How to Develop the Rural Area: A Perspective of Rural-Urban Interactions

Xuelong Wang+ and Binjie Zhao

Department of Economics, Hokkaido University, Sapporo, Japan, 060-0809

Abstract. This paper examines the interactive relationship between rural and urban economies with the data of China. Panel Granger causality tests are employed and it is found that China's rural and urban economies are significantly dependent to each other. The urban development plays an important role in driving the rural economic growth, but rural economy does not show strong influence on urban economic development.

Keywords: Rural-Urban Interaction; Causality; Inequality; Demand

1. Introduction

Rural development is very important for social progress and stability in developing countries. But how should we develop the rural sector? Can we just treat rural area separately from the urban area? Intuitively, the answer is "No". It seems that rural and urban economies have mutual influence on each other, and we should combine the rural area with the urban area in economic analysis and policy making.

Von Braun (2007) classifies the rural-urban linkages into two categories, including spatial flows and sectoral flows. If those channels for rural-urban interaction could function well, there would be a virtuous circle between the rural and urban economic growth. Rural growth can result in both the increased demand for farm inputs (like fertilizers and farm equipment) and the increased demand for manufactured goods and services (Diao et al. 2007; de Ferranti et al 2005; Mellor 1995). Those increased demand will boost the economic growth in the urban area. Analogously, the growth of the urban economy means higher demand for agricultural goods (grains, milk, meet, eggs and so on) and more importantly the increased demand for rural labor (Chowdhury et al. 2005). Both the demand for agricultural goods and rural labor will lead to economic growth in the rural area.

Based on the theoretical analysis introduced above, we are going to test the rural-urban interactions with the data of China. Since China is a typical dual economy, the conclusions may be useful to other developing countries. A special methodology is developed, following the idea of Perez-Moreno (2010), to capture the change of the rural-urban interactive relationship. We find that China's rural sector and urban sector are significantly dependent to each other. But the mutual influence is asymmetric. The remainder of the paper is organized as follows: we present the methodological framework in Section2, Section3 shows the empirical results for causality tests and the dynamics of the causality, Section4 gives an explanation of the dynamics of rural-urban interactions, Section5 analyse the policy implications of rural-urban interactions and Section6 concludes.

2. Data and Methodology

2.1. The Data

The National Bureau of Statistics of China provides the data. But the statistical approach of calculating the urban income is different from that of the rural income. The urban income is the average "disposable income" of urban residents, but rural income is the average per-capital "net income" of rural residents. The difference between the two kinds of income is that rural residents must use part of their "net income" to invest in buying seeds, machines, fertilizers. But the difference between statistical approaches is not a vital problem. If only the statistical approaches are stable, we can use the income data to implement our study, because we care the change of rural and urban income instead of the absolute value. More concretely, the causality relationship between variable y and x can also be tested with the data of y and c*x, where c is a

+Corresponding author. E-mail: wangxuelong@ec.hokudai.ac.jp; Tel. : +81-090-28105639; Fax: 011-706-4947.

constant. Since the quality of the old data are not high enough,in order to make full use of the recent high quality data, we decide to use the data of recent ten years, namely from 2000 to 2009. And the provincial panel data covering China's 31 provinces (excluding Hong Kong, Taiwan and Macao) are built.

In order to deal with the problem of omitted variable, international trade is added as a controlled variable. The reason is that products of urban sector or rural sector not only meet the needs of domestic residents, but also meet demands of foreign consumers. Consequently, international trade should have significant influence onrural and urban economies. In this paper, the measurement of trade is the provincial total export-import volumedivided by provincial GDP. This indicator can properly reflect the importance of trade to an economy.

Descriptive statistics of the data are shown in Table1. UI represents the average disposable income of urban residents, RI represents the average per-capita net income of rural residents, GDP represents GDP of each province, Trade represents the total trade volume of a certain province, Tratio is the ratio of Trade to GDP. We use the logarithm instead of level values to implement our study.

Table1. Summary Statistics of the Data

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
UI	*310*	*10414.42*	*4407.13*	*4724.11*	*28837.78*
RI	*310*	*3603.35*	*1937.76*	*1330.81*	*12482.94*
GDP	*310*	*6548.79*	*6587.73*	*117.46*	*39482.56*
Trade	*310*	*3386.28*	*7416.71*	*8.77*	*49850.32*
Tratio	*310*	*0.32*	*0.39*	*0.04*	*1.71*

Note: The data are available in the China Statistics Yearbook. The units of per-capita income are Yuan. We calculate Tratio basing on the data of Trade and provincial GDP.

2.2. The Methodology

2.2.1. Total Sample Granger Test

The underlying idea of Granger's classic method is that, if a certain variable x causes other variable y, then the past information of x should help to explain and predict y. Put differently, the lagged values of x in a regression of y on its own lagged values and other explanatory variables should significantly improve the forecasting power of the model. If the past values of y help explain x, then y is supposed to be a causal factor of x. Following such a spirit, we can apply it to the case of panel data.

Although the panel models provide a number of improvements over the separate analyses of time series data by cross-section, the methodologies testing Granger causality with panel data is very limited. A distinctive method is developed by Hurlin and Venet (2001), Hurlin and Venet (2004), which relies on F-test to analyze the existence of causality among variables. We design the following steps according to their methodology so as to test the interactive relationships between rural income and urban income.

$$UI_{it} = a_i + \sum_{k=1}^{p} \beta_k UI_{it-k} + \sum_{k=1}^{p} \gamma_k RI_{it-k} + u_{it} \quad (1)$$

$$RI_{it} = b_i + \sum_{k=1}^{p} \delta_k RI_{it-k} + \sum_{k=1}^{p} \eta_k UI_{it-k} + v_{it} \quad (2)$$

Where UI denotes the log-level of the average urban per-capita income and RI represents the log-level of the average rural per-capita income, t represents time period (t=0, 1 …T), i is the individual of the panel (i=0, 1 …N), $a_i$and b_i are fixed effects, k is the lag order and it is assumed to be common, p is the maximum number of considered lags, u_{it} and v_{it} are random terms. The autoregressive parameters ($\beta_k$and δ_k) and the regression coefficients slopes ($\gamma_k$and η_k) are assumed to be equal across provinces. It is important to note that our model is not a random coefficient model, but a fixed coefficients model with fixed individual effects. We can use F-test to check the Granger causality relationship. For example, with regard to equation (1), the null hypothesis is

$$H_0\text{: There is no causal relationsip from RC to UC.}$$

The F-statistic should be

$$F = \frac{(RSS_2 - RSS_1)/p}{RSS_1/[NT - (2p+1)]}$$

Where RSS_1 is the sum of squared residuals from the unrestricted model, RSS_2 represents the sum of squared residuals from the restricted models. In the restricted model, the coefficients of lags of RI (γ_k) are constrained to 0. N is the number of cross-sections, p is the number of lags, and T is the number of time periods. An insignificant statistic for this F-test indicates that RI does not Granger cause UI. With a similar approach we can test the causal relationship from UI to RI.

2.2.2. Subsample Analysis

Although we are able to test the Granger causality relationship with the method introduced above, it is difficult for us to get deep understanding about the structure of rural-urban interactions. Is there any structural change in the rural-urban interactive relationship as the rural and urban economies develop? Is the influence of urban economy on rural economy constant and unchanging? We propose a method, following Perez-Moreno (2010), to check the structure and the change of the rural-urban interactive relationship. Consider the four models shown below:

$$UI_{it} = a_i + \sum_{k=1}^{p} \alpha_k UI_{it-k} + \sum_{k=1}^{p} \beta_k RI_{it-1} + \sum_{k=1}^{p} \gamma_k Tratio_{it-k} + u_{it} \quad (3)$$

$$UI_{it} = a_i + \sum_{k=1}^{p} \alpha_k UI_{it-k} + \sum_{k=1}^{p} \gamma_k Tratio_{it-k} + \varepsilon_{it} \quad (4)$$

$$RI_{it} = b_i + \sum_{k=1}^{p} \alpha_k RI_{it-k} + \sum_{k=1}^{p} \beta_k UI_{it-1} + \sum_{k=1}^{p} \gamma_k Tratio_{it-k} + v_{it} \quad (5)$$

$$RI_{it} = b_i + \sum_{k=1}^{p} \alpha_k RI_{it-k} + \sum_{k=1}^{p} \gamma_k Tratio_{it-k} + \varepsilon_{it} \quad (6)$$

UI denotes the log-level of the urban per-capita income and RI represents the log-level of the rural per-capita income. t represents time period (t=0, 1 …T), i is the individual of the panel (i=0, 1 …N), $a_i$and b_i are fixed effects, k is the lag order, p is the maximum number of considered lags, u_{it} and v_{it} are random terms.Models (3) and (4) are rival models to test whether rural income (RI) is a causal factor of the urban income (UI). Model (4) adds the past information of rural income to Model (3). If rural income is a causal factor of the urban income, then the variables of RI_{it-k} should significantly improve the forecasting power of the model. Models (5) and (6) are employed to check whether urban income is a causal factor of the rural income.

A key issue is how to test whether the forecasting power of a model has been significantly improved by the new variables. A sum-difference test is useful to solve this problem. Denote φ_{1it} as the forecasting error from model (3) and φ_{2it} as the forecasting error from model (4). If the added explanatory variable does not improve model (3) at all, then $|\varphi_{1it}| = |\varphi_{2it}|$. The null hypothesis is

$$H_0: \varphi_{1it}^2 = \varphi_{2it}^2$$

If the null hypothesis is rejected, we should accept the model with models with new variable. Define

$$Sum_{12it} = \varphi_{1it} + \varphi_{2it}$$
$$Dif_{12it} = \varphi_{1it} - \varphi_{2it}$$

To test the null hypothesis is equal to test whether $\delta = 0$ from the regression

$$Sum_{12it} = \alpha + \delta Dif_{12it} + \varepsilon_{it}$$

If δ is significantly different to 0, then the null hypothesis that model (3) and model (4) have the same forecasting power is rejected. So the forecasting power of the model has been significantly improved by the added variable (RI_{it-k}). It means thatthe rural per-capita income is a causal factor of the urban per-capita income. Through the similar way we can test whether the urban per-capita income is a significant reason for the change of the rural per-capita income with models (5) and (6).

The concrete steps are as follows: 1) Divide the sample into two parts according to the period (we divide the sample averagely. the first one covers the period from 2000 to 2004 and the second one covers the period from 2005 to 2009) ; 2) Use one part of the dataset to fit the unrestricted model and the restricted model; 3) Use the estimated coefficients and the second part of the dataset to get the forecasting errors; 4) Implement the sum-difference test with the forecasting errors. And judge the existence of causal relationship with the results of sum-difference test.

This methodology can not only test the causal relationships between rural income and urban income, but also help us to observe the structural change of the causality relation. Because we divide the total sample into two parts, we can compare the coefficients of the two periods. From the comparison of coefficients in the two periods, we can see that whether rural development keeps a constant influence on urban growth; whether the influence could change at different periods.

3. Empirical Results

3.1. Empirical Results of Total Sample Test

Before estimating the model, unit root test and cointegration test are implemented. With Levin-Lin-Chu unit root test for panel data we find that all of the variables are first order stationary. In addition, the panel data cointegration test, developed by Persyn and Westerlund (2008), proves the long-term stable relation between the rural income and the urban income.

We test the causality relationship between rural income and urban income with the total sample through the method introduced in section 2.2.1. Results are shown in Table2.

Table2. Results of Total Sample Granger Test

F-statistics	H_0: *RI does not cause UI*	H_0: *UI does not cause RI*
k=1	*134.51****	*212.24****
k=2	*89.04****	*114.18****

Notes: *, ** and ***denotes the significance at the 10, 5 and 1percent level respectively. k is the lag order of models.

We can observe from the results that there are significant interactive relationships between rural income and urban income. The results prove the existence of rural-urban interactions indicated by the theoretical analysis.

3.2. Empirical Results of the Second Method

We test the causal relationship between rural and urban economies with the second method at the situation of k=1, which means that lag period is assume to be one year. are presented in Tables 2. The result simply that UI_{it-1} is a positive explanatory variable of UI_{it}, but RI_{it-1} is not a significant explanatory variable of UI_{it}. We can also observe that RI_{it} is positively influenced by RI_{it-1}, and the results of Model(5) tell us that UI_{it-1} is a positive explanatory variable of RI_{it} in both time periods. It shows that UI_{it-1} also positively influences RI_{it}, the estimated coefficients are around 0.33 in both periods. We use the log-level of the variables in the empirical analysis, so 0.33 can be interpreted as elasticity. It means that in the period from 2005 to 2009, if the income of urban residents increased by 1%, the income of rural residents would increase by 0.33% in the next year. So the urban income is likely to be a causal factor of rural income.

Table3. Sub Sample Regression Results of Models (3) and (4)

Independent Variables	*Dependent Variable: UI_{it}*				*Independent Variables*	*Dependent Variable: RI_{it}*			
	Model (3)	*Model (4)*	*Model (3)*	*Model (4)*		*Model (5)*	*Model (6)*	*Model (5)*	*Model (6)*
	2000-2004	*2000-2004*	*2005-2009*	*2005-2009*		*2000-2004*	*2000-2004*	*2005-2009*	*2005-2009*
UI_{it-1}	*0.9265*** (0.0810)*	*0.9999*** (0.0266)*	*0.7295*** (0.1691)*	*0.9713*** (0.0086)*	RI_{it-1}	*0.7248*** (0.1472)*	*1.2353*** (0.0462)*	*0.6537*** (0.1538)*	*0.9796*** (0.0098)*
RI_{it-1}	*0.1311 (0.1394)*		*0.2536 (0.1745)*		UI_{it-1}	*0.3357*** (0.0892)*		*0.3215** (0.1490)*	
$Tratio_{it-1}$	*0.0261 (0.0185)*	*0.0275 (0.0180)*	*0.0242 (0.0224)*	*0.0278 (0.0277)*	$Tratio_{it-1}$	*0.0493* (0.0275)*	*0.0599 (0.0300)*	*0.0370* (0.0204)*	*0.0354 (0.0216)*
Constant	*-0.2283 (0.4723)*	*0.1458 (0.2546)*	*0.5924*** (0.1934)*	*0.4245*** (0.1033)*	*Constant*	*-0.6715 (0.5060)*	*-1.6555 (0.3871)*	*0.0109 (0.1614)*	*0.3326*** (0.0955)*
R^2	*0.9523*	*0.9515*	*0.9716*	*0.9696*	R^2	*0.9340*	*0.9123*	*0.9695*	*0.9659*
Number of Observations	*124*	*124*	*155*	*155*	*Number of Observations*	*124*	*124*	*155*	*155*
Number of Groups	*31*	*31*	*31*	*31*	*Number of Groups*	*31*	*31*	*31*	*31*

Notes: *, ** and ***denotes the significance at the 10, 5 and 1peRIent level respectively and robust standard errors are in parentheses. FE means the fixed-effect model for panel data analysis.

From the results of the sum-difference test, which are presented in Table4, we can find that obvious inter linkages exist between China's rural and urban economies. In both periods, there is important difference between forecasting power of Models (3) and (4), because the forecasting errors of Models (3) and (4) are significantly different from each other at the 1 percent significance level. The reason is thatRI_{it-1} improves the forecasting power of the model significantly, which means *RI* is a causal factor of *UI*. Similarly, results of models (5) and (6) also indicate that *UI* is a causal factor of *RI*. So the interactive relationship between rural and urban economies is proved. The conclusions

Table4. Results of the Sum-Difference Test

	2000-2004	*2005-2009*
Models (3) and (4)	*1.9577**** *(0.1782)*	*1.1930**** *(0.1069)*
Models (5) and (6)	*-1.0346**** *(0.0712)*	*0.5488**** *(0.0944)*

Notes: *, ** and ***denotes the significance at the 10, 5 and 1peRIent level respectively and standard errors are in parentheses.

Both of the two panel Granger tests prove the rural-urban interactive relationship. Although there does exist mutual influence between rural and urban economies, the influence is not symmetric. From the comparison coefficients we can see that the influence of China's rural economy is insignificant and relatively weak. At the same time China's urban economy shows a significant and constant influence on rural economy. It implies that the virtuous circle between rural and urban economic development is not obvious in China. Although China's urban development can drive the growth of the rural area seriously, the rural economy cannot drive the growth of the urban sector. So there may be some problems with China's rural and urban development.

4. Concluding Remarks

This paper examines the interactive relationship between rural economy and urban economy with the data of China. Panel Granger causality tests are employed. China's rural sector and urban sector are found to be significantly dependent to each other. The development of urban economy plays an important role in driving the development of rural economy, but the development of rural economy could not stimulate urban development powerfully.

5. References

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