Non-Parametric Estimation of Urban-Rural Digital Gap in China

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Abstract. Urban-rural digital gap include the access and application in information technology, and it is put forward in 1995 by NTIA. China's digital gap are getting worse, and it must be bridged as soon as possible. The non-parametric estimation model is constructed in this paper to study testifying result of stability. And kernel density function is built for abstraction of new explanatory variables. Finally, some policy suggestions are given to narrow China's digital gap.

Introduction

The notion "urban-rural digital gap" was put forward in 1995 by NTIA, refers to the gap between Urban and rural in information technology(typically cyber space technology) since the coming of industrial society especially since the transition from industrial society to information society, that is in the current backdrop of global digitalization. These gaps include the access and application in information technology, the subject consciousness that affect the former factors, as well as the environmental difference. All of these gaps reflect the disparity between urban and rural informatization. Since the advent of information age, urbanization has been fast developing, but we still have to pay much attention to the digital gap which will have large impact in the process of urbanization.

Literature Review

The digital gap between urban and rural areas has a profound effect in the development of urbanization in economic and society. And it was researched mainly from the economic level, society and the urban space levels. The first kind of opinion is that urban-rural digital gap would hinder economic development in the countryside. Labrianidis and Kalogeressis (2006)[1], James (2008)[2], Digital gap widened the income gap between the urban and rural residents, and then strengthened the urban and rural economic structure. The second kind of opinion is that urban-rural digital gap inhibited the upgrading of the industrial structure.Guo (2014) thought that the existence of the information gap would make the capital, talent and technology, material resource allocated to the city, then lead to the rural areas marginalized. The third kind of idea is that urban-rural digital gap impeded the improvement of living standards of rural residents[3]. Norris and Conceicao(2014) compared the Internet penetration rate of low-income   and high income groups[4]. They thought the digital gap deprived the opportunity of urban low-income to improve their income and change their lifestyles[5], and then triggered a new city population inequality in the information age. The cycle is urban-rural digital gap, information Matthew effect, urban-rural economic gap, urban-rural economic gap, the digital gap[6].

Non-Parametric Estimation Model

Model Construction

Unlike traditional parametric estimation , with non parametric estimation we don't have to preset the relationship between the economic variables and estimate the parameters of the whole

model, thus reduces the possibility of error and makes the result closer to reality. As the dynamics in China's urbanization are caused in a complicated way that scholars haven't worked out yet, I will not set the function of $UD(\cdot,\cdot)$ in this essay but work out the damping coefficient with non parameter estimation instead. Change formula with equivalence into

$$Drag_{duS} = K^{du}UD(ED,TA) \qquad\qquad （1）$$

$Drag_{duS}$ is dependant variable, while EG、TA are explanatory variable, K^{du} is multiplier, $UD(\cdot,\cdot)$ is unknown function, then formula (1) is a non-parameter estimation model of damping coefficient.

Partial Linear Estimation

As the estimated parameter in the damping coefficient non-parameter estimation model is the multiplier K^{du}, partial linear estimation(the method used specifically to estimate multiplier in a non-parameter system) is used here.

When doing partial linear estimation, there is possibility of multicolinearity if the correlation coefficient is relatively high (r_{12}=0.67274, the standard is 0.6) between economic growth rate and technological advancement rate., in order to make up, Principal component regression can be used. In principal regression, by constructing the linear combination of the original explanatory variables, unrelated new explanatory variables can be made, most of which carry information of original explanatory variables.

Principal component regression requires there is co-integration or stability among the applied data. It's know from Table 1 that EG and TA are integrated. Therefore it's necessary only to testify the time series of dependant variable- $Drag_{duS}$ with software Eviews7.1.

Table1　Testifying Result of Stability

Sequence	ADF	Critical value		Conclusion
		1%	5%	
Variable	0.08878	-0.09992	-0.07533	Non-stationary
△*Variable*	0.06642	-0.12228	-0.09769	Non-stationary
△²*Variable*	-0.11214	-0.12072	-0.09665	Stable

Then test the co-integration among $Drag_{duS}$, EG, TA with Eviews7.1, for the result see Table 2. By comparing the trace test in Table 2 and critical value of the significance above 5% and 10%, the result indicates there is a co-integration equation on 5% significance level.

Table2　*Co*-Integration Testifying Result

Hypothesis of cointegration equation	Characteristic root	Trace statistics	1%	5%
Non**	0.17985	19.34489	22.23247	16.37239
At most one	0.14409	11.53965	17.90951	12.12305
At most two	0.08968	5.47642	8.27588	6.80486

Note：** is an indicator that the data are significant above the level of 5%.

Setting of Kernel Density Function

Abstraction of New Explanatory Variables

Abstracting main components from EG, TA with software SPSS19.0, for the result see Table 3. It can be seen that the contribution rate of $COMP_1$ amounts to 98.88393% already, which can therefore be regarded as a new variable. The loading capacity it has on EG and TA are 0.71459 and 0.32597 respectively, that is $COMP_1$=0.71459EG+0.32597TA.

Table3　Main Component Variable and Characteristic Value

Main Component Variable	Characteristic Value	Contribution Rate	Accumulating Contribution Rate
$COMP_1$	1.49908	98.88393%	98.88393%
$COMP_2$	0.19803	1.11607%	100%

Formula to Get the Partial Linear Estimation Result

According to the Kernel Density Function of partial linear estimation, suppose kernel density function in this essay as:

$$Fc(COMP_1) = \frac{1}{22 \cdot Bw} \sum_{i=1}^{22} Ke(COMP_1) \qquad (2)$$

$Ke(COMP_1)$ in Formula (2) is named Kernel Function, satisfying the

condition $Ke(COMP_1) \geq 0$, $\int_{-\infty}^{+\infty} Ke(COMP_1) d(COMP_1) = 1$, further

$$Ke(COMP_1) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{COMP_1^2}{2}\right) \qquad (3)$$

In formula（3）Bw is Bandwidth which is the most important element in setting a Kernel density function. That's because the value of Bw has the largest impact on the estimation result. If Bandwidth value is too small, the noise resulted from random error term cannot be got ridden of; if it's too large the error may also be exaggerated. Therefore the optimized Bandwidth given by a non-parameter estimation is as follows

$$\hat{Bw} = \left\{ \frac{\int [Ke(COMP_1)]^2 d(COMP_1)}{\sigma^4 \int [Fc''(COMP_1)]^2 d(COMP_1)} \right\}^{\frac{1}{5}} / 22^{\frac{1}{5}} \qquad (4)$$

In formula（4）σ is the standard deviation of the fixed point.

Set a simultaneous equation system with formula（2），（3）and（4）we can get kernel density function $Fc(COMP_1)$。

Suppose $Y_i = Drag_{duSi}$，（$i = 1,2,\cdots,22$） and linearization formula (4) at the point $X_i = COMP_{1i}$, then formula（5）is transformed to

$$Y_i = K^{du}\left[Fc(x) + (X_i - x)\frac{dFc(x)}{dx} + \varepsilon_i \right] \qquad (5)$$

ε_i is the error term after partial linearization.

The highest fluctuation range of the point-to-point estimation (maximum value-minimum $\times$ 100%) value is 1.901%. According to the stability criterion of partial linear estimation, it's stable if the maximum fluctuation range is within 5%, therefore the result shows that the estimation value is generally stable. It's also demonstration that the urban-rural digital gap represented by damping coefficient has an innate power to impair the driving force of urbanization. However the point-to-point estimation value is just stable around the general value 0.07695 for a certain period of time, specifically during 1990-2014 in this essay. If some significant changes take place in China's social and economic system in the future, then the point-to-point estimation value may appear near another general estimation value, and there may be some major change in the power of digital gap to weaken the dynamic of urbanization. Multipliers represent the power of digital gap in impairing economic dynamic and technological dynamic respectively.

Policy Suggestions

Since urban-rural digital gap has an innate power to impair the process of urbanization, the efforts and measures that government, enterprise and other organizations take to narrow down this gap will not go in vain. Although the damping effect of digital gap on urbanization is a natural law that cannot be changed by policies, it can certainly be limited with reasonable measures to ensure that urbanization goes smoothly.

In terms of the economic and technological dynamics of urbanization, it seems more cost-effective to promote urbanization through economic development for the urban-rural digital

gap has larger negative impact on the technological dynamic. This means that even if technology advances by leaps and bounds, urbanization will still meet bottleneck. We can even say that the dynamic waste will be more with the increase of technological dynamic, making urbanization less cost-effective. Therefore the author suggests that government and other organizations make policies that can promote urbanization in a economic perspective such invest more in urban infrastructure construction and improve the efficiency of urban and rural market trading.

Reference

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