shifted to non-agricultural occupations, lending credence to the dual economy theory in the Chinese context.

However, the transition of agricultural labour to other industries has not been seamless. In the 1950s, the household registration system (*'hukou'* system), intended to control migration, severely restricted rural-urban labour mobility. In other words, the hukou system limited labour interaction between modern and traditional sectors. Rural reforms were implemented in China in 1978, primarily centred on the household contract responsibility system (Fang & Zhang, 2021; Cheng & Wu, 2016) and increased labour mobility to non-farm activities. Consequently, reforms were made to the household registration system (Li et al., 2018). In the 1980s, China's migrant population grew slowly, but it increased significantly between the early 1990s and 2015 (Lu et al., 2019). The reform of the household registration system facilitated the urbanisation of active rural labour (Lu et al., 2019; Osinubi & Olomola, 2020). Lin et al. (2004) observed that despite the gradual easing of government restrictions on migration in the 1990s, many Chinese cities continued to deny migrants the right to permanent residence (*'hukou'*) (Zhang & Zou, 2012; Gustafsson et al., 2010; Yang et al., 2021). Many rural migrants could not permanently relocate to cities due to employment discrimination and high housing costs (Li et al., 2013). Some rural labourers were restricted from migrating due to migration barriers. Consequently, the gap between rural agricultural and urban industrial productivity has continued to widen due to the loss of highly qualified rural labour that is actively employed (generally those with skills or education and high competitiveness). A strong positive correlation exists between labour productivity and wages. Fang & Zhang (2021) found that wage levels were the leading cause of recent changes in urban and rural poverty and the leading cause of rising rural inequality. Agricultural incomes have been crucial in alleviating rural poverty and inequality. The Kuznets hypothesis could be explained by the fact that urbanisation has allowed some rural residents to earn higher incomes in cities (Cheng & Wu, 2016).

Numerous academics have proposed viable strategies for closing the urban-rural income gap. For instance, Wan et al. (2006) suggested that privatisation could help reduce the income gap between urban and rural areas. They argued that township enterprises were essential for bridging the gap between urban and rural areas. Chen et al. (2016) argued that China fitted the Kuznets curve, so continued urbanisation could reduce the impact of the income gap by luring more individuals to the higher-income urban sector. Lu et al. (2019) suggested adjusting income distribution and implementing further reforms in all areas, including; agriculture, education, social security, and housing, to reactivate the demographic dividend. Fang and Zhang (2021) argued that opportunities for the rural populace should be expanded to close the income gap.

3. Methodology

3.1 Theoretically Background

Kuznets (1955) argued that industrialisation and economic development would exhibit an "inverted U-shaped" pattern of income inequality. In other words, it undergoes a process of first widening and then narrowing. Industrialisation will accompany a widening income distribution gap when a nation's income is low. With economic development, income inequality enters a period of significant decline once it reaches a certain threshold.

Simultaneously, Lewis (1954) proposed the urban-rural dualistic economic structure theory. He argued that urban and rural areas could be divided into two sectors due to a country's industrialisation. These two sectors represent the emergence of a modern economy based on current manufacturing in cities and the maintenance of a traditional economy based on traditional production techniques in the countryside. A disparity between capital and labour in both sectors (industry and agriculture) exacerbates income disparities. In the initial phase of the dual economy structure, labour is abundant while capital is scarce. Following the law of supply and demand, the income of labour factor owners will decrease while the income of capital factor owners will rise, thereby widening the income gap. As a nation vigorously develops manufacturing industries in urban areas, industrial labour productivity increases significantly. Agriculture will begin to lose workers to the industrial sector. The modern sector gradually absorbs workers from the traditional sector, and the dualistic economic structure diminishes over time. The disparity in income between the two sectors will gradually narrow.

In conclusion, based on Kuznets' hypothesis and the theory of urban-rural dual economic structure, with the development of industrialisation, an income disparity will emerge between modern and traditional economies; this disparity is referred to as relative poverty.

3.2 Study Design

3.2.1 Data

This paper examined the relationship between China's the urban-rural income gap, industrialisation growth, and urbanisation. This study selected China's urban and rural per capita disposable income, value added of secondary industry, urban population, and total national population based on previous research and data availability. This study utilised public data from the National Bureau of Statistics of China (NBSC) and the World Bank Open Data. The sample interval consisted of national time series data between 1978 and 2021.

Y_U denoted the disposable income per capita of China's urban residents, which was used to express the income of the urban population. The rural population's income was described as disposable income per rural resident and was denoted by "Y_R." The urban disposable income per capita was the sum of urban households' final consumption expenditure, other non-obligatory expenditures, and savings per capita. Specifically, the discretionary income available to families. Disposable income per capita in rural areas refers to the total income received by rural households from all sources in a given year after expenses had been deducted; this is also referred to as rural net income. Net income is mainly used for

reproduction input and current year living consumption expenditure, and also can be used for savings and various non-compulsory expenditure. Disposable income was chosen over gross income to eliminate the impact of urban and rural price levels. The standard of living was more accurately reflected by disposable income. The degree of industrialisation of the nation was determined by the value added of the secondary sector, denoted by the letter "I." The value added of the secondary sector, or the proportion of industrial value added to the total GDP. This indicator revealed the overall impact of industrialisation on the nation. 3.2.2 Data Processing

Drawing on Wang (2020), the ratio of urban per capita disposable income to rural per capita net income was used to measure income inequality between urban and rural residents. The methodology used was as follows:

$Y = Y\_U / Y\_R$

This study obtained an index of income inequality between urban and rural residents, marked as "Y." Since the urban and rural populations of each province may have been missing during the sample period, considering the reasonableness and accessibility of the data, this study drew on Sun *et al.* (2021) to measure the urbanisation rate by the proportion of the urban population to the total population, denoted as "U."

3.2.3 Models and Software

After processing, this study obtained three variables with relative weights of I, U, and Y. This study built a vector autoregressive model between; income inequality (Y), industrialisation (I), and urbanisation rates (U). The analysis software used in this paper was Stata 17.

The vector autoregressive model's essence is to examine the dynamics and interrelationships among multiple variables. The model is constructed by treating each endogenous variable as a function of the lagged values of all endogenous variables. The VAR model is used when time series variables interact with each other. The previous analysis showed a theoretical interrelationship between industrialisation, urbanisation, and income inequality rates. This paper selected the data of income inequality (Y), industrialisation (I), and urbanisation rates (U) from 1978-2021 to construct the vector autoregressive model.

Due to the significant volatility of time series data, the data of the Y, I, and U indicators were simultaneously logarithmically treated in this paper. They are denoted as LY, LI, and LU, respectively.

The VAR model expressions are as follows:

$$y_t = \sum_{i=1}^{n} A_i y_{t-i} + \varepsilon_t$$

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t, t = 0, \pm 1, \pm 2, \cdots\cdots$$

Where $y_t = (y_{1t}, \cdots\cdots, y_{nt}), t = 1,2, \cdots\cdots, T, (n \times 1)$ are the random variables and A_i is the coefficient matrix.

To ensure that the data are meaningful and to avoid pseudo-regression, the variables were first tested for smoothness, and the ADF and PP unit root tests were used to test the stability of the time series data.

If the data were unstable, the first-order treatment was performed until all variables were a single integer of the same order. After determining the smoothness of the data, the lag order of the model was determined before modelling. The greater the number of lag orders, the more information the model will obtain, but an increase in lag orders will reduce the equation's degrees of freedom and make the model less accurate. Therefore, an optimal solution is often chosen between information acquisition and degrees of freedom. This paper's lag order was judged according to the information criterion. After determining the lag order (p), the VAR (p) model construction was performed. After that, the joint significance test, Granger causality test, and AR root stability test were performed on the model, respectively. Impulse response and variance decomposition analyses were then performed. Finally, the data from the last five years (2017-2021) were selected for forecasting, and the accuracy of the model used for forecasting was judged by comparing the observed and predicted values.

4. Results

4.1 Data Analysis

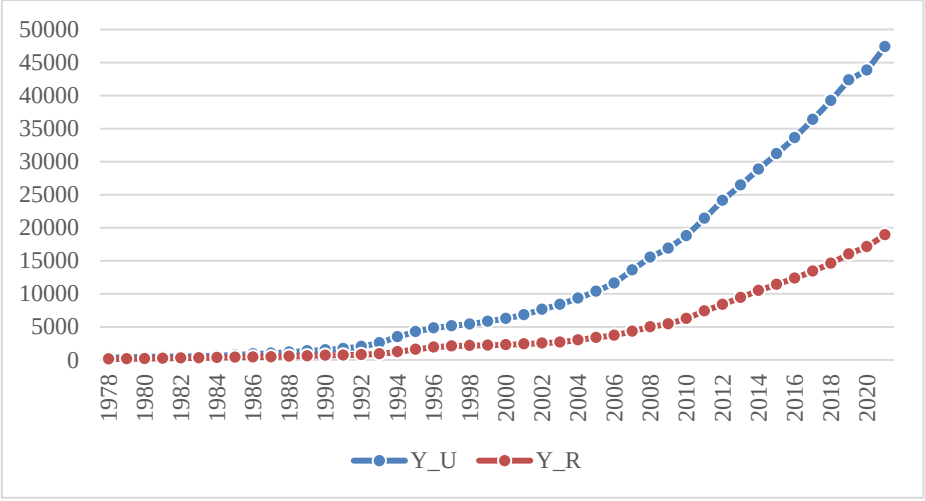

Figure 6. 'Y_U' and 'Y_R' from 1978 to 2021

Source: NBSC

Urban per capita disposable income has followed suit, rising from just RMB343 in 1978 to RMB47,412 in 2021, an increase of 138 times in 43 years. Rural per capita disposable income, only RMB134 in 1978, was expected to reach RMB18,931 in 2021, an increase of 141 times. Although the income levels of urban and rural residents have increased a hundredfold, the absolute gap between the income levels of urban and rural residents has been growing. Instead, the urban-rural income gap rose from RMB209 to RMB28,481, a 136-fold increase. This outcome was also in line with Li *et al.*'s (2013) conclusion that inequality in China was not the result of the impoverishment of the poor but the result of the rich becoming richer faster.

Figure 7. 'Y' from 1978 to 2021

Source: NBSC

In this paper, the ratio of urban residents' disposable income to rural residents' disposable income has been used to indicate urban-rural income inequality Y. As seen from the above graph, urban-rural income inequality was trending downward at the beginning of the reform and opening-up period. It reached its lowest in 1983, then rebounded and showed an upward spiral trend, going to 3.12 in 2003 and oscillating at a high level in the following years until 2009. Since 2010 it has been declining, returning to around 2.5 by 2021.

Before 1978, China's economy was in a state of complete disarray. The urban population was tiny, and industrialisation was in its infancy. Traditional production methods dominated agricultural production, and productivity levels were low. 1978 saw the development of manufacturing in cities and a significant increase in productivity in the industrial sector.

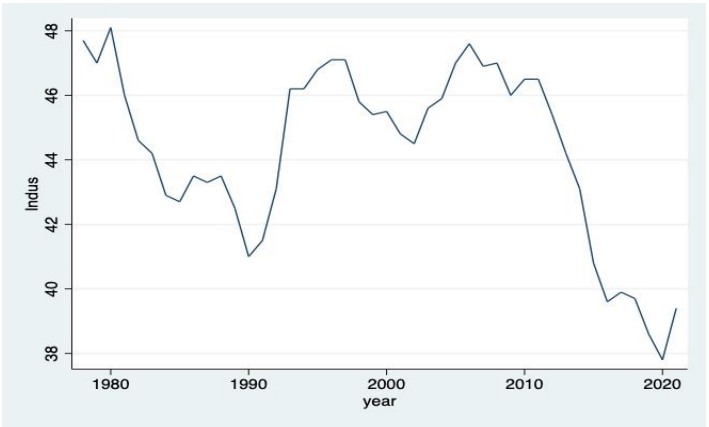

Figure 8. 'Indus' from 1978 to 2021

Source: NBSC

Considering China's industrialisation indicators, today, China is the world's manufacturing powerhouse, producing nearly half of the world's major industrial products, including; crude steel, cement, coal, and

automobiles. China's industrialisation has gone through three main stages. The first stage was the period of primitive industrialisation. It lasted from 1978 to 1988 and was a decade of economic reform driven by rural enterprises. It was characterised by the emergence of millions of rural enterprises in China's vast rural areas and small towns. The value of rural industrial output increased by more than 13.5 times, and total peasant wage income increased by 12 times. Thanks to a remarkable increase in the supply of essential consumer goods, China ended its shortage economy and, at the same time, solved the problem of food security. This phase saw a gradual decline in the share of industrialisation, as shown in the graph. The second stage was the period of the first industrial revolution, which lasted from 1988 to 1998. The mass production of labour-intensive light consumer goods in rural and urban China characterised this phase. During this period, China became the world's largest producer and exporter of textiles, the largest producer and importer of cotton, and the largest producer and exporter of furniture and toys. A gradual increase in the share of industrialisation was seen in this phase. The third stage was the second industrial revolution, which occurred after 1998. This stage has been characterised by China's large-scale production of bulk commodities. Markets, such as; machinery and transport, expanded rapidly, and significant progress was made in; coal, steel, cement, chemical fibres, machine tools, roads, and bridges. Over the last decade, it makes sense that the share of industry has gradually declined due to China's booming tertiary sector.

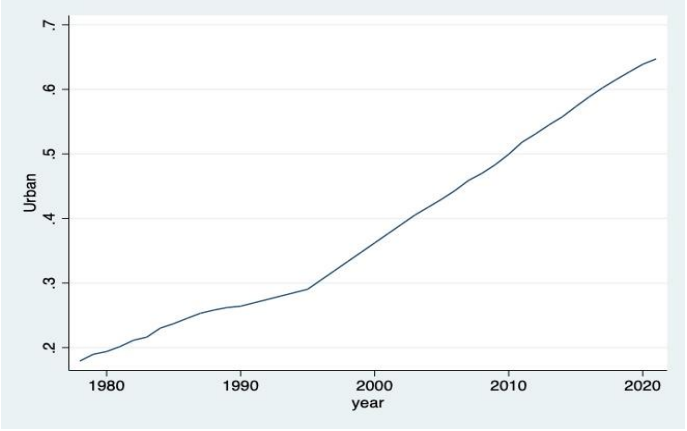

Figure 9. 'Urban' from 1978 to 2021

Source: NBSC

Finally, there has been the process of urbanisation. In 1978, the urban population was only 172.45 million, and the total population in that year was 962.59 million, an urbanisation rate of less than 18%. By 2021, the urban population will be 914.25 million, and the total population in the same year will be 1.41 billion. The urbanisation rate will be nearly 65%. The rural population has shrunk from 790.14 million in 1978 to 498.35 million in 2021. This situation indicates a sharp decline in the rural population in the face of a massive increase in the total population. This result indicates a significant rural-urban migration.

4.2 Model Analysis

4.2.1 ADF Test

The ADF test was conducted separately for the original and first-order data via Stata 17, and the results are shown in the table below (see details in the Appendices):

Table 1. ADF Test Results

Variable	Test statistics	Dickey-Fuller critical value			p-value	conclusion
		1%	5%	10%		
lnY	-1.057	-3.628	-2.95	-2.608	0.7321	unstable
lnI	-0.882	-3.628	-2.95	-2.608	0.794	unstable
lnU	-2.114	-3.628	-2.95	-2.608	0.2389	unstable
d.lnY	-3.532	-3.634	-2.952	-2.61	0.0072	stable
d.lnI	-4.347	-3.634	-2.952	-2.61	0.0004	stable
d.lnU	-4.484	-3.634	-2.952	-2.61	0.0002	stable

Source: Caculated by Stata17

From the results of the above table, it can be seen that lnY, lnI, and lnU were not smooth at the 5% significance level, but d.lnY, d.lnI, and d.lnU were all smooth after taking the first order. The results of the PP Test are shown in the table below (see details in the Appendices):

Table 2. PP Test Results

	Variable	Test Statistic	Dickey-Fuller critical value			p-value	conclusion
			1%	5%	10%		
Z(rho)	lnY	-4.570	-18.424	-13.076	-10.560	0.5333	unstable
Z(t)		-1.500	-3.628	-2.950	-2.608		
Z(rho)	lnI	-4.224	-18.424	-13.076	-10.560	0.6305	unstable
Z(t)		-1.297	-3.628	-2.95	-2.608		
Z(rho)	lnU	-0.433	-18.424	-13.076	-10.560	0.5147	unstable
Z(t)		-1.538	-3.628	-2.950	-2.608		
Z(rho)	d.lnY	-21.085	-18.356	-13.044	-10.540	0.0058	stable
Z(t)		-3.600	-3.634	-2.952	-2.610		
Z(rho)	d.lnI	-28.184	-18.356	-13.044	-10.540	0.0004	stable
Z(t)		-4.320	-3.634	-2.952	-2.610		
Z(rho)	d.lnU	-30.828	-18.356	-13.044	-10.540	0.0001	stable
Z(t)		-4.669	-3.634	-2.952	-2.610		

Source: Caculated by Stata17

The PP test results were the same as the ADF test. Thus, first-order data could be built as a VAR model.

4.2.2 Lag–order Selection

The lags were chosen, so they were neither too large nor too small. The more lag orders there were, the more information the model would obtain, but an increase in the number of lag orders would reduce the degrees of freedom of the equations, making the model less accurate. Therefore, an optimal solution is often chosen between information acquisition and degrees of freedom.

The results are shown in the table below (see details in the Appendices):

Table 3. Lag-order Selection Criteria

Lag	LL	LR	AIC	HQIC	SBIC
0	281.334		-14.2735	-14.2276	-14.1456*
1	296.582	30.497	-14.594	-14.4103	-14.0821
2	309.04	24.916	-14.7714*	-14.4499*	-13.8755
3	316.018	13.955	-14.6676	-14.2084	-13.3879
4	325.752	19.468*	-14.7052	-14.1083	-13.0417

Source: Caculated by Stata17

According to the information criterion, the VAR model's optimal lag order could be considered 2. Therefore, the VAR (2) model was established.

4.2.3 Model Construction

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t, y_t = \begin{bmatrix} d.lnI \\ d.lnU \\ d.lnI \end{bmatrix}$$

After running the model, this study obtained the results (see details in the Appendices):

Table 4. VAR Model Results

		Model 7	Model 8	Model 9
		D_LY	D_LU	D_LI
LY	LD.	0.5232**	-0.0642*	0.0199
		[3.33]	[-1.95]	[0.25]
	L2D.	0.1080	-0.0328	0.2081**
		[0.62]	[-0.90]	[2.39]
LU	LD.	0.0902	0.2855**	0.5339
		[0.13]	[1.99]	[1.56]
	L2D.	0.5990	0.3328***	-0.7090**
		[0.98]	[2.61]	[2.39]
LD	LD.	-0.0182	0.0976	0.3103*

	[-0.06]	[1.46]	[1.56]
L2D.	-0.5939*	0.0237	-0.3251**
	[-1.82]	[0.35]	[-2.00]
c	-0.0243	0.0115**	-0.0008
	[-1.08]	[2.44]	[0.07]

Notes. (1) ***, **and* denotes significant at 1%, 5% and 10% significance level, respectively.

(2) number in [] represents z-statistics.

Source: Caculated by Stata17

The results are organised as follows.

$$D\_LY = -0.243 + 0.524LD.LY + 0.108L2D.LY + 0.09LD.LU + 0.599L2D.LU - 0.018LD.LI - 0.594L2D.LI$$

$$D\_LU = 0.011 - 0.064LD.LY - 0.033L2D.LY + 0.285LD.LU + 0.333L2D.LU + 0.098LD.LI + 0.024L2D.LI$$

$$D\_LI = 0.001 + 0.02LD.LY + 0.208L2D.LY + 0.534LD.LU - 0.709L2D.LU + 0.31LD.LI - 0.325L2D.LI$$

The R^2 values for the three equations were 0.365, 0.434, and 0.323, respectively, indicating weak explanatory power. *p*>chi2 showed that all three equations were highly significant, with *p*-values much less than 0.05.

4.2.4 Model Tests

(a) Joint Significance Test

After running the test, this study obtained the results (see details in the Appendices):

Table 5. Joint Significance Test Results

lag	chi2	Prob
1	26.5393	0.002
2	25.87275	0.002

Source: Calculated by Stata17

From the results in the figure above, the model was significant at the 95% confidence level.

(b) Granger Test

Granger causality tests were performed on the estimated completed VAR models, and the analysis results are shown below (see details in the Appendices).

Table 6. Granger Test Results

Equation	Excluded	F-statistic	Prob	Conclusion
	D.LU	1.2871	0.525	Not Reject
D_LY	D.LI	3.7634	0.152	Not Reject
	ALL	5.8564	0.21	Not Reject
	D.LY	8.01	0.018	Reject
D_LU	D.LI	2.8644	0.239	Not Reject
	ALL	8.1872	0.085	Not Reject
	D.LY	8.1264	0.017	Reject
D_LI	D.LU	5.9099	0.052	Not Reject
	ALL	13.103	0.011	Reject

Source: Calculated by Stata17

For the first equation, both p-values were more significant than 0.05. Therefore, this study could not consider D.LU and D.LI as Granger factors of D_LY. The second equation showed that D.LY was a Granger factor of D_LU. The third equation showed that D.LY was a Granger factor of D_LI and that D.LY and D.LU were jointly a Granger factor of D_LI.

(c) Model Stability test

This paper tested the impulse response function to understand the degree of response to shocks between industrialisation and urbanisation and urban-rural income inequality. Therefore, the VAR (2) model was first tested for stability. The results of the test are shown in the graph and table below. The VAR (2) model was stable and could be analysed further.

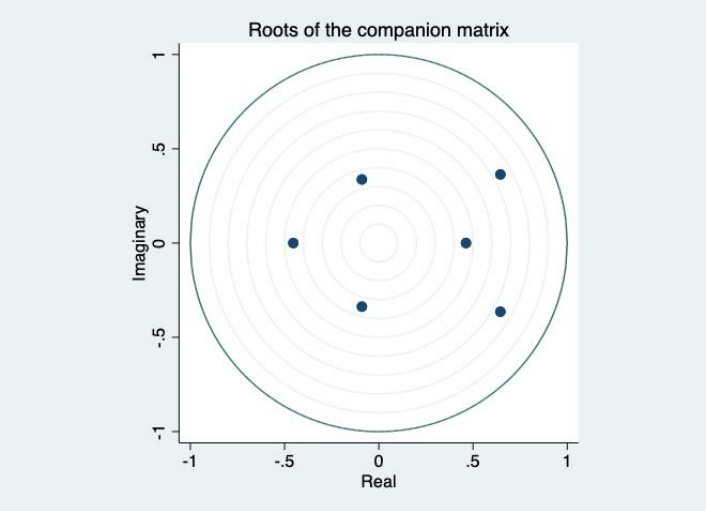

Figure 10. Roots of the Companion Matrix

Source: Drawn by Stata17

Table 7. AR Root Test Table

Root	Modulus
0.6451393 + 0.360923i	0.740789
0.6451393 - 0.360923i	0.740789
0.4628601	0.46286
-0.4537886	0.453789
-0.08968294 + 0.3373276i	0.349046
-0.08968294 - 0.3373276i	0.349046

Source: Calculated by Stata17

4.2.5 Impulse Response and Variance Decomposition Function Analysis

Based on the established VAR model, this paper used impulse response functions to measure the dynamic interactions and effects between the variables of the VAR model. The impulse response functions of d.LY and d.LI, as well as d.LY and d.LU as mutual impulse variables were established, and the results were obtained, as shown in the figure below.

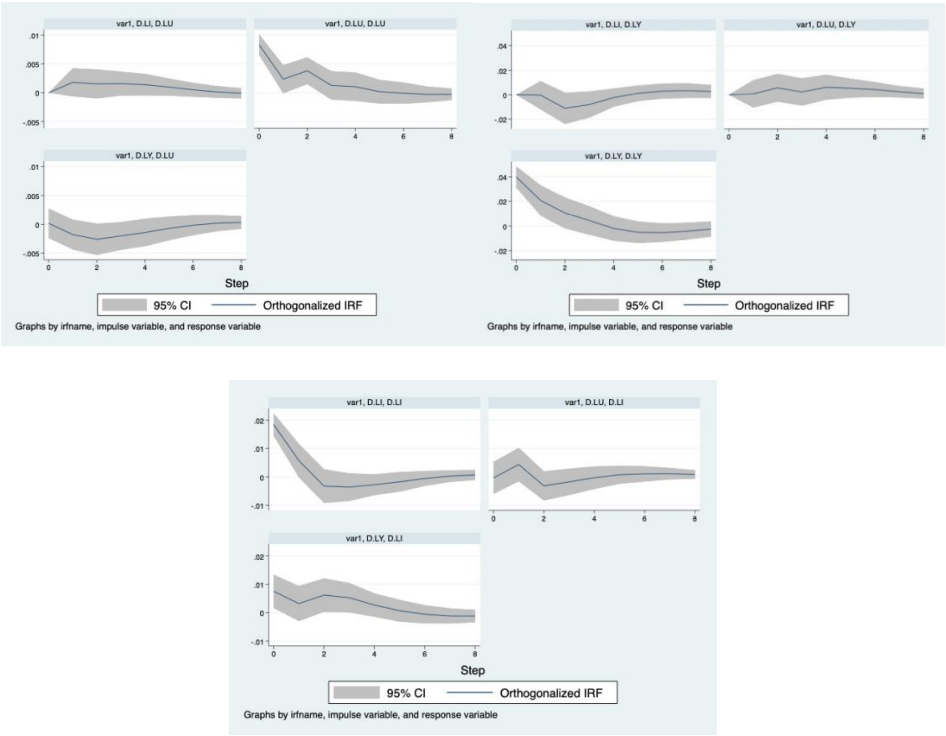

Figure 11. Impulse Response

Source: Drawn by Stata17

The results of impulse responses showed that when the rate of industrialisation impacted the rate of inequality, it had a negative effect in the second phase and then tended to be stable from the fourth phase. When the urbanisation rate impacted the inequality rate, it had a small positive effect in the first four periods and then became stable. Overall, the urbanisation and industrialisation rates influenced the inequality rate in the short term, while the influence was stable and weak in the long term.

Table 8. Variance Decomposition

step	D.LY	D.LU	D.LI
0	0	0	0
1	1	0	0
2	0.999662	0.000282	0.000055
3	0.932253	0.014481	0.053265
4	0.906043	0.016171	0.077786
5	0.890168	0.031373	0.078459
6	0.880472	0.042262	0.077266
7	0.872411	0.048546	0.079044
8	0.867384	0.050245	0.082371

Source: Calculated by Stata17

Table 4.8 shows the variance decomposition results. As shown in column d.LY, the inequality rate in the first period was only affected by itself. Over time, the rate of inequality fell under its influence. The contribution to the eighth phase accounted for about 87%. In the first phase, the impact of the urbanisation rate on the inequality rate was 0, which gradually increased from the second phase to about 5% in the eighth phase. However, the industrialisation rate was lower than the urbanisation rate in the second phase but suddenly increased in the third phase. From the fourth to the eighth period, the contribution of the industrialisation rate fluctuated between 7.7% and 8.3%.

4.2.6 Forecast

The sample was divided into two periods to examine the predictive effect of the model. The VAR model was re-fitted to the sample data from 1978-2016, and the model was used to forecast five steps forward (2017-2021). The results were as follows:

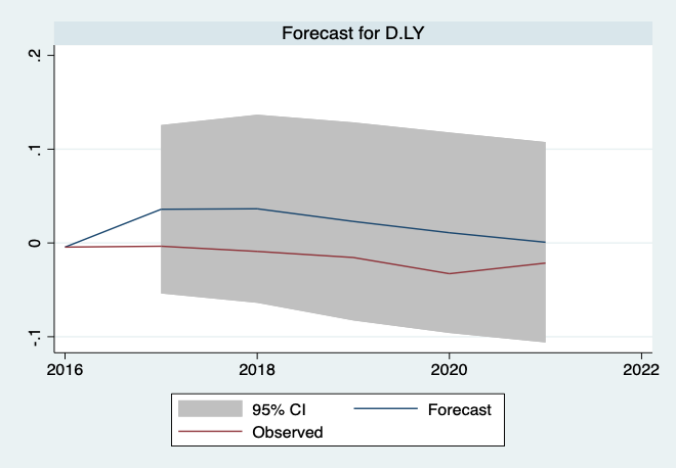

Figure 12. Forecast for D.LY

Source: Drawn by Stata17

The results of the Stata runs indicated that the actual five-step forward values all fell within the 95% confidence interval of the predicted values. This outcome showed that the model had good forecasting ability.

5. Discussion

Taking look at the urbanisation process. Consistent with the findings of Lu et al. (2019), the urbanisation process began in the 1980s, when rural populations migrated slowly to urban areas. After the 1990s, the urban population began to increase rapidly. There was a large migration of rural labour to urban centres. This phenomenon contradicted the findings of Zhang and Zou (2012), Gustafsson et al. (2010), Yang et al. (2021), and Li et al. (2013), who observed that rural residents couldn't migrate to urban areas permanently. This paper argued that so-called migration barriers had little effect on the decline of active rural labour.

First, urban populations have skyrocketed in recent years, comprising nearly 65 per cent of China's total population in 2021. Regarding policy, the urban population had expanded rapidly since the 1990s, when urban migration regulations were gradually loosened. The state's policy of subsidising rural households to narrow the gap between urban and rural areas has made rural-to-urban migration relatively simple (i.e., transfer from a rural household to a non-rural household). However, the obstacles and scrutiny faced by non-rural households seeking to move to rural areas have become more stringent. In other words, the demand for rural hukou is greater. In practical terms, agriculture has been gradually modernised due to the advancement of science and technology, and agricultural productivity has increased, freeing up a substantial amount of rural labour through more efficient production. Since the 18th National Congress (2012), several reforms have been strengthened, such as; household registration, land, finance, education, health insurance, and housing. The rate at which people have left the agricultural sector to become urban citizens has increased dramatically.

Based on the empirical findings, urbanisation had a negligible effect on the income gap in the first year, but this effect grew substantially in the second year. Thus, urbanisation has positively impacted the urban-rural divide, albeit with a lag. First, highly skilled and active rural labourers (those with skills or education who are also highly competitive) have migrated to cities by preference. In other words, obtaining higher incomes for rural labour is relatively difficult. Consequently, the de-agrarianisation of the active agricultural labour force has widened the income gap between urban and rural areas. When rural residents move to cities and towns, the cost of living and education for themselves and their children soars. Newly relocated urban residents must upgrade their skills, increase their productivity, and switch industries to earn a higher income to cover the higher cost of living. These methods and abilities to earn higher incomes do not always occur overnight. Therefore, there is a delayed positive correlation between urban residence and the ability to increase income.

Lastly, taking industrialisation, comparing the line graphs of industrialisation and the rate of income inequality. There are parallels between the trends of the two lines. Until the mid-1980s, both industrialisation progress and rural-urban inequality rates declined sharply. They increased in the 1990s and reached their short-term peaks in the mid-1990s. In the subsequent decade, they declined before recovering. There was a time lag between the two trends, however. The empirical analysis indicated that industrialisation had a small negative impact on income disparity, with a greater impact in the second year than in the current year.

Furthermore, the Granger causality test concluded that economic growth was the Granger cause of industrialisation. In the short term, industrialisation had a negligible impact on the income inequality rate. Long-term industrialisation reduced the income gap between urban and rural areas.

The migration of active rural labour to towns and cities and the industrialisation process can, on the one hand, significantly increase the productivity of citizens. On the other hand, applying industrialisation to agriculture, such as; developing seed-sowing drones and intelligent harvesting machines, can help rural residents significantly increase their efficiency. Historiographically, the emphasis of the “three rural areas” is shifting towards the comprehensive revitalisation of the countryside and the accelerated modernisation of agriculture and rural areas with Chinese characteristics. All rural poor have been lifted out of poverty, and the 832 poor counties in China have been eliminated. The effectiveness of scientific and technological aid in promoting the modernisation of agriculture and rural areas has increased. With biotechnology and information technology penetrating various agricultural and rural fields, a new round of scientific and technological revolution and industrial change has been developing. The transformation and upgrading of rural industries will be accelerated by the continued development and expansion of the digital countryside, which will also provide robust support for the modernisation of rural agriculture to promote the modernisation of agriculture and rural areas.

6. Conclusion

This study's author discovered through a review of pertinent literature that income inequality was related to the following factors: economic development, urbanisation rate, industrialisation development, opportunity inequality, and import-export trade. Opportunity inequality was more closely associated with class disparity, whereas international trade was more closely associated with regional disparities. As a measure of income inequality, the income gap between urban and rural residents was the focus of this paper. Therefore, the primary research objects of this paper were; economic development, urbanisation, and industrialisation. Regarding income, the disparity between urban and rural incomes and per capita GDP were absolute values. The inequality, urbanisation, and industrialisation rates were ratios and relative quantities. Therefore, this paper opted to construct two distinct models for analysis.

Initial image analysis suggested a roughly linear relationship between; income, income disparity, and economic development. After the model was created, the fit was satisfactory. In the meantime, given the inverted U-shaped Kuznets curve hypothesis, this study added a quadratic term for testing. According to the results, the coefficient of the quadratic term was minimal. Therefore, the authors deemed a linear model to be more suitable. In this paper, a VAR model was chosen for the three ratio values. The three variables passed the ADF and PP unit root test with a first-order smoothness and met the modelling conditions. The VAR (2) model was chosen based on the evaluation of the information criterion. Following the construction of the model, the stability test and impulse response analysis was conducted on the model in succession. Finally, predictions were made using the model, and the difference between predicted and observed values were within an acceptable range.

Based on empirical analysis, this paper concluded a positive correlation between economic development and the urban-rural income gap. Nonetheless, the data and period selected for this paper did not demonstrate that the situation in China was consistent with the inverted U-shaped Kuznets curve hypothesis. Second, the urbanisation rate has significantly increased over the past four decades. The gradual widening of the urban-rural income gap has resulted from the migration of active rural labour to the cities. However, urbanisation has a delayed effect on income disparity. Third, industrialisation has helped reduce urban-rural income disparity over time.

During the past four decades of reform and opening up, China's economic expansion has been accompanied by a significant wealth gap. China declared in 2020 that absolute and global regional poverty had been eradicated according to current standards. In the history of poverty reduction, miracles include the elimination of all poor people and all impoverished counties have been lifted out of poverty. Despite its historical beginning, China's agricultural and rural development has faced contradictions and difficulties. It is imperative to accelerate the Chinese-style modernisation of agriculture and rural areas. A significant degree of inequality has also emerged in rural China at present. Agricultural production has geographically distinct characteristics. Due to geographical conditions and factor endowments, coastal rural areas have gradually integrated into modernisation, and agricultural

production efficiency has increased significantly. However, western and remote rural regions remain resource-poor and poorly matched. Assuming these regions will attain stable and abundant production. In this case, they must accelerate technological development and employ modern materials and technical equipment to compensate for their inherent lack of natural resources. In addition, class differentiation due to unequal access to opportunities must be a primary concern.

The following policy recommendations have therefore been made:

Firstly, the agricultural sector must be transformed and modernised. Agricultural modernisation can increase agricultural sector labour productivity and household income. A rise in productivity could increase the agricultural output of impoverished farmers. Moreover, due to the increase in agricultural productivity, the price and quality of agricultural products will decrease. Farmers' productivity rises, and a greater proportion of the surplus labour force in the agricultural sector will be transferred to the non-agricultural sector.

In addition, adopt and distribute new technologies based on local conditions. Due to China's extensive geographic distribution, the geographical factor endowment varies considerably. Significant differences exist between rural agriculture in each province. There is a Chinese idiom "Nan Ju Bei Zhi" which says the sweet and juicy orange would become the bitter and sour trifoliate orange if the tree's moved from southern to northern China. Consequently, agricultural development should be tailored to the distinct characteristics of various regions. When introducing new agricultural development technologies, the comparative advantages of various regions should be maximised. Utilise new technologies that are adapted to local conditions. Private companies find it challenging to invest solely in agricultural research and development. Therefore, the government and state should conduct more vital research, development, and promotion efforts. Regional agricultural technology R&D should be conducted at the provincial level (including municipalities directly under the central government). Marketing is also essential in addition to research and development. In general, the rural labour force is characterised by a low level of education. The sector frequently requires professional guidance and training when utilising new technologies. The federal government should be responsible for its promotion.

Finally, encourage businesses to achieve sustainable industrialisation. As is common knowledge, industrialisation necessitates a substantial increase in carbon emissions, resulting in global warming and more extreme weather. Thirteen of the UN's Sustainable Development Goals refer to the urgent need to address climate change and its consequences. Climate change and industrialisation should be addressed simultaneously to ensure the smooth realisation of sustainable development. This study's findings must encourage the implementation of technological advances to promote a greener and more sustainable industrialisation. Due to the assumption of businesses being economically rational, it is difficult for them to invest large sums of money in green development to promote research and development of new technologies. Therefore, national capacity is essential for encouraging the green transformation of businesses. The state should provide businesses with appropriate incentive mechanisms to motivate them to invest in technological innovation and advance the transition to green industrialisation.

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