

Regional rural and structural transformations and farmer's income in the past four decades in China

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Abstract

Purpose – The purposes of this paper are to analyze the path and speed of rural transformation (RT) and explore the relationship between farmer's income and RT as well as structural transformation (ST) and typology of RT in the past four decades in China.

Design/methodology/approach – Based on the major indicators of RT and ST, graphic illustration is used to analyze the relationships between these indicators and farmer's income using the time-series and cross-provincial data in 1978–2017.

Findings – While China has experienced significant RT and ST, the levels and speeds of these transformations differed largely among provinces. Higher and faster RT and ST are often positively associated with the higher and faster growth of rural income. Based on this study, a general typology of rural and structural transformations and rural income is developed. The likely impacts of institutions, policies and investments (IPs) on RT are discussed.

Originality/value – The authors believe that the findings of this study provide the insights on regional RT and ST and policy implications to increase farmer's income through facilitating and speeding up RT and ST with appropriate IPs during the rural transformation.

Keywords Rural transformation, Structural transformation, Farmer's income, Typology, Region, China

Paper type Research paper

1. Introduction

China has undergone rapid agricultural growth and rural transformation since the late 1970s when rural reform was initiated. Annual growth rate of agricultural output value in real terms reached 5.4% in the past four decades. Within agriculture, livestock and aquaculture grew much faster than crops, their output value share in agriculture has increased from 16.6% in 1978 to 36.8% in 2019 (National Bureau of Statistics of China (NBSC), 2020). Within the crop sector, the production of cash crops grew much faster than grain, particularly vegetables and fruits (NBSC, 2020). Meanwhile, the participation rate of rural labor off-farm employment has increased from 9.3% in 1978 to 74.9% in 2015 (Zhang *et al.*, 2018). Accompanied with growth



in agricultural production and rising off-farm employment, per capita rural income has increased from 134 Yuan in 1978 to 16,021 Yuan in 2019 in normal terms, with an increase of 21.7 times in real terms (NBSC, 2020).

However, the level and speed of rural transformation differ among regions. The commercialization and diversification of agriculture have varied among provinces and shown a strongly space-time heterogeneity since the early 1980s (Gao *et al.*, 2014; Liu *et al.*, 2016; Huang and Li, 2019). Moreover, rural labors in eastern coastal provinces have better access to non-farm employment with higher wages (Yao *et al.*, 2014; Liu *et al.*, 2018). Owing to disparities in socioeconomic conditions, natural resources, geographical location and biophysical conditions, regional income gap and inequality have been enlarged (Wan, 2004; Liu, 2006; Ravallion and Chen, 2007; Li *et al.*, 2015).

Recent studies have pointed out the importance of facilitating inclusive rural transformation. For example, based on inter-country comparison, the International Fund for Agricultural Development (IFAD, 2016) and the Food and Agriculture Organization of the United Nations (FAO, 2017) reported that both successful structural transformation (ST) and rural transformation (RT) can facilitate poverty reduction in rural areas. According to the above studies, countries can be classified into different groups based on the speeds of RT and ST and the speed of rural poverty reduction. For the developing countries in Asia, Huang (2018) also analyzed the relationship between the speeds of RT and ST and rural poverty reduction and provided some insights on institutions, policies and investments that could facilitate inclusive rural transformation in Asia.

Recently, the typology of rural transformation has also received attention from scholars in China. For example, geographers have contributed to constructing a range of indicators in measuring rural transformation and conducting RT typology analysis (Long *et al.*, 2011, 2012; Meng *et al.*, 2013; Zhao *et al.*, 2014). But the current studies either focused on specific regions or a short time period. Although Huang (2018) examined China's rural transformation and its outcome, his analysis was at the national level and through an inter-country comparison between China and other Asian countries. Considering the facts that China is vast in territory with large variations in rural development, it will be more meaningful to conduct a rural transformation study at the regional or provincial level over a longer time period.

The goals of this paper are to analyze the path and speed of regional rural transformation and explore the relationship between farmer's income and RT as well as ST and typology of regional rural transformation in the past 40 years in China. Given the availability of data at the regional level over a long time period, we conduct the analysis at the provincial level over the period 1978–2017. To achieve these goals, the rest of the paper is divided as follows. Section 2 describes the definitions of rural and structural transformations, the indicators for RT and ST used in this paper and the pathway of regional rural transformation in China. Section 3 examines the general trend and variations of ST and RT by province in 1978–2017. Section 4 analyzes the relationships between provincial RT, ST and farmer's income and the typology of RT based on graphic illustration. Section 5 discusses the major enabling institutions, policies and investments (IPIs) that have facilitated or sped up rural transformation in China. The final section concludes this study with several policy implications and the remaining research issues for further studies in the future.

2. Rural and structural transformations in China

2.1 Definitions and indicators of rural and structural transformations

To analyze rural transformation and its relationships with the outcomes of the transformation, we need to have a clear definition of RT. We note here that rural transformation has many dimensions (e.g. social, economic and other type of transformations in rural areas). But from the economic point of view, RT often deals with agricultural

transformation (Wu *et al.*, 2015; Zhao and Zhou, 2018; International Food Policy Research Institute (IFPRI), 2019) and non-farm employment of rural labor (Reardon *et al.*, 2007; Haggblade *et al.*, 2010; Zhang *et al.*, 2018). For example, IFAD defines rural transformation (RT) as follows: “It involves rising agricultural productivity, commercialization and diversification of production patterns and livelihoods within the agricultural sector and towards the rural non-farm sector”. A similar definition of rural transformation has also been used in other studies recently (FAO, 2017; IFPRI, 2019). As highlighted by IFAD (2016), such a process of rural transformation involves more diversified and commercialized agricultural production as well as more non-farm employment opportunities. Based on the previous studies, we define the rural transformation in this study as a process that gradually adjusts agricultural production structure from cereal and other staple crops to a more diversified and commercialized high-value agriculture, and that rural labor employment gradually shifts from farm to non-farm with rising agricultural labor productivity.

With the above definition, agricultural structural change shifting production from low to high-value commodities and rising rural labor non-farm employment are seen as the major characteristics of rural transformation. Within the agricultural sector, high-value agriculture often includes horticulture, livestock and fishery. The bulk commodities such as grain, cotton, oil and sugar crops are normally considered as the relatively low-value crops. Therefore, we use the share of high-value agricultural commodities (vegetables, fruits, livestock and fishery) in the gross output value of agriculture that includes all crops, livestock and fishery as RT1 in Table 1. Apart from transformation in the agricultural sector, employment transformation of rural labor from farm to non-farm has been impressive in the past four decades in China. Here we use the share of rural labor’s non-farm employment to measure the rural labor employment transformation (RT2).

Structural transformation (ST) is a widely used economic term in literature. According to Barrett *et al.* (2010), structural transformation is characterized by four processes, including the fallen contribution of agriculture to GDP and employment, the improvement in urbanization, the development of modern industry and service and a gradual decline of birth and death rates. Of these processes, shares of agriculture in GDP and employment are the most cited in relevant studies (Timmer, 2009; IFAD, 2016; Huang, 2018). In the literature,

Dimensions	Indicators	Definitions
ST	Share of non-agricultural GDP	Share of secondary and tertiary industries in total GDP
RT	RT1: Share of high-value agriculture	Share of vegetables, fruits, livestock and fishery in gross agricultural output values (excluding forestry)
	RT2: Share of rural labor employment in non-farm	Rural non-agricultural labors divided by total rural labors
Outcome	Rural income	Per capita net income of rural households in real terms (at 2000 price)

Note(s): All raw data are collected based on the Statistical Yearbooks (various years) from each province and NBSC except for farm gate price data. Share of high-value agriculture is estimated by gross agricultural output value minus output values of all grains, rapeseed, peanut, cotton, sugarcane and sugar beet. The prices of these crops are farm gate prices from the National Development and Reform Commission, National Agricultural Commodities Cost and Benefit: Data Compilation, various years. The number of rural labors and the number of rural labors engaged in agriculture are used to estimate the share of rural non-farm labor. Rural consumer price index is used to deflate per capita rural net income. For rural income, the national statistics have replaced per capita net income by per capita disposable income after 2013. To have a consistent dataset over time, we calculate the difference of these two indicators in 2013 (the latter is about 6% higher than that of the former in 2013), and use this difference and per capita disposable income to estimate per capita net income for the years of 2014–2017

Table 1.
Indicators for
measuring rural and
structural
transformations

many studies have also emphasized the roles of agricultural growth in structural change (Johnston and Mellor, 1961; Johnston, 1970) and structural change is accompanied with the rising productivity in both agricultural and non-agricultural sectors (IFAD, 2016). In this study, we follow the previous studies and use the GDP share of industry and service (or non-agricultural sectors) as the indicator of structural transformation.

The outcomes of rural and structural transformations often refer to growth, equity and sustainability. Due to data limitations, this paper only examines one of these three outcomes: the farmer's income during rural and structural transformations. Per capita rural net income is measured in real terms at a constant price of 2000 (Table 1).

2.2 The pathway and stage of rural transformation in China

Pathway of rural transformation differs between agricultural and pastoral regions. This study focuses on rural transformation in agricultural region as it represents the majority of China's rural areas. In agricultural region, rural transformation has followed a path similar to those presented in Table 2, which includes four stages.

Stage I: Agriculture is dominated by the grain sector to meet the basic and necessary demand for food grain. This stage describes rural China before 1980. During this stage, most labor and land in every province is used towards grain production. For example, grain production accounted for nearly 90% of cultivated land in 1950, and thirty years later, in 1980, the share of grain sown area in total crop sown areas still exceeded 80% (NBSC, 2010).

Stage II: Agriculture starts diversification. The production and commercialization of labor intensive and high value cash crops (e.g. vegetables and fruits), livestock and fishery grow rapidly. Rising grain production and an overall increase in agricultural productivity enable farmers to allocate more land, labor and capital to the high-value commodities, which has significantly contributed to the rapid growth of farmer's income because the production of commercialized high-value commodities is normally more profitable than the production of grain and other staple crops (Wu *et al.*, 2015). For the nation as a whole, the share of high-value agricultural commodities increased from 45% in 1980 to 56% in 1990.

Stage III: Agricultural specialization is enhanced, the share of high-value agricultural commodities continues to rise, and rural labor's non-farm employment grows rapidly. China entered this stage in the early 1990s. During this stage, agricultural mechanization and urbanization significantly facilitate rural transformation (Wang *et al.*, 2016) together with a further increase in agricultural productivity. Rural labors increasingly shift from

Stage	Explanations
I	Primary on staple grain production (mainly food grain) before 1980
II	Agricultural commercialization and diversification, gradually rising labor intensive and high-value agricultural commodities since the early 1980s
III	Agricultural specialization, rising high-value agricultural commodities and non-farm employment since the early 1990s
	III-a: Farming and part time non-farm employment
	III-b: Increasing specialization on either farming or non-farm employment
	III-c: Rapid mechanization and more non-farm, especially off-farm migration
IV	High-value agriculture, sustainable agriculture and integrated urban-rural development since the 2010s

Table 2.
Pathway and stage of rural transformation in China

farm to non-farm employment. In China, the share of high-value agricultural commodities rose from 53% in 1995 to 75% in 2000 and fluctuated at 75% between 2000 and 2010. Based on our estimation, the share of rural labor's non-farm employment steadily increased from 21% in 1990 to 28% in 1995 and 32% in 2000, reaching at 48% in 2010.

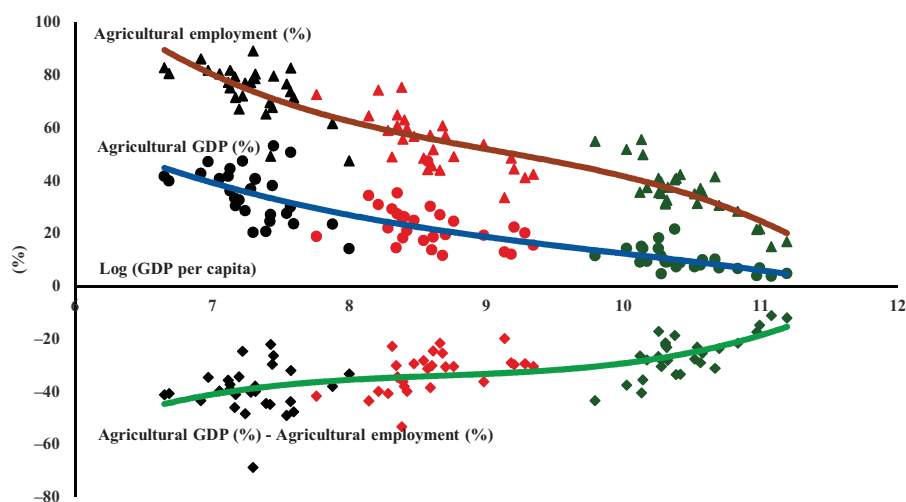
Stage IV: High-value and sustainable agriculture and integrated urban-rural development become major features of rural transformation in this last stage, which China has been in since the 2010s. During this stage, while high-value agriculture continues to rise, the most significant changes occur in a move to the more sustainable development of agriculture. The growth of agriculture in the previous three stages had come at the expense of resource and environment and had been rising the income gap between rural and urban areas (Huang and Yang, 2017). Since the early 2010s, China has pursued a nationwide urban-rural integrating development strategy. More recently, in response to the challenges of natural resource and environmental degradation, sustainable agriculture has become a rural development goal. To facilitate the modernization of agricultural and rural sector, China has implemented the Rural Revitalization Strategy since 2017. The Strategy is aimed to largely modernize agriculture and the rural economy by 2035, and fully modernize them by 2050.

3. Provincial rural and structural transformations and Farmer's income

Regional structural and rural transformations from here on are analyzed at the provincial level. On the pathway of rural transformation, it may differ between the farming region and pasturing region, as discussed above, and also between the mega cities (e.g. Beijing, Tianjin and Shanghai) and the provinces. In addition, Hainan is a unique island economy that may differ from inland provinces in path of RT. Therefore, the provincial rural transformation analysis in this study excludes Inner Mongolia, Xinjiang and Tibet in the pasturing region, the above three mega cities and Hainan. The total number of provinces included in the regional RT study is 24. On structural transformation, with the exception Figure 1, which uses 28 provinces to illustrate overall structural transformation (excluding 3 mega cities), the samples used in our other ST analyses are the same as the samples (24 provinces) used in RT. All analyses cover the time period from 1978 to 2017.

3.1 Provincial structural transformation

Figure 1 presents the trends of provincial structural transformation in the past four decades in China, which is consistent with the findings advanced by Timmer (2009) and the recent studies (e.g. IFAD, 2016; FAO, 2017; Huang, 2018) of national or international comparison analysis. The shares of agriculture in both GDP and employment have been falling with the growth of per capita GDP, which indicates that with agricultural growth, non-agriculture has been growing faster and rural labor has been transferring from agriculture to non-agricultural sectors in the process of economic development. Meanwhile, the gap between agricultural GDP share and its employment share has been generally narrowed over time, particularly in recent two decades, suggesting the labor productivity among sectors is converging. Agricultural labor productivity (or farm labor income) approaches non-agricultural labor productivity (or urban worker's income) when this gap approaches zero. The structural transformation contributes to rural income increase through several channels. First, structural transformation has created more employment for rural labor to work in non-farm sectors (Binswanger, 2013; Reardon and Timmer, 2014). Second, as more rural labor moving to non-farm sector due to structural transformation, agricultural labor productivity and therefore farmer's income has also increased accordingly (Barrett *et al.*, 2017). Third, at



Note(s): All figures are based on the data in 1978, 1998 and 2017 from each province. Per capita GDP is in real terms at 2000 price. Data are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents an observation for a province in year 1978 (black dot), 1998 (red dot) or 2017 (green dot). The triangle, circle and square dots represent agricultural employment (%), agricultural GDP (%) and the difference between agricultural GDP (%) and agricultural employment (%), respectively

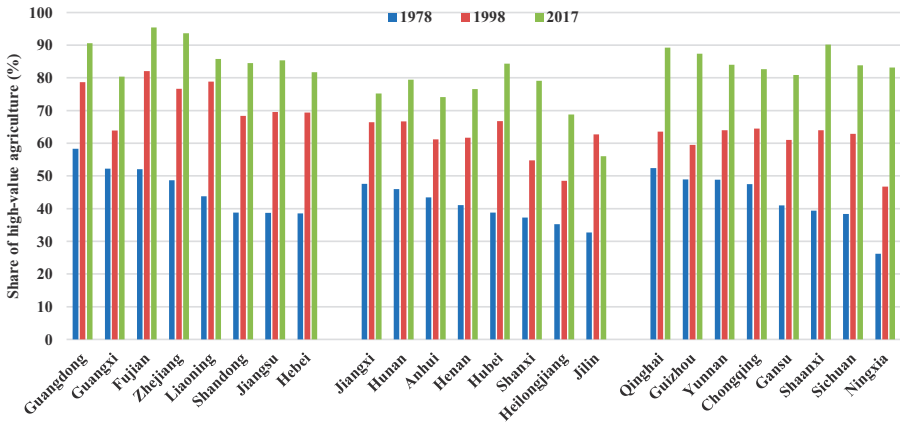
Figure 1. Convergence of shares of provincial agricultural GDP and employment in 1978, 1998 and 2017

the later stage of structural transformation when wage starts to rise, rural labors have earned more income from both the rise in non-farm wage and employment (Haggblade *et al.*, 2010; Zhang *et al.*, 2018). However, it is worth noting that the gap between agricultural GDP and employment shares still differed largely among provinces by 2017. While a few advanced provinces have lowered the difference between agricultural GDP share and employment share to near zero, the gap remained as high as about 40% in some western provinces (e.g. Yunnan and Gansu).

3.2 Provincial rural transformation

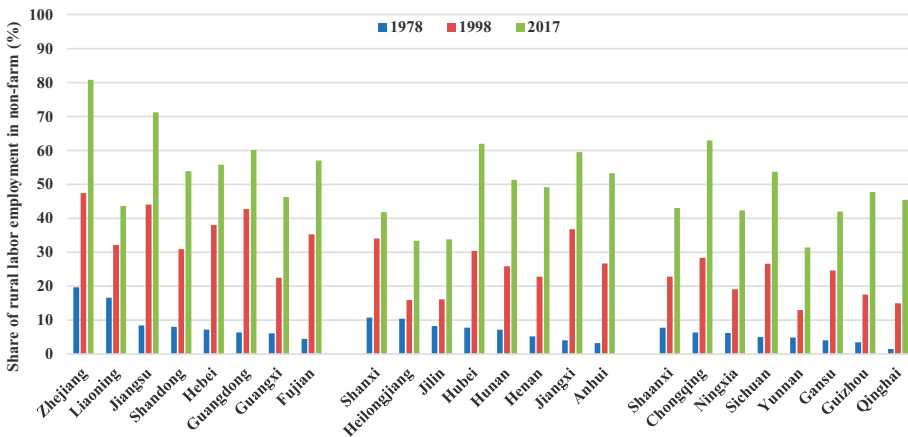
Based on the two indicators of rural transformation listed in Table 1, in this subsection, we analyze the trends and speeds of rural transformation by province in the past four decades. Figures 2 and 3 present the share of high-value agriculture and share of rural labor employment in non-farm, respectively, in 1978, 1998 and 2017. Notably, the provinces are grouped into three economic geographic regions, they are Eastern, Central and Western Regions. Eastern Region includes Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Guangxi; Central Region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; Western Region includes Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia.

The results on RT in terms of high-value agriculture show several interesting observations (Figure 2). First, while all provinces have experienced a rapid transformation from low-value to high-value agriculture, the initial level and change in the share of high-value agriculture over time differed significantly among provinces. Second, the transformation was much faster in the early period in eastern coastal provinces, while



Note(s): The raw data used to estimate the share of high-value agriculture are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Eastern Region includes Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Guangxi; Central Region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; Western Region includes Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia

Figure 2.
Shares of high-value agriculture by province in 1978, 1998 and 2017



Note(s): The raw data used to estimate the share of rural labor employment in non-farm are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Eastern Region includes Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Guangxi; Central Region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; Western Region includes Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia

Figure 3.
Shares of rural labor employment in non-farm by province in 1978, 1998 and 2017

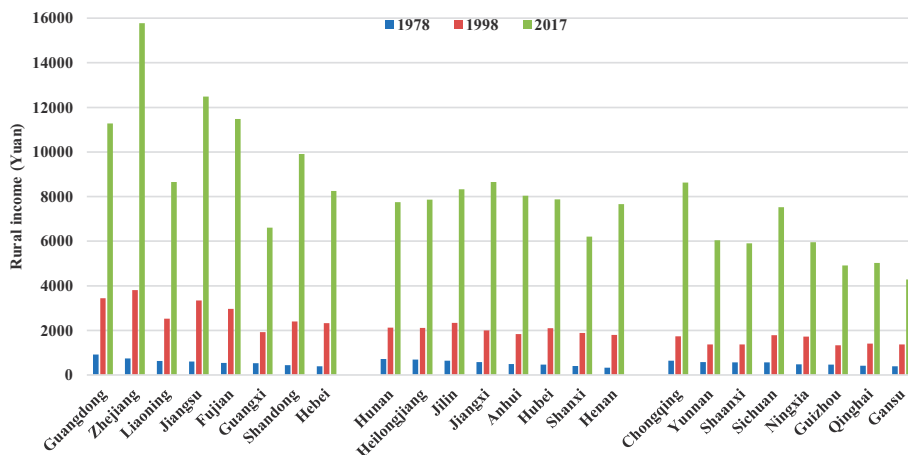
provinces in the central and western China grew faster in the latter period. Notably, Jilin is an exception in the later stage, the province has moved to low-value agriculture during 1998–2017, which is largely due to shifting of agricultural production to maize and rice after government procurement and price supporting policies (Huang and Yang, 2017). Third,

despite a large variation in the share of high-value agriculture in 1978, many provinces with lower level of high-value agriculture have been catching up over time. For example, while Guangdong had the highest level of the high-value agricultural share in 1978 (58.3%), it has only increased by 32.3% in the entire period of 1978-2017. Over the same time period, Ningxia and Shaanxi have increased their high-value agricultural shares by 57 and 51%, respectively.

Figure 3 presents the trends of rural labor non-farm employment shares over the past four decades. In general, the speed of transformation in recent two decades was faster than that of the two preceding decades. Similar to the large variation in the level of rural transformation measured in the share of high-value agriculture, the level of rural transformation measured in the share of non-farm employment of rural labor differed significantly among provinces. For example, farmers in economically developed region (e.g. Zhejiang, Jiangsu, Guangdong and Fujian) had much more non-farm employment than other provinces in the less developed regions.

3.3 The trends of provincial rural income

With rural and structural transformations, although per capita rural income in all provinces has experienced significant increase, income disparity has deepened among provinces (see Figure 4). Income growth in Jiangsu, Fujian and Shandong was impressive, with an average annual growth rate of 8% in the past four decades. In contrast, provinces in western China (e.g. Guizhou, Qinghai, Shaanxi, Ningxia and Yunnan) were falling behind, with a less than 6.5% of income growth rate. On the level of income, regional inequality has been enlarged more. In 1978, per capita income measured in 2000 constant price ranged from 923 Yuan in Guangdong to 327 Yuan in Henan. By 2017, it ranged from 15,774 Yuan in Zhejiang to 4,281 Yuan in Gansu.



Note(s): The raw data used to estimate per capita rural net income (at 2000 price) are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Eastern Region includes Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Guangxi; Central Region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; Western Region includes Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia

Figure 4. Per capita rural net income by province in 1978, 1998 and 2017

4. Provincial rural income and rural and structural transformations

4.1 *The relationship between provincial rural income and rural and structural transformations*

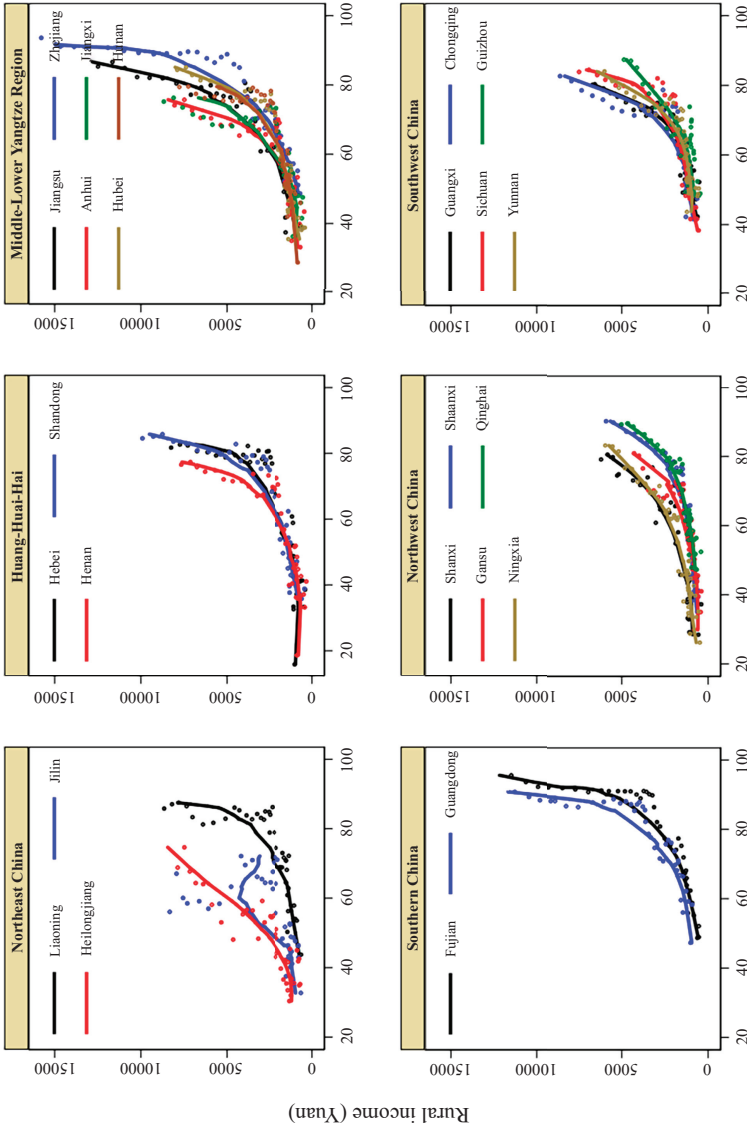
Both ST and RT have important implications to farmer's income. To examine the potential correlation between per capita rural net income and each of RT and ST, we first apply the graphic analysis by using the Locally Weighted Scatterplot Smoothing (LOWESS) method. Based on these analyses, we develop a typology for rural transformation and farmer's income. Despite some common features of provincial rural transformation, to have a better understanding of the relationship between farmer's income and RT or ST, we analyze the data by agricultural production zones. They are Northeast China, Huang-Huai-Hai, Middle-Lower Yangtze Region, Southern China, Northwest China, Southwest China. The results of the above graphic analysis are presented in [Figures 5 and 6](#).

[Figure 5](#) shows provincial rural income and the share of high-value agriculture by agricultural production zone. According to the results of LOWESS graph, major provinces follow a similar trend of a positive relationship between rural income and high-value agricultural share. That is, the higher the share of high-value agriculture, the higher the rural income. Interestingly, their relationship is not linear. In the initial stage of rural transformation, the rise in the share of high-value agriculture is only moderately associated with the rise in rural income. Moreover, the level and speed of rural transformation measured by the share of high-value agriculture differ more largely by agricultural production zones than by province within the same zone.

The strong positive relationship between per capita income and rural non-farm employment is evidenced for all provinces in each region ([Figure 6](#)). As we should have expected, the higher the ratio of non-farm employment, the higher the rural income. Similar to the pattern in share of high-value commodities in agricultural production, the contribution of non-farm employment to rural income increases more with the rise of non-farm employment in the later period. This is due to the rise of wage over time, particularly after the middle 2000s ([Li et al., 2012](#)). Notably, internal variations are also observed in the Northeast region and Southwest region. For example, the rate of non-farm employment in Liaoning is much higher than Jilin and Heilongjiang, but these three provinces have the close level of rural income. The story is similar in Yunnan, compared to Sichuan and Guangxi.

[Figure 7](#) presents provincial rural income and structural transformation. Based on the LOWESS graph, most provinces follow a similar trend whereby the higher the level of ST, the greater the rural income. This relationship is also non-linear. It is interesting to note that structural transformation does not strongly correlate with rural income in the early stage of ST. After reaching a certain level of structural transformation, rural income increases rapidly with the structural transformation, indicating that the employment created with a low level of structural transformation largely benefits urban labor employment. With further urbanization and industrialization, rural labors have obtained increasing opportunities to have non-farm jobs created during structural transformation. While in Heilongjiang, a slight decrease in non-agricultural GDP share from about 85% to 80% has occurred in recent 10 years.

While [Figures 5–7](#) present the relationships between rural income and RT (or ST) at the levels of each indicator, [Figures 8–10](#) analyze the relationships between rural income growth and the speeds of transformations. Rural income growth is measured as the average annual growth rate over the same period; and the speed of RT (or ST) is measured as the average annual percentage point change of RT (or ST) during 1978–2017. The advantage of using rural income growth rate and speeds of rural and structural transformations, compared with an analysis based on the levels of rural income, RT and ST, is that the analysis can reveal the likely relationship between rural income growth and the speed of RT (or ST) based on an inter-provincial comparison for the period studied. The weakness of this approach is that the initial conditions (e.g. the levels of RT, ST and rural income in the first year) are ignored in



Share of high-value agriculture (%)

Note(s): The raw data used to estimate rural income and share of high-value agriculture are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the level of rural income and high-value agricultural share for a province in a year

Figure 5. The LOWESS results of rural income and share of high-value agriculture by province in six regions in 1978-2017

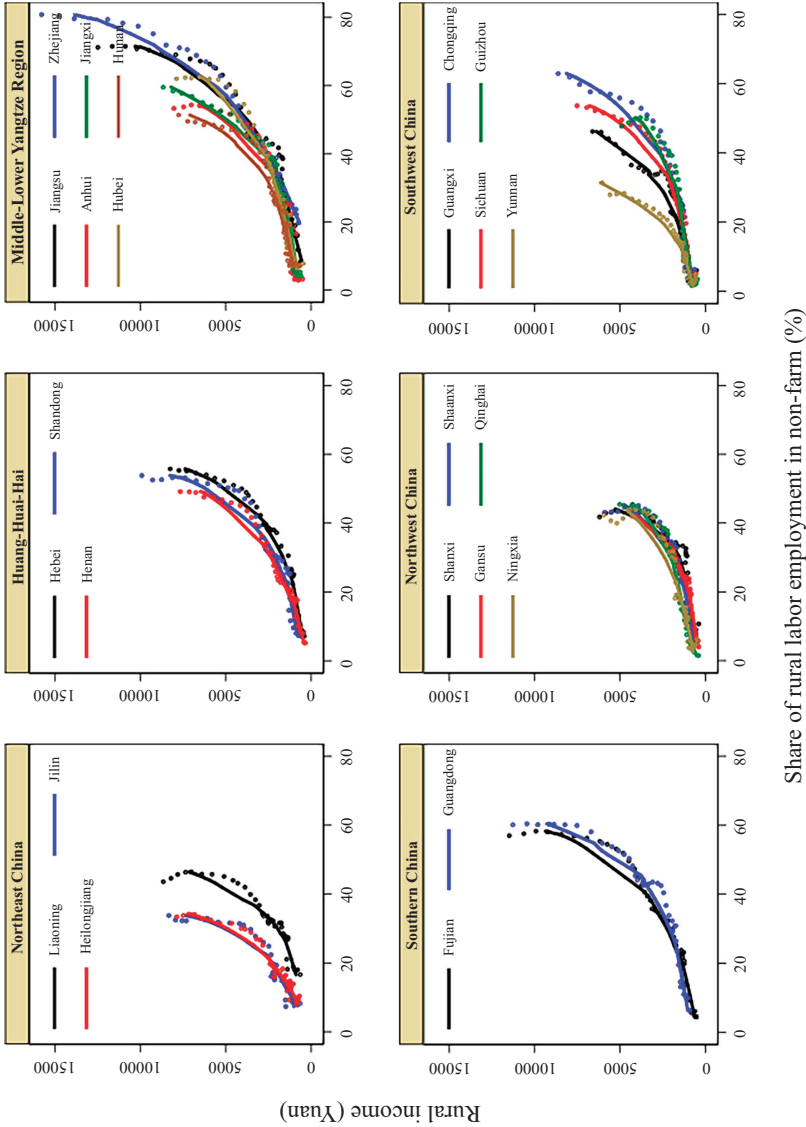
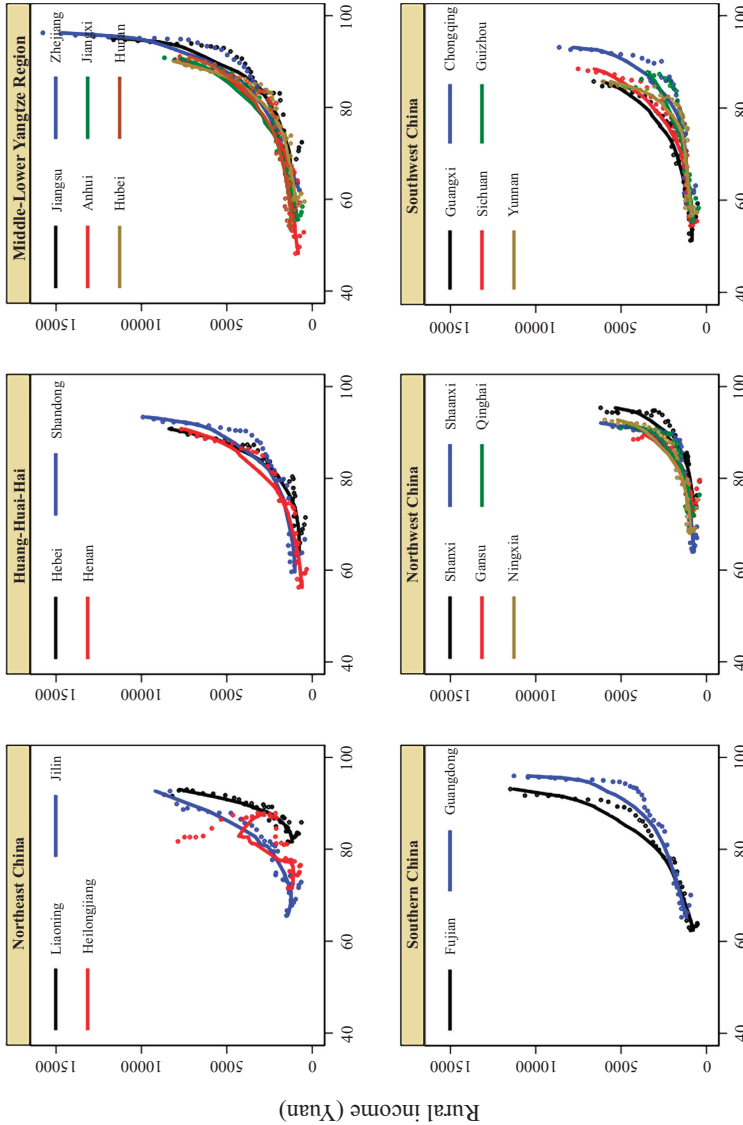


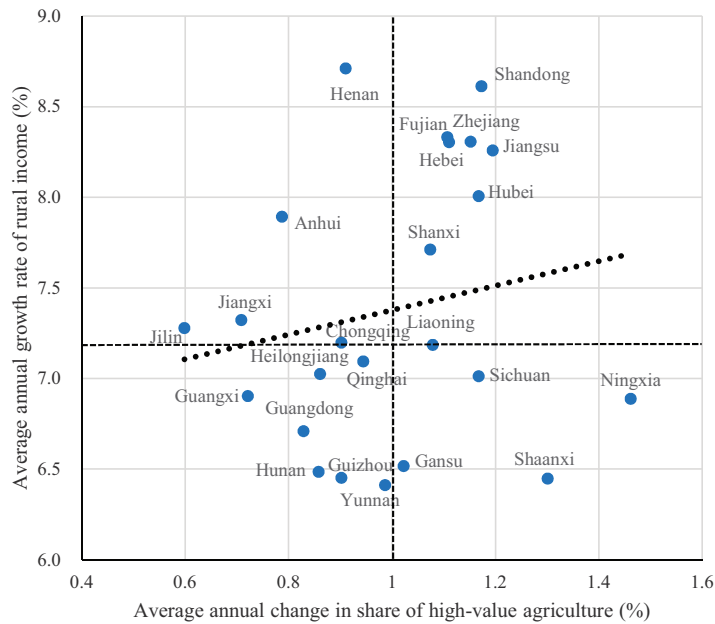
Figure 6.
The LOWESS results of rural income and share of rural labor employment in non-farm by province in six regions in 1978-2017

Note(s): The raw data used to estimate rural income and share of rural labor employment in non-farm are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the level of rural income and rural labor's non-farm employment share for a province in a year



Note(s): The raw data used to estimate rural income and share of non-agricultural GDP are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the level of rural income and non-agricultural GDP share for a province in a year

Figure 7. The LOWESS results of rural income and share of non-agricultural GDP by province in six regions in 1978-2017

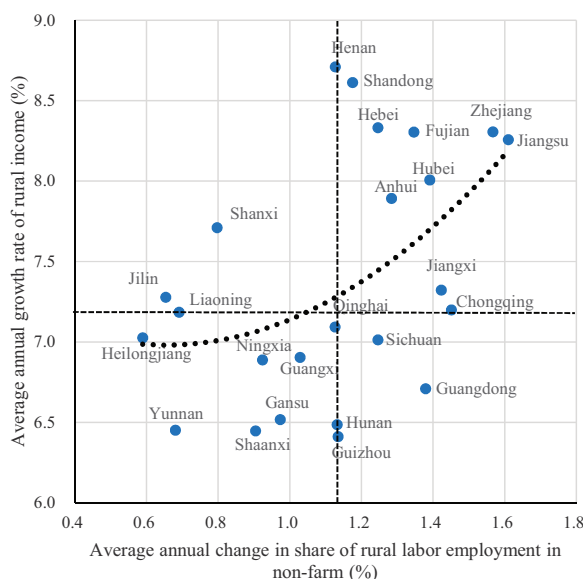


Note(s): The median values of ‘average annual growth rate of rural income’ and ‘average annual change in share of high-value agriculture’ among 24 provinces are 7.19 (indicated by the horizontal dotted line) and 1.00 (indicated by the vertical dotted line), respectively. The raw data used to estimate rural income and share of high-value agriculture are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the speed of rural income growth and high-value agricultural share change for a province during 1978–2017

Figure 8. Average annual growth rate of rural income and average annual change in share of high-value agriculture in 1978–2017

the analysis. For example, the higher level of ST (or RT) in the initial year may have the lower average annual change of ST (or RT) because the maximal number of ST (or RT) is 100%. Similarly, the province with higher level of rural income in the initial year may have lower growth rate of rural income over a long time period (e.g. Guangdong).

Both Figures 8 and 9 show that there is a positive relationship between the speed of rural and structural transformations and rural income growth. For example, the provinces with faster rural transformation in terms of an agriculture shift to high-value commodities normally have a faster rural income growth rate (Figure 8). Most provinces fall into the top-right and bottom-left quadrants, but there are some exceptions. These include Henan and Anhui in the top-left quadrant and Ningxia and Shaanxi in the bottom-right quadrant (Figure 8). Henan and Anhui have a relatively high growth rate of rural income despite the slow shifting of agriculture to high-value commodities, which is possible because they started from very low level of rural income in the initial year (Figure 4). Ningxia, Sichuan and Shaanxi have a relatively fast shifting agriculture to high-value commodities but with the slow rural income growth, which is largely due to the fact that these provinces started with a very low level of high-value agricultural in the initial year (Figure 4) and therefore the relatively faster agricultural transformation during 1978–2017.

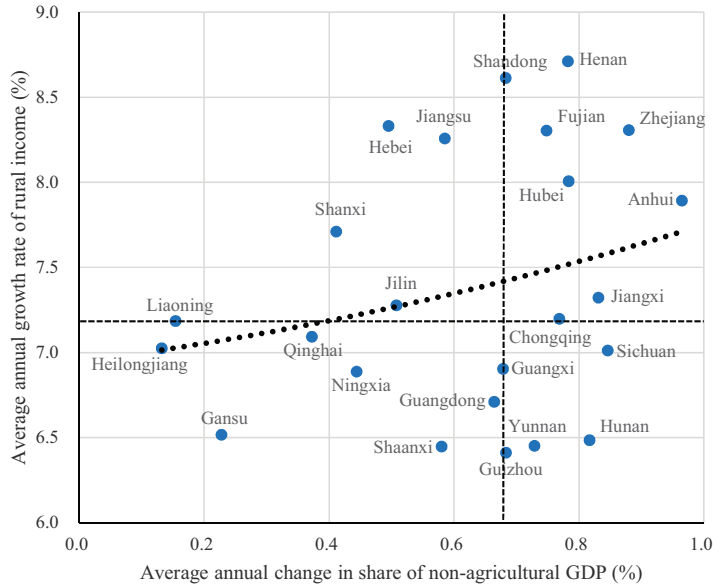


Note(s): The median values of ‘average annual growth rate of rural income’ and ‘average annual change in share of rural labor employment in non-farm’ among 24 provinces are 7.19 (indicated by the horizontal dotted line) and 1.13 (indicated by the vertical dotted line), respectively. The raw data used to estimate rural income and share of rural labor employment in non-farm are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the speed of rural income growth and rural labor’s non-farm employment share change for a province during 1978-2017

Figure 9. Average annual growth rate of rural income and average annual change in share of rural labor employment in non-farm in 1978–2017

In rural transformation shifting rural labor to non-farm employment (Figure 9), the increasing slope of fitting line between the speed of RT and rural income growth suggests that the growth of non-farm employment has played an increasingly important role in raising farmer’s income in rural China in the past four decades. Most provinces fall in the top-right and bottom-left quadrants. Major outliers are Shanxi in the top-left quadrant and Guangdong in the bottom-right quadrant. Shanxi’s rural income growth exceeds the median of all provinces, maybe due to its faster rural transformation in terms of high-value agriculture (Figure 8). Guangdong’s rural transformation started with the highest rural income in 1978, and despite ending with the fourth highest income in 2017 (Figure 4), its rural income growth rate was below the average (Figure 9).

Faster structural transformation in the provincial economy is also generally positively correlated with provincial rural income growth (Figure 10). While most provinces are located in the top-right and bottom-left quadrants, there are also six major exceptions (three each in the top-left and bottom-right quadrants). Most of these exceptions are likely due to ignoring the initial level of ST in this graphic analysis.



Note(s): The median values of ‘average annual growth rate of rural income’ and ‘average annual change in share of non-agricultural GDP’ among 24 provinces are 7.19 (indicated by the horizontal dotted line) and 0.68 (indicated by the vertical dotted line), respectively. The raw data used to estimate rural income and share of non-agricultural GDP are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province. Each dot represents the speed of rural income growth and non-agricultural GDP share change for a province during 1978–2017

Figure 10. Average annual growth rate of rural income and average annual change in share of non-agricultural GDP in 1978–2017

4.2 Typology of rural transformation: based on the graphic analysis

Typological analysis is based on the speeds of ST and RT and the rural income growth rate. With the data on rural and structural transformations presented in Figures 8–10, we divide all provinces into two groups (fast and slow ST and RT). For rural income growth, we divide into three groups (fast, moderate and slow growth rate of rural income). Specifically, for structural transformation, we use the median (0.68%) of average annual percentage point change over all provinces during 1978–2017 as the dividing point to identify the fast and slow ST provinces. Following the same method, the sample provinces are grouped into fast and slow RT provinces with respect to RT1 (average annual change in share of high-value agriculture) and RT2 (average annual change in share of rural labor employment in non-farm). The medians for RT1 and RT 2 are 1.00 and 1.13%, respectively. Finally, according to the ranges of average annual growth rate of rural income, we define the three groups of provinces with fast (a growth rate of more than 8.0%, 7 provinces), moderate (a growth rate between 6.9 and 8.0%, 10 provinces) and slow (a growth rate of less than 6.9%, 7 provinces) growths of rural income. Based on the above criteria, the results of typology analysis for RT1 and RT2 are reported in Tables 3 and 4, respectively.

Tables 3 and 4 reveal several interesting observations on the speeds of RT1/RT2 and ST and rural income growth. First, there is no province that has increased rural income fastly in

		Speed of rural income growth		
		Fast	Moderate	Slow
Fast ST	Fast RT1	Zhejiang Fujian Hubei Shandong	Sichuan	
	Slow RT1	Henan	Chongqing Jiangxi Anhui Guangxi	Guizhou Yunnan Hunan
Slow ST	Fast RT1	Jiangsu Hebei	Shanxi Liaoning	Shaanxi Gansu Ningxia
	Slow RT1		Jilin Heilongjiang Qinghai	Guangdong

Note(s): The raw data used to estimate rural income, share of high-value agriculture and share of non-agricultural GDP are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province

Table 3. Typology of rural transformation based on the speeds of ST and RT1 and rural income growth in 1978–2017

		Speed of rural income growth		
		Fast	Moderate	Slow
Fast ST	Fast RT2	Zhejiang Fujian Hubei Shandong	Sichuan Chongqing Jiangxi Anhui	
	Slow RT2	Henan	Guangxi	Guizhou Yunnan Hunan Guangdong
Slow ST	Fast RT2	Jiangsu Hebei		
	Slow RT2		Shanxi Liaoning Jilin Heilongjiang Qinghai	Shaanxi Gansu Ningxia

Note(s): The raw data used to estimate rural income, share of rural labor employment in non-farm and share of non-agricultural GDP are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province

Table 4. Typology of rural transformation based on the speeds of ST and RT2 and rural income growth in 1978–2017

the absence of both fast ST and fast RT1/RT2 (the bottom left corner is empty in both Tables 3 and 4), and their rural income has grown only either slowly or moderately in the provinces with both slow ST and slow RT1/RT2 (the bottom row, Tables 3 and 4). Second, there is no province that has increased rural income slowly in the present of both fast ST and fast RT (the top right corner is empty); and their rural income has grown either quickly or moderately in the provinces with both fast ST and fast RT1/RT2 (the first row, Tables 3 and 4). Third, the provinces that have gone through one of fast ST and RT have increased rural income either fastly or moderately or slowly.

Based on the results presented in Table 3, we divide all provinces into the following four categories of provincial rural transformation and rural income growth:

Category I: Fast in both ST and RT and fast (Zhejiang, Fujian, Hubei and Shandong) or moderate (Sichuan) rural income growth provinces (the first row, [Table 3](#)). This category has a classic but much more rapid ST and RT than the “classic” transformation experienced by OECD (Organization of Economic Cooperation and Development) countries in the 20th century. Successful RT in these provinces have facilitated ST and vice versa as RT and ST are strongly linked and interacted together. RT and ST also together facilitate rural income growth.

Category II: Slow in both ST and RT and slow (Guangdong) or moderate (Jilin, Heilongjiang and Qinghai) rural income growth provinces (the last row, [Table 3](#)). Both slow ST and slow RT contribute to slow or only moderate rural income growth.

Category III: Fast in ST but slow in RT and moderate (Chongqing, Jiangxi, Anhui and Guangxi) or slow (Guizhou, Yunnan and Hunan) rural income growth provinces (the second row, [Table 3](#)). Henan is an exception, as we noted early, the higher growth of rural income in Henan is largely due to the initial low income, the lowest among all 24 provinces in 1978.

Category IV: Slow in ST but fast in RT and nearly equal probability fall in fast (Jiangsu and Hebei), moderate (Shanxi and Liaoning) and slow (Shaanxi, Gansu and Ningxia) rural income growth provinces (the third row, [Table 3](#)).

While the major observations from the results of typology analysis based on the speed of RT1 ([Table 3](#)) and the speed of RT2 ([Table 4](#)) are similar as discussed above, there are differences in speed of rural transformation between RT1 ([Table 3](#)) and RT2 ([Table 4](#)) among provinces. For example, 8 of 24 provinces are fast in RT1 but become slow in RT2, and rural income growth of these 8 provinces is either moderate or slow one. By comparing the results of [Tables 3](#) and [4](#), the other interesting finding is that fast (or slow) RT2 is often associated with fast (or slow) ST. Among 24 provinces, 8 provinces each fall in the first and last row, and only 8 provinces can be found in the second and third rows in [Table 4](#). This pattern of non-farm employment transformation indicates that ST and RT2 often go together. This is what we should expect, because fast structure transformation can significantly create more non-farm employment opportunity for rural labors (RT2).

To have an overall typology of RT, ST and rural income that integrates the results based on [Tables 3](#) and [4](#), we use the following measures to generate an aggregate RT index. First, we normalize each of RT1 and RT2 indicators by $(RT_{it} - RT_{\min}) / (RT_{\max} - RT_{\min})$; where i is province, t is year, RT_{\min} and RT_{\max} are the minimal and maximal value of RT1 (or RT2), respectively, during 1978–2017. Then we assign an equal weight (0.5) to RT1 and RT2 with assumption of equal importance of RT1 and RT2 on rural income growth. Finally, we estimate the aggregate RT index based on the normalized RT1 and RT2 and the weights assigned. The estimated average annual change of aggregate RT index for all provinces ranged from 0.79 to 1.77 in 1978–2017, with a median value of 1.34 that is used to divide the provinces into fast and slow RT. However, there are two provinces (Guizhou and Jiangxi) with equal aggregate RT index (1.34) where the distance from this value to the next higher value is significant. Therefore, we consider both Guizhou and Jiangxi as slow RT provinces. It is worth noting that changing the weights of RT1:RT2 from 0.5:0.5 to 0.4:0.6 or 0.6:0.4 does not change the results of analysis on the typology based on the aggregate RT index.

The results on the typology of ST, RT and rural income growth based on the aggregate RT index are presented in [Table 5](#). Similar to the results in [Tables 3](#) and [4](#), [Table 5](#) also shows several interesting observations on the speeds of RT and ST and rural income growth. For example, no province has experienced slow rural income growth when both fast ST and fast RT are occurred (the top right corner is empty in [Table 5](#)); and no province

		Speed of rural income growth		
		Fast	Moderate	Slow
Fast ST	Fast RT	Zhejiang Fujian Hubei Shandong	Sichuan Chongqing	
	Slow RT	Henan	Jiangxi Anhui Guangxi	Guizhou Yunnan Hunan
Slow ST	Fast RT	Jiangsu Hebei		Shaanxi Ningxia Guangdong
	Slow RT		Shanxi Liaoning Jilin Heilongjiang Qinghai	Gansu

Table 5. Typology of rural transformation based on the speeds of ST and RT and rural income growth in 1978–2017

Note(s): The raw data used to estimate rural income, share of high-value agriculture, share of rural labor employment in non-farm and share of non-agricultural GDP are from the Statistical Yearbook (various years) published by the provincial Statistical Bureau of each province

has recorded fast rural income growth if both ST and RT are slow (the bottom left corner is empty, Table 5). The provinces which were fast in either ST or RT, but not both, show large variation in rural income growth, either fast or moderate or slow (the second and third rows, Table 5).

According to the results shown in Table 5, 24 provinces studied in this paper are classified into the following four categories of rural transformation and rural income growth:

Category I: The provinces with fast in both ST and RT and also fast (Zhejiang, Fujian, Hubei and Shandong) or moderate (Sichuan and Chongqing) in rural income growth (the first row, Table 5). RT and ST are positively linked and interacted together, which together foster rural income growth.

Category II: The provinces with slow in both ST and RT and also slow (Gansu) or moderate (Shanxi, Liaoning, Jilin, Heilongjiang and Qinghai) in rural income growth (the last row, Table 5). Both slow ST and RT result in either slow or only moderate rural income growth in these provinces.

Category III: The provinces with fast ST but slow RT and only moderate (Jiangxi, Anhui and Guangxi) or slow (Guizhou, Yunnan and Hunan) rural income growth (the second row, Table 5). Again, Henan is an exception.

Category IV: The provinces with low ST but fast RT and also fast (Jiangsu and Hebei) or slow (Shaanxi, Ningxia and Guangdong) rural income growth (the third row, Table 5). For Jiangsu and Hebei provinces, the faster rural transformation may have more effects on rural income growth than the lower growth of rural income due to slower structural change, while for Shaanxi and Ningxia, despite relatively faster rural transformation, slow structural transformation was found to be significantly associated with lower rural income growth. Guangdong fell in this category because the province started with a very high level of ST and the highest rural income among 24 provinces. Both the average annual ST change in the percentage point and average annual rural income growth became relatively low.

Major provinces have realized a faster pace of income growth with the higher speed of transformation (both structurally and rurally), which is consistent to the findings advanced by IFAD (2016) and Huang (2018). For some exceptions, we will provide some discussion about the reasons (e.g. initial conditions, institutions, policies and investments) for differences.

Starting with the category of low ST and fast ST, the slow ST group contains provinces in northeast region (Liaoning, Heilongjiang and Jilin), the provinces in northwest region (Gansu, Shanxi, Qinghai and Ningxia) and some of eastern coastal provinces (Jiangsu, Hebei, Guangdong and Guangxi). Especially for those samples with higher ST in 1978 in northeast and northwest of China, such an economic structure is closely related to the national heavy-industry-oriented development strategy after the founding of New China. The initial ST in Jiangsu, Hebei and Guangdong is 72.4%, 71.5% and 70.1%, respectively, almost 10 percentage point higher than that of Zhejiang, Fujian and Hubei.

With a closer look at the slow ST group, we find that significant differences in economic structure may affect rural transformation. Even though Shaanxi, Gansu, Ningxia and Guangdong were originally characterized by a similar higher level of ST (as mentioned above), the non-agricultural economy in Guangdong has been more labor intensive since 1978, and can absorb a mass of rural labor force inside and outside of the province. By contrast, capital intensive industries in Northwest China (mainly Shaanxi, Gansu, Ningxia) have limited ability to provide job opportunities for local peasants. Consequently, Northwestern provinces belong to the slow RT group based on the average annual change in share of rural labor employment in non-farm.

Also, in the slow ST group, the pathway of rural transformation is diversified because of arable land endowments. Taking the provinces in northeast China as an example, Heilongjiang and Jilin have a slower pace in the adjustment of agricultural production (the shift from grain to high-value crops) and migration with comparison to Liaoning, but these two provinces are faster in rising agricultural labor productivity. It is not hard to explain that per capita arable land in Heilongjiang and Jilin is almost three and two times of that in Liaoning (0.7 hector in 2017). Meanwhile, peasants are more likely to purchase agricultural machinery or mechanization services to replace labor input.

5. Major institutions, policies and investments affecting rural transformation

Many factors may have contributed to China's rural transformation. Empirical studies have shown that institutional innovations, policy supports and investments (IPIs) are the important drivers of agricultural growth (for the reviews of literature, see Huang, 2018; Huang and Rozelle, 2018). Based on the previous studies by Huang (2018 and 2020), this section briefly discusses the likely impacts of the major IPIs on rural transformation and raising rural income. More rigorously empirical analyses need to be conducted in the future.

5.1 Institutional innovations

Institutional reform has been one of the mainstreams of the 40 years of rural reform in China. China's first rural reform, the household responsibility system (HRS), was implemented during 1978–1984. The effects of HRS on agricultural productivity have been well documented in the literature (McMillan *et al.*, 1989; Fan, 1991; Lin, 1992; Huang and Rozelle, 1996). Rising agricultural productivity due to HRS has further facilitated rural transformation from grain dominated agriculture to more diversified agriculture because farmers were able to shift their land and labor from grain to cash crop and animal production. Over time, several institutional reforms on factor markets have been implemented that have helped rural transformation from Stage I to Stage IV (Table 6). These included: the reforming of institutions governing agricultural input and output markets during Stage II; the

Table 6.
Pathway and major
IPs by stage of rural
transformation

Stage	Path of transformation	Additional IPs in each stage and sequence
I	Primary on staple food production	Institutions (e.g. land), technology & extension, and irrigation
II	Agricultural diversification and rising high-value agriculture	Plus: Institutions and policies on market reform, and investment in R&D and technology, irrigation and road infrastructure
III	Agricultural specialization and rising high-value agriculture and non-farm employment	Plus: Institutions and policies to support Township and Village Enterprises, and policies and investments on labor intensive industrialization in the urban economy
	III-a: Farming and part time non-farm employment	Plus: Institutions for facilitating labor and land rental market development; more R&D investment
	III-b: Increasing specialization on either farming or non-farm employment	Plus: Institutions and policies to support mechanization and land consolidation, labor mobility and urbanization; new technology
	III-c: Rapid mechanization and more non-farm employment	Plus: Institutions and policies to eliminate urban-rural division; policy support for and investment in sustainable agriculture; Rural Revitalization Development Strategy
IV	High-value and sustainable agriculture and integrated urban-rural development	

Source(s): A summary based on [Huang \(2018 and 2020\)](#)

institutional reforms to support Township and Village Enterprises development during State III-a; the institutions and laws to promote farmer professional cooperatives ([Deng et al., 2010](#)) and the institutions to facilitate labor and land rental market development after RT moving to Stage III-b ([Gao et al., 2012](#); [Deiningger et al., 2014](#)) and the institutional innovation on farm mechanization custom services ([Yang et al., 2013](#); [Huang and Ding, 2016](#)) since RT reaching Stage III-c ([Table 6](#)).

5.2 Policy supports: agricultural technology and extension

China has a strong agricultural science & technology (S&T) innovation system. China's agricultural research and development (R&D) system is the largest in terms of staff in the world and covers nearly every discipline in agriculture and related fields ([Huang, 2013](#)). China has also developed the largest agricultural extension system in the world with about 700 thousand staff members in recent years ([Babu et al., 2015](#)). The previous studies have shown that S&T innovation is a primary source of agricultural productivity growth in the long run and has facilitated China's agricultural transformation over the past several decades ([Fan, 1991](#); [Jin et al., 2010](#)). Investments in agricultural R&D and extension have been rising significantly after China's move into Stage III-b ([Table 6](#)).

5.3 Policies to reform agricultural market

Market reform is the other mainstream of China's reform. China adopted a gradual approach to reform its agricultural markets. This gradual reform has facilitated China's smooth transformation from the previous planned economy to the market-oriented economy and helped farmers to diversify their farming activities from grain production to the production of vegetables, fruits, livestock and fishery since Stage II of RT ([Table 6](#)). Farmers have gained from increased allocative efficiency based on market price and raised their income. In international trade, the liberalization in agriculture started in the early 1990s. China also made significant commitments to liberalize its agricultural market ([Anderson et al., 2004](#)). With trade liberalization, the export of labor-intensive products (e.g. horticulture and livestock) and the import of land-intensive commodities (e.g. soybeans, cotton, edible oil and sugar) have been rising, which have stimulated structural change in agricultural production.

5.4 Investing in agriculture

Investing in agriculture sets a fundamental base for the steady growth of China's agriculture and rural transformation. Some of the most significant investments have been in irrigation since the 1950s, and land improvement and agricultural technology, which have raised agricultural productivity and facilitated rural transformation to more high-value agricultural production. The latter also helps farmers to release more of the labor force for non-farm employment. Moreover, massive investment into rural road and agricultural wholesale markets foster market integration and links hundreds of millions of small farms with retailers and consumers.

6. Concluding remarks

China has experienced significant rural and structural transformations, but the speeds of both RT and ST vary among provinces in the past four decades of reforms. Rural transformation has occurred in both agricultural structural change and the movement of rural labor from farm to non-farm employment. Agricultural structural change is featured by shifting of agriculture from low-value commodities to high-value ones such as vegetables, fruits, livestock and aquatic commodities. Over the same period, despite of rapid growth of agriculture, agricultural shares in both GDP and employment have been falling in all provinces. This study shows that there is strong evidence of the converging labor productivity between agriculture and non-agriculture during the structural transformation, particularly since the early 2000s, but the speeds of structural transformation and the convergent labor productivity differ largely among provinces.

Rural and structural transformations have been accompanied with significant rural per capita income growth in every province, but again, growth in rural income also varies among provinces. Our analyses show that there is a positive correlation between the level of RT(or ST) and rural income. Nearly all the provinces follow the similar trend, the higher the level of RT (or ST), the higher the rural per capita income. Moreover, the above positive relationships are not linear. Rural per capita income increases more in the later stages of both RT and ST.

There is also evidence of a positive relationship between the speed of RT(or ST) and rural per capita income growth. The typological analysis provides the insights on categories of provincial rural and structural transformations and rural per capita income growth during the period of 1978 and 2017. Within that period, we find no province can achieve fast (or slow) growth of rural per capita income in absent from both fast (or slow) RT and ST; and no province can have fast (or slow) growth of rural per capita income in the presence of slow (or fast) RT and ST. Therefore, fostering RT and ST may have contributed to rapid rural income growth.

This study has several policy implications for rural development and raising rural per capita income. In general, government should accelerate rural transformation by moving agriculture from low-value to high-value commodities and shifting rural labor from farm to non-farm employment, particularly for those provinces that fell behind in rural transformation in the past. The previous studies have shown that appropriate institutional innovations, policy supports and investments can improve agricultural productivity and therefore speed up rural transformation from the lower stage to the higher stage and raise rural income. Meantime, to raise rural income, structural transformation is also critically important. By 2019, more than 288 million rural labor had non-farm employment for more than 6 months, of which 40% worked locally and 60% were migrants (NBSC, 2020). However, as our paper shows, the percentage of rural labors shifting from farm to non-farm employment differs largely among provinces. Urbanization, industrialization in both urban and rural areas and reforming *Hukou* registration institution are essential for creating more jobs for rural labors.

Provinces in each category of rural and structural transformations and rural income should be aware of where they are (at which stage of rural transformation) and what are the appropriate institutions, policies and investments are needed to accelerate faster rural and

structural transformations. The provinces that fell into Category I should continue to facilitate their faster rural and structural transformations. In those provinces with only moderate rural income growth (e.g. Sichuan and Chongqing, Jiangxi and Anhui) in Category I (fast in both RT and ST), more efforts may be needed to make RT and ST more effectively in raising rural income. Accelerating rural and structural transformations is the most important for the provinces belonging to Category IV (slow in both RT and ST). The priority of these provinces should be to speed up both rural transformation through the appropriate IPIs presented in Table 6 and structural transformation through more rapid urbanization and industrialization. For the provinces that fell into Categories II and III (with one fast and one slow in RT or ST), their development priorities depend on whether rural transformation or structural transformation has been left behind in comparing to the provinces of Category I, and the corresponding IPIs should be identified and implemented to facilitate either rural transformation or structural transformation for raise farmer's income.

Finally, the major research issues examined in this paper are the relationships between rural and structural transformations and rural per capital income at the provincial level. Further analysis should be conducted at more disaggregate (e.g. prefecture, county and household) levels. We also understand that both RT and ST are endogenous to rural income. To what extent either RT or ST has actually affected rural income is an important issue that needs further study. In addition, whether RT and ST have resulted in equitable livelihood rather than just raising average rural income is the other important research and policy issue that needs rigorous analysis in the future.

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