

The Nexus of Regional Integration and Household Welfare: A Case Study of the Yangtze Delta Area

Nuo Jin⁺

Cardiff University, Cardiff, UK

Abstract Public policies of regional integration have been widely implemented recently in multiple countries as a significant approach to improving regional economic cooperation and reducing economic inequalities. In China, improving household welfare and narrowing welfare gaps become another major purpose of regional integration. Nevertheless, little attention has been paid to household-level impacts of regional integration on improving welfare. This study provides empirical analysis on impacts of regional integration on household welfare by using the case of the Yangtze Delta area from 2010 to 2020. We find that overall impacts of regional integration on improving household welfare and reducing household welfare inequality are significantly positive, and such impacts reveal spatial heterogeneity. Public transport infrastructural integration and city-level migration are two major mechanisms through which such impacts can be amplified. Results remain feasible after a series of robustness tests. We believe that integration should be further implemented to eliminate poverty and boost social welfare in both developed and developing regions in China, and cross-city and interprovincial trade needs to be promoted as an important means of regional integration.

Keywords: regional integration, household welfare, PSM-DID, China

JEL Classifications: R11, R20, R58, I38

Received 21 April 2024, Revised 7 May 2024, Accepted 8 May 2024

+Corresponding Author: Nuo Jin

Ph.D. Candidate, Economics, Cardiff Business School, Cardiff University, Aberconway Building, Colum Drive, CF10 3EU, Cardiff, UK. Tel: +44-07410499081

E-mail: JinN3@cardiff.ac.uk

Author Contributions:: Nuo Jin – Conceptualization, Methodology, Data curation, Formal Analysis, Visualisation, Writing-Original draft preparation, Writing-Reviewing and Editing.

Disclosure Statement: No potential conflict of interest is reported by the author.

Funding Statement: This project was funded by the Cardiff Business School Studentship. The author benefits from financial supports from this funding source to complete this project.

Ethics Statement: This paper does not involve research with human participants.

Data Availability Statement: The datasets generated and analysed in this paper are not publicly available due to restricted access but are available from the corresponding author on reasonable request.

Acknowledgements: The author thanks Professor Max Munday from Cardiff University, Dr Wanxiang Cai from the University of Bristol, Dr Peng Zhou from Cardiff University, Professor Geoffrey Hewings from University of Illinois and other distinguished scholars from Regional Studies Association, Cardiff University, Newcastle University, and University of Illinois for their review and valuable comments and remarks.

I. Introduction

As regional economic cooperation increasingly prevails across the globe, regional integration stands out as a key outcome amid the ongoing process of globalisation (Sideri, 1997). By eliminating impediments that exert negative effects on such cooperation, regional integration is developed from the internal economic integration to the multi-urban or even multi-national integration of the economy. The establishment of the European Union and the free trade zone of Mexico, Canada, and the US are two examples of cross-border international integration of economies. It is also found that inside a country, attempts to promote interprovincial economic cooperation can lead to the rapid progress of regional integration (Poncet, 2003). For instance, Tokyo Bay Area has witnessed massive interprovincial integration of Tokyo and its surrounding prefectures such as rail connection, cross-border business development, and construction of bed towns, and obtained significant economic growth from the 1960s to the 1980s (Lin, 2007). Since the 1950s, the Ruhr area benefited from the growing demand for industrial cooperation of the steel industry and achieved the coordination of regional development and integration amid rounds of urban agglomeration (Hennig, 2019).

Fuelled by the Reform and Opening-up Policy since the 1980s, China has experienced waves of regional integration that reshaped multiple regions, such as the Pearl River Delta area and the Yangtze Delta area, two economic engines of the country. More recently, the Guangdong-Hong Kong-Macau Greater Bay Area was proposed in 2015, which includes all cities in the initial Pearl River Delta area along with two SARs, namely Hong Kong and Macau (Chen & Wang, 2020), forming a symbolic example of regional integration. In 2022, GDP in the Greater Bay Area and the Yangtze Delta Area occupied 10.8% and 24.2% of the total GDP in China, respectively¹⁾. Based on the gravity theory of regional growth and the theory of new structural economics, it is believed that regional integration can lead to overall upgrades of local development and narrowing gaps in economic growth in the whole integrated region regardless of initial endowments (Lin, 2011; Longhi & Musolesi, 2007).

Household welfare is one of the most important measurements for local economic growth and can act as a mechanism through which residents can perceive the encouraging outcomes of regional integration. Nevertheless, the economic miracle in China comes with considerable spatial gaps in household welfare and widespread poverty in less developed areas. It is important to note that even in the most developed regions such as the Yangtze Delta area, poverty still exists in specific cities and extremely large disparities of household welfare among cities in these regions question the effectiveness of regional integration (Labar & Bresson, 2011). Eliminating poverty has become a priority agenda in modern China and the central government

1) See the website of China Statistical Book 2022 (Chinese version): <https://www.stats.gov.cn/sj/ndsj/2022/indexch.htm>

seeks to enhance household welfare in less developed cities by incorporating them into regions earmarked for the implementation of regional integration policies, although results of such intention are unclear (Zhang et al., 2024). It is essential to notice that regional integration driven by administrative or political power rather than internal economic factors might not be as effective as expected (Schiff & Winters, 2003) while the motion of Yangtze Delta integration and the Greater Bay Area in China is widely considered to be led and controlled by the central government. Thus, such administrative attempt to improve welfare through regional integration and its outcomes remain to be thoroughly analysed. In general, recognising effects of integration and interconnectedness on improving welfare especially in left-behind regions and smoothening spatial welfare inequalities presents a significant research gap. This paper aims to fill the gap of empirical studies on impacts of regional integration on household welfare by using the Yangtze Delta area as the case. Focusing on household welfare, we make it possible to examine whether regional integration leads to the overall improvement in individual conditions of welfare and smaller welfare gaps across cities in the integrated region.

Taking 41 prefecture-level cities in major provinces in the Yangtze Delta area, i.e., Jiangsu, Anhui, and Zhejiang Provinces along with the city of Shanghai as the research object, this paper focuses on whether and how regional integration has impacts on improving household welfare in relatively less developed regions and reducing gaps in household welfare across regions. As such, this paper can hopefully make three main contributions as follows. First, this paper for the first time includes analysis on all prefecture-level cities in the Yangtze Delta area to examine how the inclusion in the policy of regional integration for each city has affected local household welfare and spatial gaps in household welfare in the Yangtze Delta area, which includes the feature of various time points when different cities were included in the policy. Second, different from the existing measurement of household welfare by household annual income based on macro-level data, this paper adopts two main variables to measure household welfare, i.e., household disposable income and household consumption expenditure by taking advantage of updated CFPS database, which not only introduces a new comprehensive measurement based on individual-level data but also enhances the connotation of household welfare. Finally, this paper inserts discussion on impacts of regional integration on spatial gaps in household welfare in the context of the Yangtze Delta integration promoted by the government, filling the gap in the existing literature of analysing the effects of policy-driven regional integration on household welfare improvement and unlocking a new policy path for eliminating poverty and household welfare gaps.

The remainder of this paper is organised as follows. Section 2 provides literature review on regional integration and household welfare, followed by main hypotheses to be examined. Section 3 introduces variables, data, and empirical methods. Section 4 demonstrates empirical results and main findings. Section 5 discusses and verifies potential mechanisms and Section

7 concludes this paper with summary and policy implications.

II. Literature Review

A. Regional integration

Regional integration initially refers to the voluntary amalgamation and blending of independent national states with their neighbours, leading to a loss of some sovereign attributes while gaining new methods for resolving conflicts (Haas, 1970). In China, multiple studies have revealed that inter-city and cross-province regional integration such as the Yangtze Delta area and the Greater Bay area has encouraged multi-level economic cooperation including the unification of regional infrastructure projects, exchange of capital and labour, and the construction of united markets (Zhang et al., 2020; Hui et al., 2020).

Regarding initiatives of regional integration, Schiff and Winters (2003) list the following major factors that contribute to the existence of regional integration: enhancing bilateral trade relationship, unified business environment for the private sector, the development of shared infrastructure, the coordination of public policies, the construction of inclusive civil society, and rights of free movement for citizens. These factors echo empirical evidence of interprovincial integration around the world. In China, existing studies have figured out that regional economic interaction, interprovincial migration, concentration of labour, and administrative orders are main drivers of regional integration (Kang et al., 2022; Zheng et al., 2023).

Regional integration can lead to various environmental, economic, and other effects. Zhang et al. (2020) reveal that the market integration and regional cooperation of business contributed to decreasing pollution emissions in the whole Yangtze Delta area. Zhao and Jiang (2022) find that the demand for reducing gaps of economic growth between rural and urban areas caused the integration of the Yangtze Delta area and such integration successfully narrowed the spatial inequality of economic development. Yu et al. (2012) examine the correlations between spatial clusters and infrastructure development in China demonstrate that the development of regional integration has significant impacts on improvements in connections of infrastructure, such as high-speed rails, undergrounds, and highways.

The Yangtze Delta area has witnessed regional integration on an immense scale and contributes to over 20% of total GDP of the country since the 1990s²⁾. The Yangtze Delta area, situated in Eastern China (see Figure 1), stands out as a prominent urban agglomeration characterized by significant levels of socioeconomic advancement, cooperation, and urbanisation. Ye et al. (2019) find that the index of mutual dependence of economic activities³⁾ across cities

2) See the official website of China Statistical Books: <https://www.stats.gov.cn/sj/nds/>

in the Yangtze Delta area is 35% higher than the national average in the period of 2000-2016. They also claim that such a high level of economic connection benefits from shared infrastructure, similar culture, and local endeavour to promote interprovincial trade. Wang et al. (2022) attribute the rapid economic growth since the 1980s in the Yangtze Delta area to significantly high levels of inter-city and cross-province integration and demonstrate that improvements in income and household welfare are positively correlated with the process of integration.

Figure 1. The study area: Yangtze Delta area



It is also crucial to acknowledge that the boundary of the Yangtze Delta area as a concept of integrated region and its member cities have changed for several times since the 1980s. The enlarged scale of the Yangtze Delta area leads to concerns over increasing spatial gaps in economic growth and inequality of social welfare across cities, given that the economic centre, i.e., Shanghai, and cities classified as the extreme poverty area are all included in this region (Qin et al., 2023), which raises the issue of examining impacts of regional integration on eliminating gaps in growth and welfare in the Yangtze Delta area.

B. Household welfare

Household welfare denotes the overall well-being and standard of living of a household and includes various factors such as income, employment status, access to basic needs like food, shelter, healthcare, education, and public transport (Hentschel & Lanjouw, 2000). Since the concept of household welfare consists of numerous aspects and dimensions of household socioeconomic benefits, there are various indicators and measurements to quantify household

3) It is an index that measures the magnitude of economic connections in a region, proposed by Loichinger et al. (2014). This index is constructed mainly based on the following variables: trade, migration, investment, and shared infrastructure.

welfare proposed by the existing literature, such as household income and consumption (Bockstael and McConnell, 1983).

In China, particular research interests lie in per capita disposable income with regard to measuring household welfare since individual income has been widely considered as the core proxy to examine the effectiveness of local economic growth and welfare improvements (Khan et al., 2017). In addition, household welfare is closely linked to poverty alleviation in China. As such, the central government of China launched the Targeted Poverty Alleviation (TPA) project that aims to provide targeted assistance for those in extremely poor conditions and to make all Chinese citizens above the national poverty line⁴). The core objective of this project is to comprehensively improve individual and household welfare by examining household income and consumption (Liu et al., 2017). Following existing literature, this study adopts household disposable income and consumption expenditure as two measurements of household welfare in China.

In terms of determinants of household welfare, the existing literature has uncovered multiple factors that have significant impacts on household welfare, such as education, employability, healthcare access, housing conditions, social support, and gender equality (Dewilde, 2008; Biyase & Zwane, 2018; Han et al., 2016; Guiso & Zaccaria, 2023). It is also widely acknowledged that regional integration can boost household welfare with multiple mechanisms and mediating-effect variables as follows:

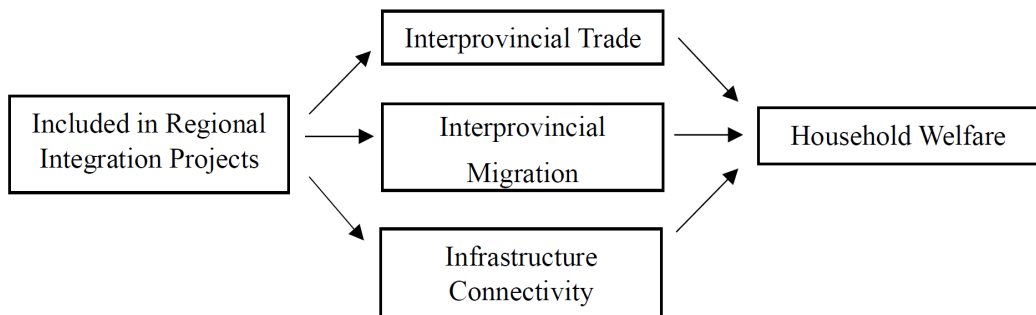
First, the current literature has revealed that household welfare can be encouraged by integration of local economies through the mechanism of bilateral trade in integrated regions. For instance, Bazaluk et al. (2022) adopt a broader country-level lens to examine potential mechanisms through which international integration across countries can affect domestic welfare and find that trade liberalisation marked by regional trade agreements (RTA) is a significant mechanism that improved welfare and economic growth for countries joining the groups of integration. Jiang et al. (2020) use the input-output method to analyse interprovincial trade in China and find that the growing trade across provinces contributes to improvements in welfare.

Second, interprovincial and international migration is another mechanism that can stimulate impacts of integration on household welfare improvement (Carmel & Cerami, 2012; Marta et al., 2020) since migration can result in stronger economic growth, rising entrepreneurship and innovation, higher labour productivity, and boosts on the real estate market. In China, waves of interprovincial migration since the 1980s partially accounted for the rapid economic growth, regional integration, and increasing income (Hao et al., 2020) although the Hukou system, a Chinese household registration system that might discourage interprovincial migration, has existed for decades. Ma and Tang (2020) also reveal that interprovincial migration increased welfare in destination cities in the context of rounds of regional integration.

4) See the official website of Chinese Central Government: https://www.gov.cn/zhengce/2015-12/07/content_5020963.htm

Third, regional cooperation in public services such as public transportation could be another pathway through which regional integration leads to household welfare increase. In China, the connection of highways and rail between cities and regions is proved to significantly promote regional integration and welfare (Li et al., 2016; Feng et al., 2023) due to the effects of these public transportation projects, such as facilitating interprovincial trade, promoting domestic and international investment, enhancing socioeconomic exchange, and reducing isolation-driven poverty. Thus, the conceptual framework on the relationship between joining the regional integration project and household welfare is shown in Figure 2 below.

Figure 2. Conceptual framework on the relationship between integration and household welfare



In addition to the discussion on various mechanisms that strengthen impacts of regional integration on household welfare, spatial heterogeneity in such impacts has attracted sufficient attention. For instance, Shan et al. (2022) reveal that the spatial heterogeneity in the process of rural-urban integration has led to significantly variant effects on local economic development in China. Hong et al. (2019) focus on the case of integration in China in 1997-2011 and also claim that spatial inequality of to what extent can different cities economically benefit from regional integration results from their own initial economic growth and productivity.

C. Hypotheses

Following discussions above, we have three main hypotheses proposed for the following empirical sections of this study.

- 1) For all cities in Jiangsu, Zhejiang, Anhui provinces along with the city of Shanghai, whether or not to be included in the Yangtze Delta integration project will have significant impacts on their local household welfare and household welfare inequalities across these cities.
- 2) Impacts of joining the integration project on household welfare in the Yangtze Delta area are justified through several mechanisms, i.e., trade, migration, and infrastructure.

- 3) Such impacts will show significant spatial heterogeneity in accordance with different levels of initial economic endowments.

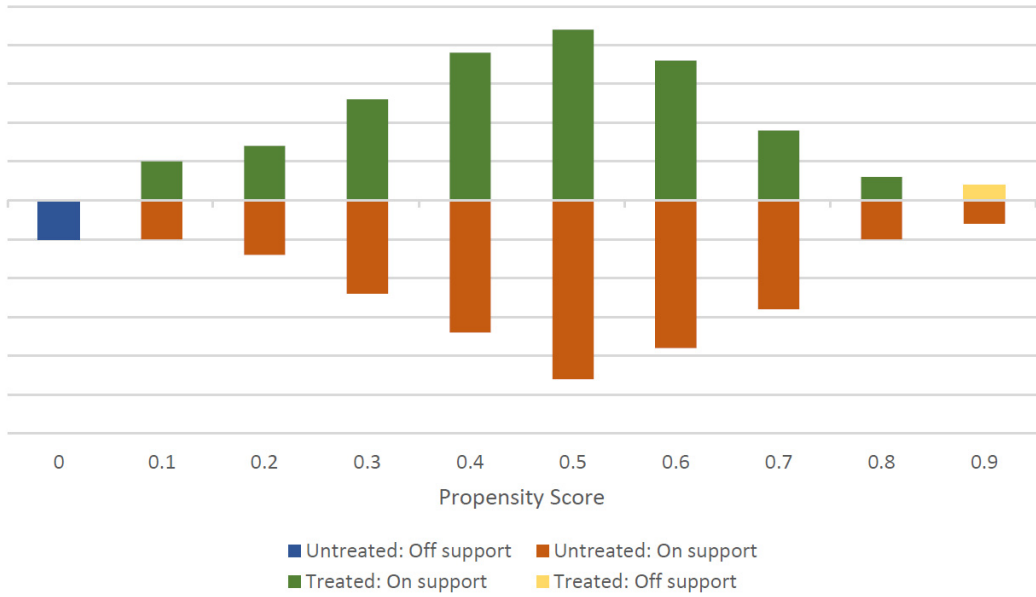
III. Methodology

A. Empirical method

This study employs a quasi-experimental difference-in-difference (DID) method to estimate treatment effects of being included in the Yangtze Delta integration project on improving household welfare and reducing household welfare gaps. As is demonstrated in previous sections, there are differences in the time points of joining the Yangtze Delta integration area for different prefecture-level cities in Jiangsu, Zhejiang, and Anhui Provinces while whether to be included in this project depends on the regional development strategy proposed by the central government rather than local governments, according to the top-down decision-making mechanism in China (Wu & Sun, 2023). It presents a quasi-experimental feature that is suitable for the DID method. The central government might also select cities with biased inclination that prefers those with higher-level economic development to be included in the integration project prior to others (Li, 2010), which leads to potential selection bias for this study. Thus, we further apply the Propensity Score Matching (PSM) methodology to construct a comparable control group and eliminate selection bias.

The propensity score denotes the likelihood of a unit to participate in a program or be impacted by a policy or event, derived from observed characteristics (Caliendo & Kopeinig, 2008). The PSM method then matches treated units to untreated ones based on propensity scores for all units. More specifically, the implementation process of the PSM in this study comprises several steps. First, covariates such as GDP per capita, population density, and trade volume are carefully selected to delineate the similarity among individuals from different cities in the Yangtze Delta area. A binary choice logit model is then employed to estimate this similarity. Second, linearized propensity scores are computed to ensure consistency between the propensity score similarity and covariate similarity across cities. Finally, the outcomes of the PSM process gauge the effectiveness of the matching, as illustrated in Fig. 3. As is shown in this figure, the nuclear density in accordance with propensity scores shows almost normal distribution, which means that the operation of propensity score matching has achieved an ideal result and selection bias can to a large extent be eliminated (Abadie & Imbens, 2016).

Figure 3. Bar chart of propensity scores



After the methodological framework is justified above, we establish the benchmark model to examine general impacts of regional integration on household welfare in the Yangtze Delta area, demonstrated in Eq. (1) as follows:

$$Welfare = \alpha_0 + \alpha_1 integration_{it} + \lambda X_{it} + \delta_i + \mu_t + \epsilon_{it} \tag{1}$$

where the dependent variable, i.e., $Welfare_{it}$ denotes the level of household welfare measured by household disposable income and household aggregate consumption for household i at year t . The core independent variable, i.e., $Integration_{it}$ is an interaction term of the policy dummy variable ($Treat_i$) and the time dummy variable ($Post_t$). If the city where household i lived belonged to the Yangtze Delta integration project, $Treat_i$ equals 1, otherwise it takes the value of 0. This variable is used to distinguish treated and control groups. If in year t , the city where household i lived was included in the integration project, then $Post_t$ equals 1, 0 otherwise. Thus, the coefficient of this interaction term reflects the impact brought by the integration project on household welfare. X_{it} represents a vector of control variables, including GDP per capita, population density, urbanisation rates, and other macroeconomic measures in the city where each sample family lives. Finally, δ , μ , and ϵ are individual fixed effects, time fixed effects, and error terms, respectively.

To further examine potential mechanisms through which joining the integration project can

impact household welfare in the Yangtze Delta area, following previous discussions, we introduce the following equations of mechanism tests that examine the potential mechanisms of interprovincial trade, migration, and infrastructural connectivity which is measured by the number of inter-city highways in the area, respectively. The interaction terms, i.e., $Integration_{it} \times T_{it}/M_{it}/H_{it}$, are applied for justifying effects of these mechanisms on correlations between the integration project and household welfare using the panel data. Coefficients of these interaction terms measure the efficiency of mechanisms in impacts of integration on household welfare.

$$Welfare_{it} = \phi_0 + \phi_1 Integration_{it} + \phi_2 (Integration_{it} \times T_{it}) + \lambda X_{it} + \delta_i + \mu_t + \epsilon_{it} \quad (2)$$

$$Welfare_{it} = \phi_0 + \phi_1 Integration_{it} + \phi_2 (Integration_{it} \times M_{it}) + \lambda X_{it} + \delta_i + \mu_t + \epsilon_{it} \quad (3)$$

$$Welfare_{it} = \phi_0 + \phi_1 Integration_{it} + \phi_2 (Integration_{it} \times H_{it}) + \lambda X_{it} + \delta_i + \mu_t + \epsilon_{it} \quad (4)$$

B. Variables

The core independent variable, i.e., $Integration_{it}$ decides whether the city where the sample family i lives belonged to the Yangtze Delta integration project at time t and equals to 1 if the city where the designated sample family lived belonged to the integration project and equals to 0 if otherwise. Again, we believe that the top-down administrative decision pattern in China makes the integration a quasi-natural experiment and individual household can hardly have impacts on such decisions (Li et al., 2015).

The dependent variable includes two measurements, i.e., household disposable income and household consumption expenditure, both of which are the most common measurements of household welfare in the existing literature and contain adequate samples in the database used in this study. The definition of household disposable income in China, given by the National Bureau of Statistics, is total sum available to family members for final consumption expenditure, other non-obligatory expenses, and savings while the household consumption expenditure refers to all expenses used to meet the daily living needs of the family including expenses of food, clothing, housing, education, and healthcare⁵).

A series of control variables are considered in this study to eliminate initial gaps in economic growths and social developments. According to Firebaugh & Beck (1994), local economic growth can largely impact the initial capability of obtaining and maintaining household welfare, which can be measured by GDP per capita (GDP), unemployment rates (UR), inflation rates (IR), proportions of the tertiary industry ($Industry$), and total trade volumes ($Trade$). In addition, following previous studies such as Long & Ji (2019) and Tsen (2010), we also include

5) See the document issued by National Bureau of Statistics: <http://222.240.193.190/19tjnj/zk/html/zb06.pdf>

the population density (*POP*) and urbanisation rates (*Urban*) as socioeconomic control variables since these variables might also correlate with household welfare. Finally, three mechanism variables are measured by total domestic trade volumes, the number of inter-city migrants, and the number of inter-city highways in the city where each household lives.

IV. Data

Data of the dependent variable comes from the database of Chinese Family Panel Studies (CFPS) which aims to reflect the changes in Chinese society, economy, population, education, and health by tracking and collecting data at three levels: individual, household, and community. In terms of household welfare, this database contains data on multiple core variables of welfare which makes it one of the most widely-used databases in empirical research on welfare in China. For our study, we use the data of household disposable income and household consumption expenditure from the CFPS database for the period of 2010-2020. Data from 2,280 households spanning 41 prefecture-level cities in the Yangtze Delta region was collected. This study encompasses both rural and urban households, aiming to offer a thorough examination of the subject matter. Furthermore, households previously separated during the sampling period were consolidated. Following the elimination of observations containing missing data and outliers, we compiled a panel consisting of 19,532 responses spanning the period from 2010 to 2020.

The values of the independent dummy variable are based on different time points of being included in the integration project for individual prefecture-level cities in the Yangtze Delta area. Verifying these time points depends on the official Outline of the Yangtze River Delta Regional Integrated Development Plan⁶⁾ and the key word of "being included in the Yangtze Delta integration project" in each year's Report on Administrative Work, a Chinese version of State of the Union address, for each city.

Data of the control variables and mechanism variables relies on the China City Statistical Yearbook (2010-2020) and Statistical Yearbooks for each prefecture-level city in this area during this period. To justify the feasibility of data and eliminate errors, we also refer to data from the China Regional Economic Statistical Yearbook, the National Economic and Social Development Statistical Bulletin of China, and the CEIC database. It is also important to note that interpolation has been adopted to serve the purpose of completing absent data points, thereby facilitating the acquisition of balanced panel data. Variables with extremely large values of data are log linearised.

6) See the website of State Council of China (in Chinese): https://www.gov.cn/zhengce/2019-12/01/content_5457442.htm

V. Results and Discussions

A. Descriptive statistics

The initial phase involves acquiring descriptive statistics for variables and offering an overview of the historical trends associated with these variables. Table 1 shows the summary statistics for all relevant variables.

Table 1. *Variable Definitions and Descriptive Statistics*

Variable	Definitions	Obs.	Mean	S.D.	Min	Max
Integration	Equal to 1 if the city where the household lives belongs to the integration project; 0 otherwise	19,532	0.566	0.325	0.000	1.000
Welfare (1)	Disposable income (1000 Yuan/capita/year)	19,532	52.892	11.233	25.678	84.834
Welfare (2)	Consumption expense (1000 Yuan/capita/year)	19,532	29.005	9.902	14.798	47.657
Family	Number of family members in the household	19,532	3.219	2.356	2.000	8.000
Poverty	Equal to 1 if the household is categorised as state-registration poverty family ⁷⁾	19,532	0.177	0.269	0.000	1.000
Dependency	The ratio of family members aged below 14 and over 64 to members between 15 and 63	19,532	0.525	0.658	0.125	1.278
GDP	GDP per capita of the city (log)	19,532	5.005	1.764	4.482	5.256
UR	Unemployment rate of the city	19,532	7.025	0.645	6.338	8.856
Industry	Proportion of the tertiary industry of the city	19,532	0.563	1.322	0.244	0.733
Trade	Total trade volumes of the city (log)	19,532	7.202	2.755	5.551	8.624
POP	Population density of the city (log)	19,532	3.025	1.779	2.412	3.602
Urban	Urbanisation rate of the city	19,532	0.687	2.456	0.503	0.893

This table especially demonstrates extremely diverse features of households and local economic growth across the Yangtze Delta area. For example, the standard deviations of household disposable income, consumption expenditure, GDP per capita, trade volumes, and urbanisation rates are remarkably high. More explicitly, Figs 4 and 5 show that household disposable income and consumption expenditure among all prefecture-level cities in this area vary to a large extent, i.e., the city of Shanghai and the majority of cities in Jiangsu and Zhejiang provinces have witnessed relatively higher levels of income and consumption while cities in Anhui province still suffer from low income and consumption expense. Following Yang et al. (2023), it is important to note that both the city of Shanghai, the Chinese economic centre, and Anhui Province which owns dozens of state-registered poverty areas are included in the Yangtze Delta integration project, which might lead to the notable variations in household

7) It is a nationwide system that categorises state-registration poverty families whose income is no more than 8700 RMB Yuan per year. For more information, see the website of the State Council: http://english.scio.gov.cn/featured/chinakeywords/2021-05/13/content_77493374.htm

welfare and economic growth.

Figure 4. Household disposable income in the Yangtze Delta area (2023)

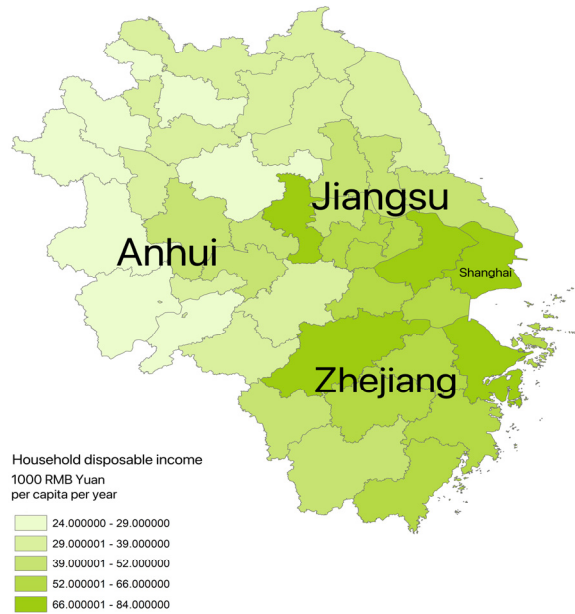
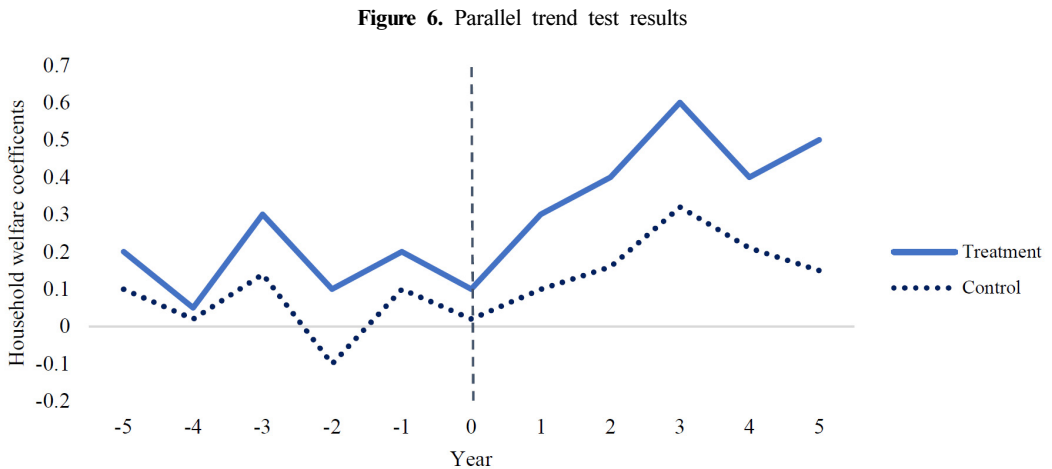


Figure 5. Household consumption expenditure in the Yangtze Delta area



B. Parallel trend test

One essential assumption of feasibility of applying the DID method is the common trend assumption which necessitates that both the treatment and control groups exhibit similar trends in household welfare prior to the initiation of the Yangtze Delta integration project. To preliminarily assess this assumption, Figure 6 displays the carbon emission efficiency of both groups and illustrates the trends in the average values of household welfare regression coefficients from 2010 to 2020. The black dash line highlights the threshold year when a major statement of Yangtze Delta integration was announced. It clearly shows that household welfare coefficients in treatment group cities have a rather same variation trend with samples in the control group cities before 2015, which verifies the common trend assumption.



C. Benchmark model results

Regression results of the benchmark model are presented in Table 2. Columns from I1 to I3 represent relevant coefficients with regard to household disposable income with household fixed-effect controlled only, regional fixed-effect controlled only, and with both household and regional fixed-effect controlled. Columns from C1 to C3 represent coefficients with regard to household consumption expenditure with the same order of fixed-effect controlled as above. We specifically focus on results in columns I3 and C3 which demonstrate comprehensive regression outcomes by controlling both household individual and city-level regional fixed-effect vectors.

Table 2. *General Impacts of Yangtze Delta Integration on Household Welfare*

Variable	(1) I1	(2) I2	(3) I3	(4) C1	(5) C2	(6) C3
Integration	0.766*** (2.582)	0.643*** (0.584)	0.732*** (1.004)	0.367*** (1.345)	0.378*** (2.558)	0.362*** (5.743)
Family	-0.034** (5.772)		-0.036* (1.111)	0.035 (-0.345)		0.036 (-0.033)
Poverty	-1.245*** (3.338)		-1.255*** (7.723)	-0.433*** (0.989)		-0.456*** (1.021)
Dependency	-0.004** (0.885)		-0.005** (0.002)	-0.032* (-2.233)		-0.034 (1.667)
GDP		0.233*** (2.726)	0.237** (0.589)		0.104*** (1.003)	0.107** (1.478)
UR		-0.032 (2.389)	-0.036 (-3.377)		-0.014 (5.762)	-0.010 (2.614)
Industry		0.344*** (6.655)	0.368*** (2.678)		0.204** (2.003)	0.225** (4.698)
Trade		0.006* (0.988)	0.008** (1.005)		0.002* (-0.036)	0.003** (3.902)
POP		0.002** (-2.033)	0.004** (-0.989)		0.003** (0.558)	0.003** (3.905)
Urban		0.188** (4.723)	0.194*** (2.679)		0.142* (3.373)	0.152** (0.836)
Constant	1.208*** (5.549)	1.047*** (2.346)	1.326*** (-3.389)	0.987*** (-5.654)	0.956*** (-2.217)	0.968*** (-1.013)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
ID FE	Yes	No	Yes	Yes	No	Yes
Regional FE	No	Yes	Yes	No	Yes	Yes
R-Squared	0.678	0.623	0.532	0.779	0.682	0.633
Observations	19,532	19,532	19,532	19,532	19,532	19,532

Note. The t-statistics clustered by households are reported in parentheses. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Results show that coefficients of the policy variable, i.e., integration, in all columns are positive at the 5% significance level, indicating that in general, regional integration indeed has significant impacts on improving household welfare in the Yangtze Delta area, which supports Hypothesis 1. Meanwhile, it is important to note that such impacts seem to be more outstanding on household disposable income than on household consumption due to higher values of coefficients for the former than the latter with similar levels of significance. Regarding household and regional control variables, based on columns I3 and C3, we can find that (1) the family size and the ratio of family dependencies have significant impacts on household disposable income, (2) being registered as state-level poverty families is significantly correlated with household disposable income and consumption expenditure, (3) GDP per capita, the proportion of the tertiary industry, trade volumes, population density, and urbanization rates

are all significantly correlated with household disposable income and consumption expenditure.

D. Spatial heterogeneity

Columns from (1) to (8) of Table 3 report the results of the spatial heterogeneity test, which confirms the existence of regional heterogeneity in impacts of the Yangtze Delta integration on household welfare in this area. More specifically, impacts of regional integration on household disposable income are more significant in cities in Anhui Province compared to those in wealthier Jiangsu and Zhejiang provinces and the city of Shanghai, while impacts of integration on household consumption are more significant in cities in Jiangsu and Zhejiang provinces than those in Anhui Province, which might result from the fact that the initial level of household welfare in Anhui Province is significantly lower than that in Jiangsu and Zhejiang provinces and marginal improvement in welfare can lead to more significant increases in income and less significant growth in consumption due to inferior local economic growth in less-developed Anhui Province (Qin et al., 2023). The coefficient of household disposable income impacted by integration in Shanghai is not significant, potentially due to Shanghai being the founding member of the Yangtze Delta integration project and the economic centre in China for decades, making it difficult to have significant variations in household welfare driven by integration in past decades.

Table 3. *Spatial Heterogeneity Test Results*

Variable	(1) I: S	(2) I: J	(3) I: Z	(4) I: A	(4) C: S	(5) C: J	(6) C: Z	(7) C: A
Integration	0.235 (0.038)	0.638** (1.119)	0.702*** (2.277)	0.815*** (-1.544)	0.118** (3.348)	0.311*** (5.673)	0.389** (1.588)	0.461* (0.238)
Constant	1.218*** (3.575)	1.445*** (-0.989)	1.227*** (0.054)	1.308*** (-4.489)	0.852*** (0.332)	0.888*** (-1.115)	0.904*** (4.443)	0.948*** (-0.032)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.527	0.586	0.607	0.628	0.501	0.544	0.722	0.697
Observations	2,675	6,245	4,973	5,639	2,675	6,245	4,973	5,639

Note. The t-statistics clustered by households are reported in parentheses. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Results above can justify that the project of regional integration in the Yangtze Delta area contributes to the overall increase in household disposable income and consumption expenditure in the whole area, and positive impacts of the integration on household disposable income are more significant in cities in Anhui Province with inferior initial welfare compared to cities in other provinces, showing that regional integration leads to smaller gaps in household income across

cities in this area. This finding is consistent with studies such as Tang et al. (2022) and Qin et al. (2023), both of which claim that cities with inferior endowments of welfare in the Yangtze Delta area have witnessed stronger correlations between integration and welfare improvements. Therefore, to further improve household welfare and narrow the welfare gaps across regions in the Yangtze Delta area, the integration policy such as urban cluster planning and cross-provincial infrastructural cooperation should be continuously implemented (Zhen et al., 2023).

E. Mechanism verification

Based on equations (2) to (4), we identify the mediating effect of regional integration through potential mechanisms, i.e., trade, migration, and public transport infrastructure. Results of the mechanism test are shown in Table 4. Three major potential mediating-effect variables in accordance with potential mechanisms are tested, and three interaction terms are explicitly analysed to examine whether these variables accelerate impacts of integration on household welfare.

Table 4. Mechanism Test Results

Variable	(1) I1	(2) I2	(3) I3	(4) C1	(5) C2	(6) C3
Integration (I)	0.674*** (0.046)	0.688** (1.557)	0.628** (5.779)	0.304*** (1.323)	0.328*** (-1.129)	0.377*** (3.989)
Trade (T)	0.007** (2.223)			0.004** (-0.032)		
Migration (M)		0.032** (1.033)			0.027** (3.333)	
Transport (H)			0.079*** (1.167)			0.067** (0.007)
I×T	0.006 (-5.678)			0.004 (0.032)		
I×M		0.031** (1.458)			0.021* (3.385)	
I×H			0.088** (0.687)			0.046* (0.023)
Constant	1.034*** (0.345)	1.088*** (1.556)	1.023*** (-1.219)	0.845*** (1.594)	0.885*** (-0.004)	0.867*** (-2.608)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.523	0.673	0.588	0.634	0.505	0.627
Observations	19,532	19,532	19,532	19,532	19,532	19,532

Note. The t-statistics clustered by households are reported in parentheses. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Columns (1) to (3) show the test results for the mediating effect of trade, migration, and public transport infrastructure with regard to household disposable income, respectively. Columns (4) to (6) show the test results for the mediating effect of trade, migration, and public transport infrastructure in terms of household consumption expenditure. We find that coefficients of most mediating-effect variables are significant at the 5% significance level while coefficients of the integration-trade interaction term are insignificant, showing that trade might not be a channel that accelerates improvements in household welfare due to regional integration. Coefficients of other two interaction terms are nevertheless significant, suggesting that growing migration and connections of public transport infrastructure are two mechanisms through which the Yangtze Delta integration project led to overall improvement in household welfare. This finding is consistent with relevant studies on positive correlations between interprovincial migration and welfare (Li & Sicular, 2014; Zhu & Luo, 2010) and encouraging effects of advanced public transportation such as high-speed rail on welfare improvement (Qin, 2017). It is also interesting to note that such mediating effects are relatively powerless on household consumption expenditure, which might be the result of traditional high savings rates and reluctance to consume amid heavy burden and inequality of education and healthcare in China (Yang et al., 2012; Gu et al., 2020).

F. Robustness tests

Table 5 present the results of three robustness tests: replacing the policy shock with a new definition, the removal of outliers, and the adjustment for regression samples. More specifically, columns (1) to (3) and (4) to (6) show results of robustness tests for impacts of integration on household disposable income and consumption expenditure, respectively. First, to replace the policy shock, we use the announcement of Yangtze River Economic Belt in 2015 as the new policy shock with results shown in columns (1) and (4). Second, the top and bottom 1% of the sample regarding household disposable income and consumption expenditure, is omitted as outliers with results shown in columns (2) and (5). Third, the sample period is expanded to 2005-2020 with the number of samples increasing to 23,367 and results are shown in columns (3) and (6). It can be found that all regressions pass the 1% level of significance, which justifies the robustness of this study.

Table 5. Robustness Test Results

Variable	(1) I: Policy	(2) I: Outlier	(3) I: Sample	(4) C: Policy	(5) C: Outlier	(6) C: Sample
Integration (I)	0.603*** (3.378)	0.672*** (2.987)	0.638*** (1.527)	0.336*** (-0.432)	0.317*** (3.939)	0.345*** (1.476)
Constant	1.256*** (1.667)	1.045** (2.738)	1.112*** (-5.802)	0.946*** (1.654)	0.894** (1.617)	0.872*** (1.514)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.328	0.428	0.503	0.534	0.499	0.605
Observations	19,532	14,328	23,367	19,532	14,328	23,367

Note. The t-statistics clustered by households are reported in parentheses. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

VI. Conclusions and Policy Implications

Regional integration has been considered one of the key elements that encourage local economic growth, welfare, and overall competitiveness of regions around the world. Based on the data for 41 prefecture-level cities in the Yangtze Delta area in 2010-2020, we study how regional integration affect household welfare in this typically successful example of integration in China. We then use the mechanism test to examine mediating effects of potential mechanisms, followed by the test of spatial heterogeneity and robustness tests. The following conclusions for this study are drawn. First, the PSM-DID analysis confirms that regional integration can in general improve household welfare significantly in the Yangtze Delta area, and this result is robust to a series of robustness tests. Second, results of the test of spatial heterogeneity show that impacts of integration on household welfare are different among cities in Anhui, Jiangsu, and Zhejiang provinces. Specifically, impacts of integration on household disposable income are more significant in developing regions such as cities in Anhui Province while impacts of integration on household consumption expenditure are more significant in developed regions such as Jiangsu and Zhejiang provinces. Finally, regional integration improves household welfare through the mediating paths of inter-city migration and connections of public transport infrastructure.

These findings raise various policy implications concerning regional integration projects and household welfare. First, policy makers need to emphasize effects of regional integration on improving welfare and eliminating poverty when the nationwide anti-poverty project is currently underway in China. It is important to note that even though China officially declared in 2021 that extreme poverty had been stamped out, poverty still exists in even developed areas such as the Yangtze Delta area. Integration can act as an effective way to further conduct targeted

anti-poverty projects in less developed regions.

Second, interprovincial and inter-city migration and infrastructural connectivity ought to be focused on as they are two potential mechanisms that encourage effects of integration on improving local welfare. With multiple waves of domestic migration in past decades, the Hukou system has almost become ineffective in terms of preventing migration (Chan, 2019). However, invisible barriers preventing migrants from having equal opportunities of housing, education, and healthcare still need to be reduced. China has witnessed rapid development of public transport infrastructure such as highways and high-speed railways (HSR) since the 2000s with the total mileage of highways and HSR ranked the first in the world (Yu et al., 2012). However, administrative obstacle to connectivity of public transport such as cease the operation of inter-city railways during the Zero-Covid period needs to be fixed.

This study nevertheless has following restrictions that can be further solved in the future. First, the Yangtze Delta area represents a successful example of integration in China with relatively higher levels of economic development while integration in less developed regions in China should also be analysed to form a comprehensive picture of integration. Second, restricted data availability of inter-city trade might have caused insignificant impacts of trade as a potential mechanism through which household welfare benefits from integration. Finally, depending on updated data, we aim to decompose impacts of integration on household welfare by adding the Covid-19 pandemic and trade conflict between the US and China to the existing research framework in the future.

References

- Abadie, A., & Imbens, G. W. (2016). Matching on the estimated propensity score. *Econometrica*, 84(2), 781-807.
- Bazaluk, O., Yatsenko, O., Reznikova, N., Bibla, I., Karasova, N., & Nitsenko, V. (2022). International integration processes influence on welfare of country. *Journal of Business Economics and Management*, 23(2), 382-398.
- Biyase, M., & Zwane, T. (2018). An empirical analysis of the determinants of poverty and household welfare in South Africa. *The Journal of Developing Areas*, 52(1), 115-130.
- Bockstael, N. E., & McConnell, K. E. (1983). Welfare measurement in the household production framework. *The American Economic Review*, 73(4), 806-814.
- Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, 22(1), 31-72.
- Carmel, E., & Cerami, A. (2012). Governing migration and welfare: institutions and emotions in the production of differential integration. In *Migration and welfare in the new Europe* (pp. 1-20). Policy Press.

- Chan, K. W. (2019). China's hukou system at 60: Continuity and reform. In *Handbook on urban development in China* (pp. 59-79). Edward Elgar Publishing.
- Chen, Z., Li, Y., & Wang, P. (2020). Transportation accessibility and regional growth in the Greater Bay Area of China. *Transportation Research Part D: Transport and Environment*, 86, 102453.
- Dewilde, C. (2008). Individual and institutional determinants of multidimensional poverty: A European comparison. *Social Indicators Research*, 86, 233-256.
- Feng, Y., Lee, C. C., & Peng, D. (2023). Does regional integration improve economic resilience? Evidence from urban agglomerations in China. *Sustainable Cities and Society*, 88, 104273.
- Firebaugh, G., & Beck, F. D. (1994). Does economic growth benefit the masses? Growth, dependence, and welfare in the third world. *American Sociological Review*, 59(5), 631-653.
- Gu, X., Tam, P. S., Li, G., & Zhao, Q. (2020). An alternative explanation for high saving in China: Rising inequality. *International Review of Economics & Finance*, 69, 1082-1094.
- Guiso, L., & Zaccaria, L. (2023). From patriarchy to partnership: Gender equality and household finance. *Journal of Financial Economics*, 147(3), 573-595.
- Haas, E. B. (1970). The study of regional integration: reflections on the joy and anguish of pretheorizing. *International Organization*, 24(4), 606-646.
- Han, J., Liu, R., Marchand, B. U., & Zhang, J. (2016). Market structure, imperfect tariff pass-through, and household welfare in urban China. *Journal of International Economics*, 100, 220-232.
- Hao, T., Sun, R., Tombe, T., & Zhu, X. (2020). The effect of migration policy on growth, structural change, and regional inequality in China. *Journal of Monetary Economics*, 113, 112-134.
- Hennig, B. D. (2019). The growth and decline of urban agglomerations in Germany. *Environment and Planning A: Economy and Space*, 51(6), 1209-1212.
- Hentschel, J., & Lanjouw, P. (2000). Household welfare measurement and the pricing of basic services. *Journal of International Development: The Journal of the Development Studies Association*, 12(1), 13-27.
- Hong, T., Yu, N., Storm, S., & Gao, B. (2019). How much does regional integration contribute to growth? An analysis of the impact of domestic market integration on regional economic performance in China (1997-2011). *Economic Research-Ekonomska Istraživanja*, 32(1), 3189-3210.
- Hui, E. C., Li, X., Chen, T., & Lang, W. (2020). Deciphering the spatial structure of China's megacity region: A new bay area—The Guangdong-Hong Kong-Macao Greater Bay Area in the making. *Cities*, 105, 102168.
- Jiang, M., Liu, L., Behrens, P., Wang, T., Tang, Z., Chen, D., Yu, Y., Ren, Z., Zhu, S., Tukker, A., & Zhu, B. (2020). Improving subnational input-output analyses using regional trade data: A case-study and comparison. *Environmental Science & Technology*, 54(19), 12732-12741.
- Kang, J., Yu, C., Xue, R., Yang, D., & Shan, Y. (2022). Can regional integration narrow city-level energy efficiency gap in China? *Energy Policy*, 163, 112820.
- Khan, A. R., Griffin, K., Riskin, C., & Renwei, Z. (2017). Household income and its distribution in China. In *Chinese Economic History Since 1949* (pp. 1054-1089). Brill.
- Labar, K., & Bresson, F. (2011). A multidimensional analysis of poverty in China from 1991 to 2006. *China Economic Review*, 22(4), 646-668.

- Li, L. C. (2010). Central-local relations in the people's Republic of China: Trends, processes and impacts for policy implementation. *Public Administration and Development*, 30(3), 177-190.
- Li, S., & Sicular, T. (2014). The distribution of household income in China: Inequality, poverty and policies. *The China Quarterly*, 217, 1-41.
- Li, T., Yang, W., Zhang, H., & Cao, X. (2016). Evaluating the impact of transport investment on the efficiency of regional integrated transport systems in China. *Transport Policy*, 45, 66-76.
- Li, Y., Wu, F., & Hay, I. (2015). City-region integration policies and their incongruous outcomes: The case of Shantou-Chaozhou-Jieyang city-region in east Guangdong Province, China. *Habitat International*, 46, 214-222.
- Lin, J. Y. (2011). New structural economics: A framework for rethinking development. *The World Bank Research Observer*, 26(2), 193-221.
- Lin, Z. J. (2007). From megastructure to megalopolis: Formation and transformation of mega-projects in Tokyo Bay. *Journal of Urban Design*, 12(1), 73-92.
- Liu, Y., Liu, J., & Zhou, Y. (2017). Spatio-temporal patterns of rural poverty in China and targeted poverty alleviation strategies. *Journal of Rural Studies*, 52, 66-75.
- Long, X., & Ji, X. (2019). Economic growth quality, environmental sustainability, and social welfare in China-provincial assessment based on genuine progress indicator (GPI). *Ecological Economics*, 159, 157-176.
- Longhi, C., & Musolesi, A. (2007). European cities in the process of economic integration: towards structural convergence. *The Annals of Regional Science*, 41, 333-351.
- Ma, L., & Tang, Y. (2020). Geography, trade, and internal migration in China. *Journal of Urban Economics*, 115, 103181.
- Marta, J., Fauzi, A., Juanda, B., & Rustiadi, E. (2020). Understanding migration motives and its impact on household welfare: evidence from rural-urban migration in Indonesia. *Regional Studies, Regional Science*, 7(1), 118-132.
- Poncet, S. (2003). Measuring Chinese domestic and international integration. *China Economic Review*, 14(1), 1-21.
- Qin, X., Wei, Y. D., Wu, Y., & Huang, X. (2023). Regional development and inequality within city regions: A study of the Yangtze River delta, China. *Geographical Review*, 113(3), 359-385.
- Qin, Y. (2017). 'No county left behind?' 'The distributional impact of high-speed rail upgrades in China. *Journal of Economic Geography*, 17(3), 489-520.
- Schiff, M. W., & Winters, L. A. (2003). *Regional integration and development*. World Bank Publications.
- Shan, B., Zhang, Q., Ren, Q., Yu, X., & Chen, Y. (2022). Spatial heterogeneity of urban-rural integration and its influencing factors in Shandong province of China. *Scientific Reports*, 12(1), 14317.
- Sideri, S. (1997). Globalisation and regional integration. *The European Journal of Development Research*, 9(1), 38-82.
- Tang, Y., Gao, J., & Chen, W. (2022). The Spatial-Temporal Evolution of Population in the Yangtze River Delta, China: An Urban Hierarchy Perspective. *Land*, 11(10), 1764.
- Tsen, W. H. (2010). Exports, domestic demand, and economic growth in China: Granger causality analysis. *Review of Development Economics*, 14(3), 625-639.

- Wang, J., Yang, X., Qalati, S. A., & Deng, Y. (2022). Spatial spillover effect and spatial distribution characteristics of transportation infrastructure on economic growth: a case of the Yangtze River Delta. *Frontiers in Environmental Science*, 10, 900209.
- Wu, J., & Sun, W. (2023). Regional Integration and Sustainable Development in the Yangtze River Delta, China: Towards a Conceptual Framework and Research Agenda. *Land*, 12(2), 470.
- Yang, D. T., Zhang, J., & Zhou, S. (2012). Why are saving rates so high in China? In *Capitalizing China* (pp. 249-278). University of Chicago Press.
- Yang, J., Li, G., Zhong, Z., Li, Q., Du, G., & Guo, J. (2023). Current situation, bottlenecks, and path options for the development of capital flows and integration in the Yangtze River Delta region. *Frontiers in Sustainable Cities*, 5, 1100685.
- Ye, C., Zhu, J., Li, S., Yang, S., & Chen, M. (2019). Assessment and analysis of regional economic collaborative development within an urban agglomeration: Yangtze River Delta as a case study. *Habitat International*, 83, 20-29.
- Yu, N., De Jong, M., Storm, S., & Mi, J. (2012). Transport infrastructure, spatial clusters and regional economic growth in China. *Transport Reviews*, 32(1), 3-28.
- Zhang, K., Shao, S., & Fan, S. (2020). Market integration and environmental quality: Evidence from the Yangtze River delta region of China. *Journal of Environmental Management*, 261, 110208.
- Zhang, X., Xu, Y., Zhou, C., & Zou, Y. (2024). Governing regional inequality through regional cooperation? A case study of the Guangdong-Hong Kong-Macau Greater Bay area. *Applied Geography*, 162, 103135.
- Zhao, W., & Jiang, C. (2022). Analysis of the Spatial and Temporal Characteristics and Dynamic Effects of Urban-Rural Integration *Development in the Yangtze River Delta Region*. *Land*, 11(7), 1054.
- Zhen, Y., Shi, D., & Lu, Y. (2023). The Impact of Regional Integration Strategies on the Formation of City Regions and Its Agglomeration Shadow: Evidence from the Yangtze River Delta, China. *Land*, 12(5), 1053.
- Zheng, X., Zhang, X., & Fan, D. (2023). Research on the Coordinated Development of Innovation Ability and Regional Integration in Guangdong-Hong Kong-Macao Greater Bay Area. *Sustainability*, 15(4), 3426.
- Zhu, N., & Luo, X. (2010). The impact of migration on rural poverty and inequality: A case study in China. *Agricultural Economics*, 41(2), 191-204.