Urbanization's effects on the urban-rural income gap in China: A meta-regression analysis

Yuan Yuan^a, Mingshu Wang^{b,*}, Yi Zhu^a, Xianjin Huang^{a,*}, Xuefeng Xiong^c

^a School of Geography and Ocean Science, Nanjing University, P.O. Box 210023, No. 163 Xianlin Avenue, Qixia District, Nanjing, Jiangsu Province, PR China

^b Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, P.O. Box 217, 7500 AE, Enschede, the Netherlands

^c School of Economics, Renmin University of China, P.O. Box 100872, No. 59 Zhongguancun Street, Haidian District, Beijing, PR China

ARTICLE INFO

Keywords:

Urbanization

Urban-rural income gap

China

Meta-regression analysis

ABSTRACT

The considerable gap between urban and rural areas in China has been one of those social problems during the urbanization process. Since the early 2000s, an increasing number of theoretical and empirical studies have discussed the association between urbanization and urban-rural income gap (URIG) in China. However, a very limited consensus has been reached so far, which makes it challenging to support formulating well-informed policies. To identify factors contributing to different conclusions of the effects of urbanization on URIG in China, we conducted a systematic literature review of 29 empirical studies and stepwise meta-regression analysis from 94 direct effect-size estimates. Our findings reveal that while urbanization is associated with larger URIG when URIG is measured via urban-rural income/consumption, urbanization is associated with smaller URIG when URIG is measured with inequality index (e.g., Theil index and/or Gini coefficient). Additionally, financial development is correlated with larger URIG. By contrast, human capital level, agricultural support policy, and farmland scale contribute to narrowing URIG. Finally, we did not find a significant publication bias from the primary studies. This work suggests that it is worth to conduct more in-depth analysis to examine the heterogeneous effects of different indicators of URIG and their associations with other potential driving factors. Future work is suggested to investigate the effects of financial development level, human capital level, agricultural support policy, farmland scale, and urban land scale on the relationship between urbanization and URIG. In the urbanization process, policymakers need to pay attention to the practice of remedying income-based urban-rural inequality.

1. Introduction

Urban expansion in the developing world has been dramatic (Jedwab et al., 2017). From 1950 to 2018, urban population in less developed regions has increased more than tenfold, from approximately 0.3 billion to 3.23 billion; the proportion of urban population has been more than doubled, from 18 % to 51 % (United Nations, 2019). Developing countries commonly face the problem of a large urban-rural divide during the urbanization process, which has been recognized as one of those major differences between developing countries and developed ones (Fields, 1974; Sahn and Stifel, 2004). The urban-rural income gap (URIG) is defined as the gap between urban and rural household incomes, which is frequently used as an important economic indicator delineating urban-rural divide in many studies, such as Selden (1988); Carter (1997), and Tian (2001).

China has already experienced several periods of economic development and reform (Yang and Cai, 2000). In China, there remains substantially higher productivity in urban industries than in the rural sectors, confirming an important sectoral division between rural and urban economies (Yang and Zhou, 2007). China's URIG is large by international standards and has increased over time (Sicular et al., 2007; Chen and Lin, 2014; Wang et al., 2019a). As urbanization rate (i.e., urban residents' share of the total population) proliferates, China's urban-rural residents' income ratio surged from 2.57 in 1978, at the beginning of the reform and opening up, to a peak of 3.33 in 2009 (Fig. 1). Although it has been declining since then, the overall trend is fluctuating and continues to be higher than its initial stage of the reform and opening up. This may cause serious social consequences for Chinese economy during rapid urbanization period (Yu et al., 2014; Tian, 2001). Therefore, understanding drivers of URIG has significant

* Corresponding authors.

E-mail addresses: oliviayuan0630@163.com (Y. Yuan), mingshu.wang@utwente.nl (M. Wang), zy_julie@yeah.net (Y. Zhu), hj369@nju.edu.cn (X. Huang), xxfruc@163.com (X. Xiong).

<https://doi.org/10.1016/j.landusepol.2020.104995>

Received 30 October 2019; Received in revised form 10 July 2020; Accepted 6 August 2020

0264-8377/ © 2020 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Fig. 1. The increasing urbanization rate (right axis) and fluctuating urban-rural income gap (URIG) in China, calculated by authors based on China Statistical Yearbooks. The URIG is the ratio of the average per capita annual income between urban and rural residents (left axis) in nominal terms.

implications for research and policy. Furthermore, an analysis of URIG in the context of China could be potentially helpful for other developing countries around the world.

Since 2004, there has been an increasing number of empirical studies on the association between urbanization and URIG in China. However, empirical results were oftentimes contradicting, and there has been no consensus regarding those driving factors yet. On the one hand, urbanization may be helpful to narrow URIG because the decrease of agricultural share and the expected income gap between urban and rural areas help to transfer the labor force from agricultural to non-agricultural industries. If the surplus rural labor force can be substantially included, the average income of the urban labor force will decrease due to a more competitive labor market. Therefore, the income level of the rural labor force will increase due to the decline of the rural surplus labor force and enhanced overall productivity. Consequently, the URIG will be narrowed, and the living standard of urban and rural residents will tend to be equal (Stark, 1988). Such an argument is already supported by some empirical studies (Chen and Jiang, 2014; Yang et al., 2013).

On the other hand, studies have revealed that the discriminatory institutional arrangements during the process of urbanization contribute to enlarging the URIG in China. These institutions have hindered the development of the labor market, for example, the household registration system has separated population and labor between rural and urban areas; the social security system has excluded rural residents from its welfare policy (Cai, 2007). The widening URIG is also considered to be caused by the urban-biased development policy, which extracts more than it invests in rural areas (Carter, 1997; Tian, 2001).

Despite some reviews summarizing the driving factors enlarging URIG in China (e.g., Cheung, 2012; Wang et al., 2013; Cai et al., 2019), there is a lack of comprehensive review of the relationship between urbanization and URIG. Importantly, substantial heterogeneity amongst empirical works makes it difficult to formulate appropriate policy recommendations. For example, empirical studies have adopted different data sources, indicators of urbanization and URIG, control variables, estimation methods, temporal span, etc. Against this backdrop, it is necessary to synthesize existing evidence. Meta-regression analysis (MRA) is explicitly designed to integrate econometric estimates and provide objective and comprehensive summaries of econometric findings (Stanley and Jarrell, 2005). To the best of our knowledge, this work is the first attempt to use meta-analysis in understanding the relationship between urbanization and URIG in China. Specifically, this paper employed MRA to identify the sources and levels of heterogeneity in empirical studies on the association between urbanization and URIG in China.

The rest of this paper is structured as follows. Section 2 presents a brief overview of the MRA method along with the estimation strategies and the procedure of literature selection. The findings of MRA are presented in Section 3. Then, the implications of the findings for further research are discussed in Section 4. Finally, Section 5 concludes this paper.

2. Meta-regression Analysis (MRA) method

Meta-analysis is a series of systematic methods for integrating quantitative research (Sterne, 2009). MRA is one of the meta-analysis approaches that is used to integrate econometric estimates, and it can provide an objective and comprehensive summary of quantitative research. To avoid potential “abuse” of the MRA in economics (Nelson and Kennedy, 2009) and ensure the objectivity of the MRA results, we followed the widely recognized reporting guidelines for MRA in economics proposed by Stanley et al. (2013). The workflow of the MRA (Fig. 2) included three steps: (i) selection and review of the primary studies, (ii) integration of the meta-dataset that connects measures of study heterogeneity sources to the meta-regression model, and (iii) analysis of variables with significant effects.

2.1. Literature search and review

A concrete definition of urbanization is needed before the literature search. In this study, we have adopted a principal-agent definition of urbanization suggested by OECD:

“urbanization means an increase in the proportion of the population living in urban areas; the process by which a large number of people become permanently concentrated in relatively small areas, forming cities” (OECD, 2008).

By focusing on the dimension of population, studies without such are excluded in this meta analysis. By using this principal-agent definition of urbanization, we finally excluded 3.8 % of articles.

Literature published both in Chinese and English were searched from five academic research databases. We used the keywords “城市化” or “城镇化” (urbanization), “城乡收入差距” (urban-rural income gap), and “中国” (China) for Chinese literature via the database of China National Knowledge Infrastructure (CNKI), which is the most resourceful and authoritative academic sharing platform in China. Additionally, we used Baidu Scholar as a supplementary source for Chinese literature. For English literature, “urbanization”, “urban-rural income gap/disparity,” and “China” were used as keywords to search the databases of JSTOR, Taylor & Francis, and Web of Science.

Fig. 2. The workflow of the Meta-regression Analysis (MRA).

Given that the number of empirical studies on the association between urbanization and URIG in China began to increase since 2000, the publication date of journal articles, working papers, book chapters, and thesis with empirical analysis was set between 2000 and 2019.

We screened the title and abstract of 511 studies on urbanization and URIG in China. Then we examined full texts of these studies to exclude:

- 1) studies without estimates of direct effect-size;
- 2) empirical studies without statistical indicators (t-statistics or standard errors) necessary for the calculation of partial correlation coefficients (PCCs);
- 3) studies using measures for urbanization such as industrial structure and urban land scale instead of the population;
- 4) studies using regional instead of nationwide datasets.

The criteria left us with 29 studies (see the full list in Appendix A) and 94 estimates for the following MRA. Among these 29 studies, four are degree theses, and 25 are journal articles. Only two studies were published in English, and the rest were in Chinese¹.

2.2. Estimators and modeling

Partial correlation coefficients (PCCs) are used widely in MRA (Churchill et al., 2017). In this study, they were calculated to measure the association between urbanization and URIG in China. PCCs are independent of the metrics with which the independent and dependent variables are measured. Therefore, PCCs allow those effect-size estimates reported in primary studies to be comparable. The PCC(r_i) of each selected effect-size estimate can be calculated via Eq. 1:

¹ One possible reason for the low proportion of English literature is that researchers who conduct empirical studies on this issue are mostly Chinese. In fact, the (first) authors of the two English articles included in this study are also Chinese researchers. These studies were mainly published in Chinese journals in the 2000s. Since 2010, there has been a growing number of English publications, but the total number is still very small.

$$r_i = \frac{t_i}{\sqrt{t_i^2 + df_i}} \quad (1)$$

Where t_i and df_i , respectively, are the test statistics and degrees of freedom reported by primary studies. The standard error (se_{ri}) of the PCC(r_i), as specified in Eq. 1, represents variations due to sampling error (Eq. 2).

$$se_{ri} = \sqrt{\frac{1 - r_i^2}{df_i}} \quad (2)$$

One study may report multiple effect-size estimates; therefore, fixed-effect weighted means ($\bar{X}_{FEW}$) of PCCs is calculated (Eq. 3):

$$\bar{X}_{FEW} = \frac{\sum r_i (1/se_{ri})}{\sum (1/se_{ri})} \quad (3)$$

Where $(1/se_{ri})$ represents the precision of each estimate, which can be used as a weight to calculate fixed-effect weighted means at study level (Ugur, 2014). Consequently, a higher weight will be assigned to more precise estimates, which will also reduce the within study variations. Appendix B summarizes those fixed-effect weighted means of PCCs in this study.

If primary studies suffer from publication bias (i.e., significant results are more likely to be published), fixed-effect weighted means calculated in Eq. 3 are no longer robust measures. Therefore, we apply the funnel plot and the jointed estimations of the precision-effect test (PET), funnel asymmetry test (FAT), and precision-effect estimation with standard errors (PEESE) to test if publication bias is a significant issue regarding the included primary studies.

The funnel plot is the most commonly used method to visually examine if publication bias exists (Sutton et al., 2000), which is a scatter plot of estimated effect (such as PCCs) against their precision $(1/se_{ri})$. PET-FAT (Eq. 4) is used to test if there is a significant publication bias issue (Doucouliagos and Stanley, 2009, 2013):

$$t_i = \alpha_0 + \beta_0 (1/se_{ri}) + \varepsilon_i \quad (4)$$

Where t_i and se_{ri} are the t -value and standard error of PCCs specified in Eq. 1 and Eq. 2; ε_i is the error term. In the PET-FAT test, while FAT tests if $\alpha_0 = 0$, PET tests if $\beta_0 = 0$. The existence of publication bias can be

Table 1
A summary of variables in the MMR.

Variable types	Name of variable	Definition
Dependent variable	t-value	t-statistics reported by reviewed articles
Urbanization indicators	Resident	Take value 1 if the population of registered urban residents was used to represent urban population, otherwise 0
	Working	Take value 1 if the working population was used to represent urban population, otherwise 0
URIG indicators	Ratio	Take value 1 if the urban-rural income/consumption ratio was used to represent URIG, otherwise 0
	Inequality indices	Take value 1 if the inequality index was used to represent URIG, otherwise 0
Control variables	Industry	Take value 1 if the effect of industrial structure on URIG was estimated, otherwise 0
	Urban land	Take value 1 if the effect of urban land scale on URIG was estimated, otherwise 0
	Farmland	Take value 1 if the effect of farmland scale on URIG was estimated, otherwise 0
	Economy	Take value 1 if the effect of economic development level on URIG was estimated, otherwise 0
	Investment	Take value 1 if the effect of investment in urban fixed assets on URIG was estimated, otherwise 0
	Fiscal expenditure level	Take value 1 if the effect of fiscal expenditure level on URIG was estimated, otherwise 0
	Agricultural support	Take value 1 if the effect of agricultural support policy on URIG was estimated, otherwise 0
	Openness	Take value 1 if the effect of openness to trade on URIG was estimated, otherwise 0
	Financial	Take value 1 if the effect of financial development level on URIG was estimated, otherwise 0
	Market	Take value 1 if the effect of marketization degree on URIG was estimated, otherwise 0
	Human	Take value 1 if the effect of human capital level on URIG was estimated, otherwise 0
	Spatial	Take value 1 if spatial econometric estimation was used, otherwise 0
	OLS	Take value 1 if OLS estimation was used, otherwise 0
Estimation methods	2SLS	Take value 1 if 2SLS estimation was used, otherwise 0
	3SLS	Take value 1 if 3SLS estimation was used, otherwise 0
	GMM	Take value 1 if GMM estimation was used, otherwise 0
Data characteristics	Starting	Starting year of data
	Ending	Ending year of data
Publication information	Publication date	Publication date (year)

confirmed if it is statistically significant that $\alpha_0 \neq 0$ (Stanley, 2008). β_0 is the coefficient of precision, indicating the overall effect for a specific research (i.e., urbanization's effect on URIG in this study). A significant PET result indicates that there is a non-linear relationship between the reported effect-size estimates and their standard errors. Therefore, a precision-effect estimation with standard errors (PEESE) proposed by Stanley and Doucouliagos (2012) should be used to obtain a corrected estimate of β_0 . Eq. 5 presents the estimation model of PEESE,

$$t_i = \alpha_0 se_{ri} + \beta_0 (1/se_{ri}) + \varepsilon_i \quad (5)$$

Furthermore, the multivariate meta-regression (MMR) model enables us to identify heterogeneity sources and the exact effect of each variable contributing to the variation in results of empirical studies (Churchill et al., 2017), which can be estimated in Eq. 6:

$$t_i = \alpha_0 + \beta_0 (1/se_{ri}) + \sum \beta_j Z_{ji}/se_{ri} + \varepsilon_i \quad (6)$$

Where Z_{ji} is a vector of covariates which may account for variation in the evidence base and be considered as potential sources of heterogeneity; ε_i is the error term.

We applied stepwise regression as the modeling approach. The PET-FAT, PEESE, and MMR models will be estimated based on the ordinary least squares (OLS). Primary studies regarding one topic usually applied data from the same or similar sources, for which the estimated magnitude of the effect may not be independent (Gerrish and Watkins, 2018). Therefore, we report the heteroskedasticity-robust standard error to partly mitigate such a potential issue (Ugur, 2014).

2.3. Variables of multivariate meta-regression (MMR) model

In total, 23 independent variables were included by the MMR model (Eq. 6) to test their effects with t-statistics of 94 effect-size estimates reported by primary studies (Table 1). The dependent variable is the t-statistics reported by reviewed articles.

Different methods are used to construct indicators of urbanization and URIG in reviewed articles. There are two primary methods for constructing urbanization indicators: 1) urbanization based on the ratio

between the registered urban population who have urban *hukou*² and the total population; 2) urbanization based on the ratio between the working population in the secondary and tertiary sectors and the total population. There are also two types of URIG indicators adopted by primary studies, namely urban-rural income/consumption ratio (referring to the ratio of per capita income between urban and rural areas and/or the ratio of per capita consumption between urban and rural areas) and inequality index (e.g., Theil index and Gini coefficient).

Urbanization is a comprehensive process, including the transfer of industrial structure from agriculture to the secondary and tertiary sectors, urban expansion, and economic development. Therefore, reviewed articles often include different control variables, such as industrial structure, urban land scale, farmland scale, economic development level, investment in urban fixed assets, fiscal expenditure level, agricultural support policy, openness to trade, financial development level, marketization degree, and human capital level. Additionally, variations in estimation methods, data characteristics, and publication information may also lead to systematically different effect-size estimates. Therefore, we included those as control variables in the MMR model.

3. Results

3.1. Characteristics of the evidence base

An overview of the reviewed articles included in the meta-analysis are presented in Fig. 3 and Appendix B. One prominent finding is that 63 % of studies indicate a negative relationship between urbanization and URIG. In other words, a higher level of urbanization is conducive to reducing the URIG in China. Regarding indicators of urbanization and URIG, the hukou urban population and urban-rural income/consumption ratio were used more frequently. About 79 % of articles used urban

² *Hukou* is the household registration system in China. Urban residents with urban *hukou* have the right to access public welfare provided through employment in state-owned enterprises, while rural residents only have the right of land usage and a share in the collective village economy for a minimum subsistence.

Fig. 3. Descriptive statistics of articles reviewed in this article.

Notes: Working = Working population; Resident = Urban hukou population; SLS = Two or Three-Stage Least Squares; GMM = Generalized Method of Moments; Spatial = Spatial econometric models; OLS = Ordinary Least Squares.

Fig. 4. Common control variables included by primary studies regarding URIG.

Fig. 5. Funnel plot of a total of 94 estimates in the primary studies.

hukou population to measure urbanization, and about 77 % of studies used the urban-rural income/consumption ratio to measure URIG. Furthermore, about 59 % of studies applied the OLS method; 15 % of them used spatial econometric models. Also, a relatively smaller number of studies applied Two-Stage Least Squares (2SLS), Three-Stage Least Squares (3SLS), and Generalized Method of Moments (GMM). Finally, more than half of the articles were published between 2010 and 2015.

Control variables included by primary articles (Fig. 4) suggests that more than half of the articles included the effect of industrial structure, openness to trade, economic development level, and fiscal expenditure level as control variables. On the contrary, it is less common to include the effect of variables like the investment in urban fixed assets, financial development level, human capital level, agricultural support policy, marketization degree, urban land scale, and farmland scale.

3.2. Publication bias test

If no publication bias exists, the funnel plot (Fig. 5) should be symmetric and reflect more variations in PCCs with low precision and vice versa (Stanley, 2008). Following this criterion, some degree of publication bias can be observed in Fig. 5. Therefore, we have further employed the PET-FAT and PEESE.

Table 2 presents the results of both PET-FAT and PEESE. The constant term (α_0) is not statistically significant, which indicates that the effect of publication bias is not significant. Importantly, the coefficients of precision (β_0) are statistically significant in both PET-FAT and PEESE,

Table 2

Estimation results of the precision-effect test, funnel asymmetry test (PET-FAT) and precision-effect estimation with standard errors (PEESE).

	PET-FAT results	PEESE results
Bias (α_0)	0.785 (0.710)	11.669 (7.261)
Precision (β_0)	-0.050* (0.028)	-0.042** (0.021)
N	94	94
R ²	0.0230	0.0393
F statistic	3.14*	2.20

Notes: **p < 0.05, *p < 0.10; Heteroskedasticity-robust standard errors in parentheses. Positive coefficients indicate the effect of urbanization on enlarging urban-rural income gap; negative coefficients indicate the effect of urbanization on narrowing the urban-rural income gap.

which indicates the overall effects of urbanization on URIG is significant.

3.3. Multivariate meta-regression (MMR) model results

The MMR model was applied to estimate the exact effect of covariates contributing to the variations in empirical results. Tables 3 and 4 presents our MMR results. While positive coefficients indicate the effect of urbanization on enlarging URIG (i.e., an adverse effect), negative values suggest the effect of urbanization on narrowing URIG (i.e., a beneficial effect).

In Table 3, the first column reports the unconditional effect size of

Table 3
Multivariate meta-regression Results: Different Indicators of Urbanization and URIG.

	(1)	(2)	(3)	(4)	(5)
Precision ($1/se_{it}$)	−0.050* (0.028)	−0.047* (0.028)	−0.046 (0.037)	−0.143*** (0.032)	−0.039* (0.022)
Urbanization indicators					
Working		−0.050 (0.032)			
Resident			−0.004 (0.033)		
URIG indicators					
Ratio				0.104*** (0.035)	
Inequality indices					−0.104*** (0.035)
Constant	0.785 (0.918)	0.933 (0.707)	0.765 (0.744)	0.984 (0.610)	0.984 (0.610)
Number of Observations	94	94	94	94	94
Number of Studies	29	29	29	29	29
R ²	0.023	0.035	0.023	0.075	0.075
F statistic	3.14*	3.70**	1.62	10.46***	10.46***

Notes: ***p < 0.01, **p < 0.05, *p < 0.10; Heteroskedasticity-robust standard errors in parentheses. Positive coefficients indicate the effect of urbanization on enlarging urban-rural income gap; negative coefficients indicate the effect of urbanization on narrowing the urban-rural income gap.

Table 4
Multivariate meta-regression results: Different Control Variables, Estimation Methods, Data Characteristics, and Publication Information.

	(6)	(7)	(8)
Precision ($1/se_{it}$)	−0.143* (0.082)	−0.202** (0.098)	−1.167 (10.517)
Control variables			
Industry	0.069 (0.056)		
Urban land	−0.166 (0.111)		
Farmland	−0.252** (0.118)		
Economy	0.062 (0.048)		
Investment	0.015 (0.053)		
Fiscal expenditure level	0.078 (0.048)		
Agricultural support	−0.128* (0.065)		
Openness	−0.072 (0.068)		
Financial	0.127** (0.054)		
Market	−0.054 (0.053)		
Human	−0.191*** (0.073)		
Estimation methods			
Spatial		−0.128 (0.105)	
OLS		0.105 (0.092)	
2SLS		0.140 (0.094)	
3SLS		0.139 (0.093)	
GMM		−0.002 (0.091)	
Data characteristics			
Starting			−0.003 (0.002)
Ending			−0.009 (0.010)
Publication information			
Publication date			0.013 (0.008)
Constant	3.068 (1.636)	2.741** (1.260)	0.220 (0.972)
Number of Observations	94	94	94
Number of Studies	29	29	29
R ²	0.436	0.178	0.061
F statistic	8.53***	4.81***	1.99

Notes: ***p < 0.01, **p < 0.05, *p < 0.10; Heteroskedasticity-robust standard errors in parentheses. Positive coefficients indicate the effect of urbanization on enlarging urban-rural income gap; negative coefficients indicate the effect of urbanization on narrowing the urban-rural income gap.

precision ($1/se_{it}$) on URIG, which represents the average effect of urbanization on URIG from primary studies. The unconditional coefficient on precision is −0.050 and is statistically significant (p < 0.1), which echoes our finding that the majority of primary studies indicate a negative relationship between urbanization and URIG. Columns 2–5

examine how different urbanization and URIG indicators would affect their relationship. We tested four different indicators (i.e., two different urbanization measures and two different URIG indices) separately because primary studies oftentimes used only one indicator to measure urbanization and one to represent URIG. Results show that precision is statistically significant in all columns except Column 3, which suggests that the marginal effect of urbanization on URIG is condition on how urbanization is defined and measured.

Columns 2 and 3 include urbanization indicators used by primary studies, namely *working* (measured by the ratio between the working population in the secondary and tertiary sectors and the total population) and *resident* (measured by the ratio between hukou population and total population). By adding these control variables, magnitude of precision decreases from −0.050 to −0.047 and from −0.050 to −0.046, respectively. Nevertheless, the coefficients of the two urbanization indicators are insignificant by themselves.

In Columns 4 and 5, we tested the effects of different URIG indicators. Results show that studies have reported the opposite finding regarding the effect of urbanization on URIG. Specifically, when measuring URIG via the urban-rural income/consumption ratio (i.e., the ratio of per capita income between urban and rural areas or the ratio of per capita consumption between urban and rural areas), urbanization tends to enlarge URIG (p < 0.01). Conversely, when measuring URIG via inequality index (e.g., Theil index or Gini coefficient), urbanization tends to narrow the URIG (p < 0.01). The contradictory results suggest that how URIG indicators are constructed plays a critical role in the effect of urbanization on URIG.

Table 4 presents the MMR results regarding different control variables, estimation strategies, data characteristics, and publication date. The coefficients of precision are negative in all three columns and those coefficients of precision are significant except in Column 8. Notably, the magnitude of urbanization on URIG is conditioning on the set of control variables and the choice of estimation method.

Column 6 includes eleven control variables applied in primary studies. Among all those variables with a positive effect, while *Financial* significantly influences the relationship between urbanization and URIG (p < 0.05), the rest covariates (i.e., *industry*, *economy*, *investment*, and *fiscal expenditure level*) are statistically insignificant. Such findings may indicate that primary studies controlled for these variables tend to report the adverse effect of urbanization on URIG. The coefficients of the rest control variables are negative, where the coefficients of *farmland*, *agricultural support*, and *human* are statistically significant. Column 7 includes five different estimation methods adopted by primary studies. None of the coefficients regarding estimation methods is statistically significant, suggesting that the choice of the estimation strategy may not be an essential factor in understanding the relationship

between urbanization and URIG. Finally, Column 8 examines the roles of the range of datasets and the year of publication. As none of the coefficients associated with these variables is statistically significant, the temporal span of the empirical data and publication information seems not so critical in understanding the relationship between urbanization and URIG.

4. Discussion

This study used MRA to understand urbanization's effect on the URIG in China by synergizing studies quantitatively, which is different from the previous qualitative review articles, where general viewpoints and research contents of reviewed studies were summarized qualitatively (cf., Zeng and Hu, 2007; Tan et al., 2016; Colsaeta et al., 2018). With the tools of MRA, we found supportive evidence that urbanization is, on average, associated with narrowing URIG, based on the evidence that all the eight models of our meta-regression show the effect of urbanization on narrowing the URIG, and six coefficients associated with precision are significant, including the unconditional model for precision (i.e., Column 1, 2, 4, 5 in Table 3 and Column 6, 7 in Table 4). While China has its own characters in the urbanization process, there are many similarities between China and other developing countries when it comes to the rural-urban divide (Dong and Puterman, 2000; Cai, 2007; Tan et al., 2016). Therefore, studies of China's urbanization and URIG would have positive implications for other developing countries.

Our analysis shows that different measures of URIG have significant influence on the relationship between urbanization and URIG. Studies using urban-rural income/consumption ratio and inequality indices to measure the URIG tend to report contradictory findings regarding such relationship. Specifically, the coefficients of *ratio* reveal that urbanization is positively associated with URIG. Conversely, the coefficients of *inequality indices* illustrate that urbanization is negatively associated with URIG. One possible explanation is how these URIG indicators are calculated. The urban-rural income/consumption ratio is widely used because it is easy to calculate. However, compared to the inequality index based on the Theil index and/or Gini coefficient, it is inadequate to reflect urban-rural income inequality because the ratio itself does not reflect the distribution of urban and rural populations (Wang and Ouyang, 2008). We found that about 77 % of primary studies have used the urban-rural income/consumption ratio to measure URIG, while the inequality index was only chosen by 23 % of studies. Our analysis reveals that measures of URIG are critical in understanding the relationship between urbanization and URIG. Therefore, future research can make a more elaborated comparison of the results generated by urban-rural income/consumption ratio and inequality index.

Previous studies have shown that in developing countries, urban-bias in policy contributes to the widening rural-urban gap, through which urban industrial prosperity is created at the expense of rural sectors and rural dwellers (Lofchie, 1997; Fesselmeyer and Le, 2010). On the one hand, our analysis has confirmed that major national policies (e.g., control variables of *financial development*, *agricultural support policy*, *human capital level*, and *farmland scale* in regressions) have a significant effect on the results reported by primary studies. On the other hand, we did not find China's development policy is always urban-biased. Specifically, we found a significant positive effect of financial development on URIG, where five out of seven primary studies controlled for financial development have revealed a positive relationship between urbanization and URIG. As public policy is often biased toward urban areas, financial development which often supports urban development and facilitates the urbanization process (Kim, 1997; Cho and Bogges, 2003) may only benefit urban areas, therefore, enlarges the income inequality (Lou, 2008; Zhang and Zhu, 2010). Nonetheless, empirical evidence also finds that financial development has narrowed URIG in China (Clarke et al., 2003). Since 2004, the Chinese government has increased financial and fiscal investment in

rural villages, rural enterprises, and rural farmers (*nong cun*, *nong ye*, *nong min*, or *san nong*), including tax-exemption policies to increase the income of farmers (Li, 2017). It is consistent with our finding that there is a significant negative effect of the agricultural support policy on the association between urbanization and URIG. However, only less than one-fourth primary studies have estimated the effect of agricultural support policy. More research can be conducted to understand the role of such a policy.

Additionally, the significant negative effect of human capital level, which is often measured by the number of college students or the average years of education, reveals that the enhancement of human capital plays a critical role in narrowing URIG. There are mainly two explanations. Firstly, the Chinese government has increased investment in rural education and improved the level of human capital in rural areas (Li, 2015). Secondly, although the quality of education in rural areas is relatively low, most young people in rural areas choose to work in urban areas at an earlier age to improve their income, thus reducing URIG (Qin and Liu, 2016). While the policy implication of these two explanations is consistent, that is, to increase the investment in rural education, we suggest more analysis of the long-term effect of education on the human capital level as well as URIG in future research.

Furthermore, we found a significant negative coefficient on the farmland scale. Farmland is an important source of income for most farmers. The more farmland they have, the higher the possibility for them to realize scale management and yield more income (Yang et al., 2013). Meanwhile, while it is argued that urban land scale might enlarge URIG during the process of urbanization (Wang et al., 2015), our regression results find that urban land scale is statistically insignificant. However, we suggest that the potential role of urban land scale cannot be ignored as it refers to the ongoing debate about China's existing urban-rural dual land tenure system (Ye et al., 2018). The transformation of agricultural land into urban construction land is a flagship embodiment of China's urbanization process (Zhong et al., 2011; Feng et al., 2019; Chen et al., 2019; Huang and Li, 2020). At the same time, studies have found that farmers' rights and interests were compromised during the urbanization process (He et al., 2014; Wang et al., 2020). We argue that the protection of farmers' rights and interests should be paid more attention in both policy design and academic research to promote urban-rural equality and reduce URIG.

The findings regarding control variables also have several policy implications for remedying income-based urban-rural inequality during the urbanization process. With the analysis of those three control variables with significant effects, we argue that it is necessary to improve the supply of financial resources for agricultural activities and expand financing channels for rural households (Zhong et al., 2019). Besides, the government should spend more fiscal expenditure on rural human capital by investing more in the development of rural education. In the meantime, reform of employment and household registration system should be accelerated to alleviate institutional obstacles of migration and establish a unified urban-rural labor market (Fields and Song, 2020). Last but not least, during the agricultural land to non-agricultural land conversion, policy needs to focus on the long-term protection of farmers' rights and interests, such as giving reasonable compensation and providing employment guidance (Huang et al., 2018).

This meta-analysis work provides synergy of previous studies regarding the effect of urbanization on URIG from a quantitative perspective. Of course, there are some caveats and limitations of this study. First, this research draws on studies on the *average* effect of urbanization and URIG in China. Regional differences in such a relationship reported in some studies (Cao, 2010; Liu et al., 2013) are not taken into account. Studies using the data of regional areas of China could be included in MRA in future research to provide more nuanced evidence. Second, while some scholars argue that URIG is an important driving factor of urbanization (Lall et al., 2006; Zeng and Zuo, 2013), we did not analyze the effect of URIG on urbanization due to limited

empirical studies in the reverse direction.

5. Conclusion

This article synergizes primary studies on the relationship between urbanization and URIG in China. Generally, empirical studies tend to report that urbanization narrows URIG. Our MRA reveals the heterogeneous effects from 94 effect-size estimates in 29 studies. The jointed interpretation of PET-FAT and PEESE tests shows that publication bias is not a significant concern of those included primary studies. The results of MMR show a general negative association between urbanization and URIG in China. However, we found more nuanced evidence on the impact of different URIG indicators and set of control variables. More specifically, urbanization shows a positive effect on URIG amongst articles where the urban-rural income/consumption ratio is adopted to measure URIG. By contrast, urbanization is negatively associated with URIG amongst articles where inequality index is used to measure URIG.

These findings suggest that research priorities of urbanization's effect on URIG in China are twofold. First, future analysis can be conducted to understand how and why different indicators play a role in the association between urbanization and URIG. Second, different factors (e.g., financial development, agricultural support policy, human capital, farmland, and urban land scale, etc.) can be examined in detail to understand the pathways and mechanisms related to URIG. Additionally, factors related to urban spatial structure (e.g., Liu and Wang (2016) and Liu et al. (2018)) may provide nuanced implication regarding the relationship between urbanization and URIG. For example, Wang et al. (2019b) found a mixed relationship between polycentric urban structure and economic productivity. More recently, Wang (2020) revealed that urban polycentricity is associated with a higher quantity and diversity of urban consumption places.

Based on the empirical findings, this work has the following policy implications regarding remedying income-based urban-rural inequality during urbanization. First, the supply of financial resources for agricultural activities can be improved, and financing channels for rural households can be expanded. Second, fiscal expenditure on rural human capital can be increased through investing more on rural education in conjunction with removing institutional obstacles of migration. Third, actions are needed to protect farmers' rights and interests in the long run, especially those whose agricultural land would be converted to non-agricultural land during the urbanization process.

CRediT authorship contribution statement

Yuan Yuan: Conceptualization, Methodology, Writing - original draft. **Mingshu Wang:** Writing - review & editing, Validation. **Yi Zhu:** Investigation, Software. **Xianjin Huang:** Supervision, Project administration. **Xuefeng Xiong:** Resources.

Acknowledgments

This work was supported by the Ministry of Nature Resources of China (Grant No. 0904/133047), the Major Program of National Fund of Philosophy and Social Science of China (Grant No. 17ZDA061), the Key Laboratory of Regional Sustainable Development Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (Grant No. KF2018-08) and the Postgraduate Research & Practice Innovation Program of Jiangsu Province, China (Grant No. KYCX19_0018).

Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.landusepol.2020.104995>.

References

- Cai, F., 2007. Rural urban income gap and critical point of institutional change. *Econ. Chang. Restruct.* 40, 189–206.
- Cai, Z., Liu, Z., Zuo, S., Cao, S., 2019. Finding a peaceful road to urbanization in China. *Land Use Policy* 83, 560–563.
- Cao, H., 2010. Urban-rural income disparity and urbanization: what is the role of spatial distribution of ethnic groups? A case study of Xinjiang Uyghur Autonomous Region in western China. *Reg. Stud.* 44 (8), 965–982.
- Carter, C.A., 1997. The urban-rural income gap in China: implications for global food markets. *Am. J. Agri. Eco.* 79 (5), 1410–1418.
- Chen, B., Lin, J.Y., 2014. Development strategy, urbanization and the urban-rural income gap in China. *Soc. Sci. China* 35 (1), 5–20.
- Chen, S., Jiang, J., 2014. The relationship of financial development, urbanization and urban-rural income gap: Empirical research based on provincial panel data in China. *Biochem. Biophys. Res. Commun.* 6 (3), 1228–1233.
- Chen, Z., Zhang, X., Huang, X., Chen, Y., 2019. Influence of government leaders' localization on farmland conversion in Chinese cities: a "sense of place" perspective. *Cities* 90, 74–87.
- Cheung, C., 2012. The paradox of China's urban-rural integration: the hukou system, rural policy, and rural land development. *Urban Anthropol. Stud. Cult. Syst. World Econ. Dev.* 41 (2,3,4), 293–328.
- Cho, S., Boggess, W.W.G., 2003. Measuring interactions among urbanization, land use regulation, and public finance. *Am. J. Agric. Econ.* 85 (4), 988–999.
- Churchill, S.A., Ugur, M., Yew, S.L., 2017. Does government size affect per-capita income growth? A hierarchical meta-regression analysis. *Econ. Rec.* 93 (300), 142–171.
- Clarke, G., Xu, L.C., Zou, H., 2003. Finance and Income Inequality: Test of Alternative Theories. Working Paper No. 2984. Available at SSRN. World Bank Policy Research <https://doi.org/10.2139/ssrn.364160>.
- Colsaeta, A., Laurans, Y., Levrel, H., 2018. What drives land take and urban land expansion? A systematic review. *Land Use Policy* 79, 339–349.
- Dong, X., Putterman, L., 2000. Prereform industry and state monopsony in China. *J. Comp. Econ.* 28, 32–60.
- Doucoulagos, C.H., Stanley, T.D., 2009. Publication selection bias in minimum-wage research? A meta-regression analysis. *Br. J. Ind. Relat.* 47 (2), 406–428.
- Doucoulagos, C.H., Stanley, T.D., 2013. Theory competition and selectivity: Are all economic facts greatly exaggerated? *J. Econ. Surv.* 27, 316–339.
- Feng, W., Liu, Y., Qu, L., 2019. Effect of land-centered urbanization on rural development: a regional analysis in China. *Land Use Policy* 87, 104072.
- Fesselmeyer, E., Le, K.T., 2010. Urban-biased policies and the increasing rural-urban expenditure gap in Vietnam in the 1990s. *Asian Econ. J.* 24 (2), 161–178.
- Fields, G.S., 1974. Rural-urban migration, urban unemployment and underemployment, and job-search activity in LDCs. *J. Dev. Econ.* 2 (2), 165–187.
- Fields, G.S., Song, Y., 2020. Modeling migration barriers in a two-sector framework: a welfare analysis of the hukou reform in China. *Econ. Model.* 84, 293–301.
- Gerrish, E., Watkins, S.L., 2018. The relationship between urban forests and income: a meta-analysis. *Landsc. Urban Plan.* 170, 293–308.
- He, W., Huang, X., Chen, Z., Zhong, T., 2014. Estimation of farmers' loss of land rights and interests in China's urbanization process from 1990 to 2010. 1990-2010年间中国城镇化进程中农民土地权益损失估算 (in Chinese). *J. Land Eco.* 01, 137–159.
- Huang, X., Li, H., 2020. Resources, Environment and Green Development of the Yangtze River Economic Belt. Nanjing University Press, Nanjing.
- Huang, X., Li, H., Zhang, X., Zhang, X., 2018. Land use policy as an instrument of rural resilience - the case of land withdrawal mechanism for rural homesteads in China. *Ecol. Indic.* 87, 47–55.
- Jedwab, R., Christiaensen, Gindelsky, M., 2017. Demography, urbanization and development: rural push, urban pull and ...urban push? *J. Urban Econ.* 98, 6–16.
- Kim, K.H., 1997. Housing finance and urban infrastructure finance. *Urban Stud.* 34 (10), 1597–1620.
- Lall, S.V., Selod, H., Shalizi, Z., 2006. Rural-Urban Migration in Developing Countries: A Survey of Theoretical Predictions and Empirical Findings. World Bank Policy Research Working, pp. 1–63 Paper, No. 3915.
- Li, C., 2015. Does urbanization narrow the urban-rural income gap? An empirical study based on panel data of 31 provinces in China from 2004 to 2013. 城镇化缩小城乡收入差距了吗? 基于全国31省区2004-2013年面板数据的实证分析 (in Chinese). *Res. Dev.* 6, 121–125.
- Li, L., 2017. Balancing rural and urban development: applying coordinated urban-rural development (CURD) strategy to achieve sustainable urbanisation in China. *Sustainability* 9 (11), 1948.
- Liu, X., Wang, M., 2016. How polycentric is urban China and why? A case study of 318 cities. *Landsc. Urban Plan.* 151, 10–20.
- Liu, Y., Lu, S., Chen, Y., 2013. Spatio-temporal change of urban-rural equalized development patterns in China and its driving factors. *J. Rural Stud.* 32, 320–330.
- Liu, X., Derudder, B., Wang, M., 2018. Polycentric urban development in China: a multi-scale analysis. *Environ. Plan. B Urban Anal. City Sci.* 45 (5), 953–972.
- Lofchie, M.F., 1997. The rise and demise of urban-biased development policies in Africa. In: Gugler, J. (Ed.), *Cities in the Developing World Issues Theory & Policy*. Oxford University Press, Oxford, pp. 23–39.
- Lou, Y., 2008. The study of the relation between financial development disparity and the income gap between urban and rural residents. 金融发展差异与城乡居民收入差距关系研究 (in Chinese). *J. Huazhong Uni. Sci. Technol.* 22 (5), 42–47 Social Science Edition.
- Nelson, J.P., Kennedy, P.E., 2009. The Use (and Abuse) of Meta-analysis in environmental and natural resource economics: an assessment. *Environ. Resour. Econ. (Dordr)* 42, 345–377.

- OECD, 2008. Urbanisation. OECD environmental outlook to 2030. OECD publishing. Paris. <https://doi.org/10.1787/9789264040519-7-en>. Available at.
- Qin, C., Liu, P., 2016. Urbanization and income disparity between urban and rural areas: An analysis based on provincial panel data. 城镇化与城乡收入差距: 基于省域面板模型的分析 (in Chinese). *J. Ind. Technol. Econ.* 10, 3–11.
- Sahn, D.E., Stifel, D.C., 2004. Urban–rural inequality in living standards in Africa. *J. Afr. Econ.* 12 (4), 564–597.
- Selden, M., 1988. City versus countryside? The social consequences of development choices in China. *Review (Fernand Braudel Center)* 11 (4), 533–568.
- Sicular, T., Yue, X., Gustafsson, B., Li, S., 2007. The urban-rural income gap and inequality in China. *Rev. Income Wealth* 53 (1), 93–126.
- Stanley, T.D., 2008. Meta-regression methods for detecting and estimating empirical effects in the presence of publication selection. *Oxf. Bull. Econ. Stat.* 70 (1), 103–127.
- Stanley, T.D., Doucouliagos, H., 2012. *Meta-Regression Analysis in Economics and Business*. Routledge, Abingdon and New York.
- Stanley, T.D., Jarrell, S.B., 2005. Meta-regression analysis: a quantitative method of literature surveys. *J. Econ. Surv.* 19 (3), 299–308.
- Stanley, T.D., Doucouliagos, H., Giles, M., Johnston, R.J., Laroche, P., Nelson, J.P., Paldam, M., Poot, J., Pugh, G., 2013. Meta-analysis of economics research reporting guidelines. *J. Econ. Surv.* 27 (2), 390–394.
- Stark, O., 1988. Migration, remittances, and the family. *Econ. Dev. Cult. Change* 36 (3), 465–481.
- Sterne, J.A.C., 2009. *Meta-Analysis in Stata: an Updated Collection From the Stata Journal*. Stata Press, College Station, TX.
- Sutton, A.J., Abrams, K.R., Jones, D.R., Sheldon, T.A., Song, F., 2000. *Methods for Meta-analysis in Medical Research*. John Wiley and Sons, Chichester, pp. 1574.
- Tan, Y., Xu, H., Zhang, X., 2016. Sustainable urbanization in China: a comprehensive literature review. *Cities* 55, 82–93.
- Tian, Q., 2001. China's new urban-rural divide and pitfalls for the Chinese economy. *Can. J. Dev. Stud.* 22 (1), 165–190.
- Ugur, M., 2014. Corruption's direct effects on per-capita income growth: a Meta-analysis. *J. Econ. Surv.* 28 (3), 472–490.
- United Nations, 2019. Department of economic and social affairs, population division. *World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420)*. United Nations, New York.
- Wang, M., 2020. Polycentric urban development and urban amenities: Evidence from Chinese cities. *Environ. Plan. B Urban Anal. City Sci.* <https://doi.org/10.1177/2399808320951205>.
- Wang, S., Ouyang, Z., 2008. The threshold effect of the urban-rural income disparity on real economic growth in China. *Soc. Sci. China* 29 (3), 39–53.
- Wang, X., Piesse, J., Weaver, N., 2013. Mind the gaps: a political economy of the multiple dimensions of China's rural-urban divide. *Asia. Econ. Lit.* 27 (2), 52–67.
- Wang, J., Gu, G., Yao, L., 2015. Urbanization, spatial spillover effects and urban-rural income gap in China: Based on provincial panel data from 2002 to 2012. 城市化进程、空间溢出效应与城乡收入差距: 基于2002-2012年省级面板数据 (in Chinese). *J. Finance Econ.* 5, 55–65.
- Wang, S., Tan, S., Yang, S., Lin, Q., Zhang, L., 2019a. Urban-biased land development policy and the urban-rural income gap: evidence from Hubei Province, China. *Land Use Policy* 87, 1–11.
- Wang, M., Derudder, B., Liu, X., 2019b. Polycentric urban development and economic productivity in China: a multiscale analysis. *Environ. Plann. A: Eco. Space* 51 (8), 1622–1643.
- Wang, Y., Li, X., He, H., Xin, L., Tan, M., 2020. How reliable are cultivated land assets as social security for Chinese farmers? *Land Use Policy* 90, 104318.
- Yang, D.T., Cai, F., 2000. The Political Economy of China's Rural-urban Divide, Center for Economic Research on Economic Development and Policy Reform Working Paper No. 62. Stanford Institute of Economic Policy Research Stanford University.
- Yang, D.T., Zhou, H., 2007. Rural-urban disparity and sectoral labour allocation in China. *J. Dev. Stud.* 35 (3), 105–133.
- Yang, Z., Liu, X., Wang, Y., 2013. Can urbanization of county narrow gap of urban-rural income? Empirical test based on panel data of 1523 counties (cities) 县城城镇化能缩小城乡收入差距吗? 基于1523个县(市)面板数据的实证检验 (in Chinese). *J. Huazhong Agric. Univ.* 4, 42–48.
- Ye, L., Huang, X., Yang, H., Chen, Z., Zhong, T., Xie, Z., 2018. Effects of dual land ownerships and different land lease terms on industrial land use efficiency in Wuxi City, East China. *Habitat Int.* 78, 21–28.
- Yu, A.T.W., Wu, Y., Zheng, B., Zhang, X., Shen, L., 2014. Identifying risk factors of urban-rural conflict in urbanization: a case of China. *Habitat Int.* 44, 177–185.
- Zeng, G., Hu, J., 2007. A review on the evolution and causes of the income gap between urban and rural residents in China. 中国城乡居民收入差距演变趋势及原因研究述评 (in Chinese). *Contem. Eco. Res.* 6, 26–30.
- Zeng, Z., Zuo, J., 2013. Spatial agglomeration of Chinese provincial urbanization and driving mechanism: based on spatial panel data model. 中国省域城镇化的空间集聚与驱动机制研究——基于空间面板数据模型 (in Chinese). *Chin. J. Manage. Sci.* 11, 580–586.
- Zhang, W., Zhu, Y., 2010. The reason analysis of the slow transformation dualistic economic structures in China: from an angle of the duality of factor market. 我国二元经济结构转变缓慢的原因分析——基于生产要素市场二元性的解释 (in Chinese). *East China Economic Management* 24 (1), 49–53.
- Zhong, T., Huang, X., Zhang, X., Wang, K., 2011. Temporal and spatial variability of agricultural land loss in relation to policy and accessibility in a low hilly region of southeast China. *Land Use Policy* 28 (4), 762–769.
- Zhong, T., Zhang, X., Huang, X., Liu, F., 2019. Blessing or curse? Impact of land finance on rural public infrastructure development. *Land Use Policy* 85, 130–141.