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RELATIONSHIP BETWEEN POPULATION MOBILITY AND ECONOMIC GROWTH: A CASE STUDY OF NORTH EAST CHINA

LI Xialing[12]

Abstract:

The paper attempts to analyze the relationship between population mobility and economic growth. Currently, economic indicators appear to be weakening and population flow out in northeast of China. Based on this phenomenon, the paper analyzes dynamical mechanism between population flow and economic growth in northeast by VAR model and VEC model. The study reveals that population flow and economic growth of northeast of China are co-integrated and have a longtime equilibrium. However, population flow hasn't contributed to economic growth. If economic growth were hard hit, it would lead to population flow out. Population crisis of northeast of China is caused by inside trusting.

Keywords: Population Flow; Economic Growth; Impulse Response; Variance decomposition; VEC

[1] **School of Economics, Shanghai University, Shanghai**

[2]**School of Business, Jiangsu University of Technology, Changzhou, Jiangsu**

1. Introduction

As heavy industrial base, northeast of China has greatly promoted the process of industrialization in China and made a great contribution to national economic growth. However, according to the statistics of the National Bureau of Statistic, the economic growth rate of Heilongjiang and Jilin province ranked last in the country in 2015, Nominal GDP growth rate of Heilongjiang、Jilin and Liaoning province were -0.29%、3.41% and 0.26%, which was similar to national GDP growth rank in 2014.In 2014, northeast of China was in the last five provinces. At the same time, the population net outflow、the super low birth rate and aging in northeast of China are critical civil phenomenon. According to the sixth national census statistics, annual net flow of population is 1800 thousand; fertility rate of Heilongjiang、Jilin and Liaoning is 1.03%、1.03% and 1.0%, which is lower than 1.5% of the national level and lower than Japan and South Korea's fertility rate. Population problem has become a bottleneck to economic growth in northeast of China because the decline of population and labor force outflow will lead to the emergence of city and crisis in real estate market, even affect the safety of local government debt. The paper selects the northeast of China as the research object and argues population crisis of northeast of China is caused by outside gravitation or inside trusting by using VAR model.

2. Review of Literature

Foreign scholars don't distinguish the definition of population migration and population mobility when studying population flow, even fully use the two definition admixture. The study of the population mobility appeared in late nineteenth century, its research mainly concentrated on two categories: first, study on the law of population mobility, patterns and influencing factors, and so on from the perspective of sociology. E.G. Ravenstein analyzed the seven laws of population migration and pointed out that the economic crisis was the main cause of population migration. R·Herberle (1938) put forward the "push and pull" theory firstly, and pointed out that the cause of population flow was one part of thrusting , and the other part was pulling force. Lee (1966) considered the factors affecting the migration of the population were related to the

immigration, emigration and all kinds of middle barriers and personal factors. D.J.Burge (1969) summarized the "push and pull" model of population migration. Second, study on the dynamic mechanism of population mobility from the economics. The most famous study was the migration model under the dual economic structure proposed by Lewis in 1954, which was further developed by Fei & Ranis. D·W·Jorgenson abandoned the basic assumption of the surplus labor force and the fixed wage in the Lewis model, considered that the agricultural surplus was the motive force of the labor flow from the agricultural sector to the industrial sector. Todaro (1969) deemed the difference of expected return between urban and rural areas was the key cause of population flow, the reason of difference of expected return between urban and rural areas was the wage and employment probability of the modern sector.

Due to special conditions and the industrialization of China, large-scale population flow continues to appear. In China, the research on population flow started to late in the 80's of last century and mainly focused on the following aspects: first, studying the relationship between population mobility and the urbanization. FU Xiaodong (2007) pointed out that in China, immigration period has come and mass migration of population would have a profound impact on the process of city. QIAN Zhengrong (2010) considered the trend of the population mobility in the city showed the importance and urgency of social integration. Second, studying the relationship between population migration and the regional economic development. WANG Keqiong、SHI Guangshuai、JI Li、LI Junwei、TAND Xingui(2012) put forward the reasonable city's structure was closely related to sustained economic growth. GAO Duanjun、PENG Jialin、LI Zi(2015) analyzed the relationship between population mobility and economic growth in Chongqing and considered that it had strong correlation between population mobility and economic growth. Third, studying influence factors of population flow. ZHANG Zhiwei、HU Shiqing (2005) thought average wage of per capita of farmers and workers would have a positive impact on the population flow. Fourth, studying spatial pattern of population migration. LI Yang、LIU Hui(2010) classified the population migration space into space physics、space sociology and

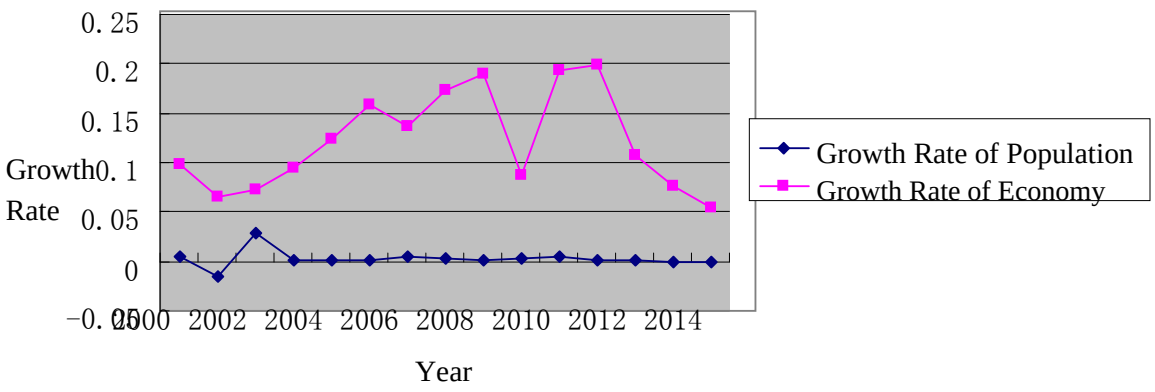
spatial economics, considered the research of population migration would focus on the spatial process simulation based on mathematical research.YU Lu (2006) studied the dynamic changes of population suburbanization of Beijing using spatial statistical methods and considered population of Beijing was gathering suburb forward.

Hence the current literature has laid a foundation to study the relationship between population mobility and economic development. However, the existing literature hasn't paid close attention to the relationship between weak economic growth and the population crisis of the northeast of China. The paper analyzes the interactive relationship between the loss of population and economic growth using VAR model, demonstrate that whether population crisis of northeast of China is caused by outside gravitation or inside trusting.

3. The Facts about Population and Economic Growth in Northeast of China

The paper the population growth rate and the GDP growth rate in northeast of China. From the 21 century, the population growth rate has been lower than the national population growth of 1.05% in northeast region, which can be seen from the figure 1. The fastest growth was 2.94%, emerging in 2002 and the negative population growth emerged in 2001. The population growth rate was maintained at about 0.29% in other years. From the point of economic growth, under the support of the old industrial base and the promotion strategy, the economic growth rate of the northeast regions was very fast in 2003 to 2011, the fastest growth was 19.96%, emerging in 2011.But since then, the economic growth rate showed a significant decline. Since 2000, the average economic growth has been 12.2% in the northeast region, which was lower than the national average of 14%. So, there is a certain correlation between the slow decline of population growth and the decline of economic growth rate in the northeast region. The paper should demonstrate the interaction between the two issues.

Figure 1 the Economic Growth and Population Growth



4.

The Sources of Data

Considering the validity and relativity of the data, the total population of Liaoning、Jilin and Heilongjiang province was selected from 1990 to 2014, behalf of the population growth in the northeast region, denoted by X. The GDP of three provinces was selected also, behalf of the region economic development, denoted by Y. Considering inflation factors, Y was reduced by the consumer price index based on 1978. All data were treated by logarithm, which were from <Statistical Yearbook of China>、<<Statistical Yearbook of Heilongjiang>、< Statistical Yearbook of Jilin>、< Statistical Yearbook of Liaoning>.

5. Empirical Results

a. ADF Test and Co-Integration Test

In the paper, the ADF test is used to test the stability of X and Y variables. The assumption that the unit root is existed was rejected at the 1% confidence level by the two-order difference of each variable. The two-order difference of variable are stable, which can be seen from table 1.

Table1 The Result of ADF Test

Variable	Test type (c,T,d)	Value of ADF	1% Critical Value	Prob.	Conclusion
Y	（c,0,0）	-1.0563	-3.7378	0.7127	unstable

Y2	（c,0,2）	-6.7438	-3.7880	0.0000	stable
X	（c,0,0）	-2.6489	-3.7529	0.0981	unstable
X2	(c,0,2)	-5.5092	-3.8085	0.0003	stable

Note：（c，T，d）represents the test equation includes intercept、time trend and the lag order number; 0 means

It's not include T and d；the lag order number is determined by the criterion of minimum SC；Y2、X2 is the

second order difference of Y and X.

Since Y and X are two-order integer sequences, the co-integration test of variables can be carried out, its result is listed in the table 2. The ADF test value of the residual error is -4.4454, which is less than the critical value of 1%、5%and 10% of the significant level. At each significant level, the assumption that the unit root of the residual error is rejected and the residual sequence is stable. So, there is a co-integration relationship and a long-term dynamic equilibrium relationship between economic development and population growth in the northeast region.

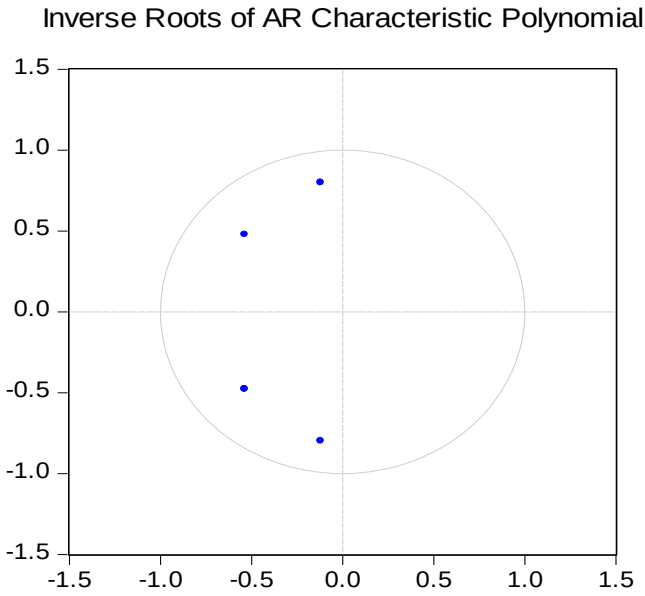
Table2 The Result of Residual Error Test

Variable	Value of ADF Test	1% Critical Value	5% Critical Value	10% Critical Value	Conclusion
Residual Error	-4.4454	-2.6857	-1.9590	-1.6074	stable

b. Model Stability Test

The optimal lag period for the VAR model is 2 based on the LR、FPE、AIC、SC and HQ 5

commonly used model lag structures, that is adopted VAR (2) model. The stability test of VAR (2) model is carried out, its result can be seen in below figure. The model unit root is in the unit



circle, which can be seen from the figure of characteristic root and illustrates the VAR (2) model is stable.

c. Impulse Response Analysis

The impulse response shows how changes in any of the endogenous variables affect all other endogenous variables through the model, how to finally feedback to the original one of the variables themselves. The impulse response will depend on the order of the equation in the model if the random interference term is exactly related.

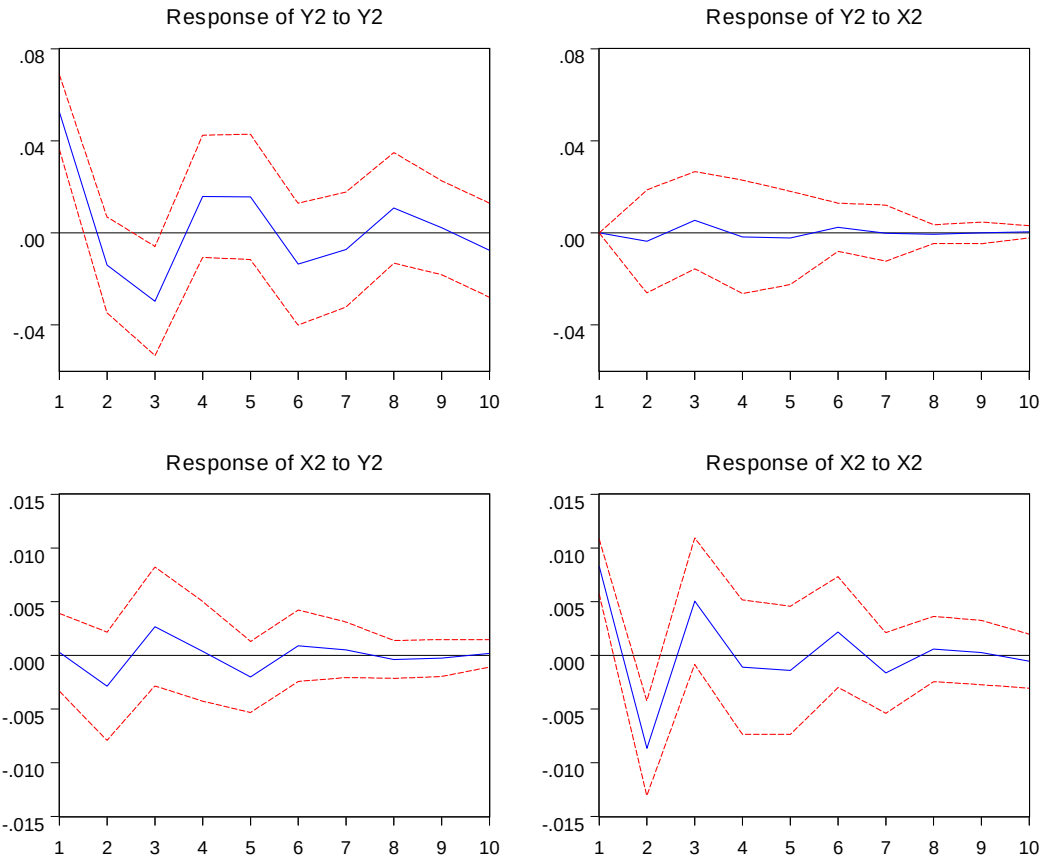
Economic growth and population growth are sensitive to their own shocks, which can be seen from figure 3.The impulse response of the upper left and lower right corner of figure 3 indicates the time path of the economic growth Y and the population growth X respectively on their own response function, after a positive impulse on economic growth and population growth, economic growth and population growth will decline rapidly at first and then fluctuates from the

second period and will be stable at the ninth/eighth period, which illustrates that when the two variables are affected by the external shock, it will decline at first and then the impact will disappeared slowly.

It is the economic growth impulse response to population growth in upper right corner of figure 3, when a positive shock is put to population growth in this period the economic growth will be changed a little, which indicates that the shock of population scale in the northeast region has little effect on the economic growth. However, when a positive shock is put to economic growth in this period, the population outflow will immediately appear, followed by a slight fluctuation later, which can be seen from lower left corner of figure 3 that is the population's response to the shock of the economic growth.

These two impulse response diagrams show that the pulling effect of economic growth on population flow is stronger than the effect of population migration on economic growth, so the falling of economic growth rate in northeast region is not related to the population crisis, the population crisis is caused by the internal trusting in the short term and in the long term, the population crisis by the lack of economic growth will tend to disappear.

Figure 3 Response to Cholesy One S.D. Innovations±2 S.E.



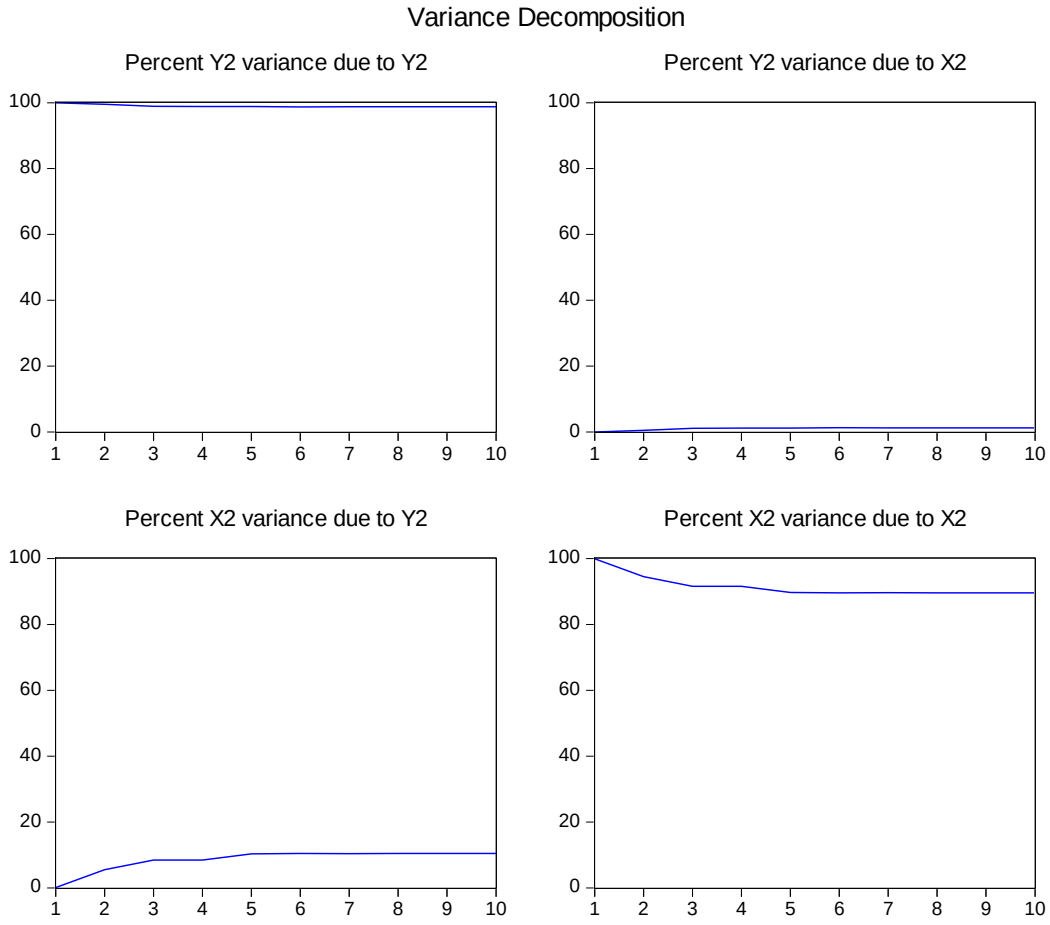
d. Variance Decomposition Analysis

The variance decomposition of VAR can decompose the variance of the prediction error of endogenous variables, judge its variance's source, discover the cause the change of endogenous variables, illustrate if other variables have predictive effect on the change of the variable.

The above two graphs are the variance decomposition of economic growth in the northeast region, the left graph is the own variance decomposition of economic growth, whose time path has been 100 maintaining stability. So the contribution of the current economic growth to the later has been great, up to 100. The right graph is the variance decomposition of economic growth to population growth, the time path has been kept to 0, which proves the contribution of

population growth to economic growth in northeast of China is zero.

The lower two graphs are the variance decomposition of the time path of population growth, the left graph is the variance decomposition of population growth to economic growth, whose time path has been positive and growing to stable, which shows that the economic growth has more and more contribution to population growth, the contribution reached nearly 20% in the 10 period lag. The right of graph is the own variance decomposition of population growth, whose time path has been positive and declining, which shows the population growth has more and more little contribution to economic growth.



The result of variance decomposition shows that population growth has no contribution to the economic growth, but stable and sustained economic growth will contribute to the growth of

population in northeast of China, whose contribution is nearly 20%.

e. Error Correction Model

According to the co-integration test results, it is a co-integrate relationship between the economic growth and population flow in northeast of China. So it is necessary to establish the Vector Error Correction model, which is VAR model applied by co-integration constraints and can be used for non-stationary time series with co-integration.

VEC model is below:

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_i$$

In the function, $y_t=(y\ x)T;\Delta$is first difference of variable; p is lag order; $y_t=(y\ x)^T;\triangle$is error correction term reflecting the long-term equilibrium relationship between variables; is coefficient matrix reflecting the speed of adjustment to equilibrium when variables deviating from the long-term equilibrium. All difference coefficients of explanatory variable reflect short-term fluctuation of variables how to affect the short–term changes of explanatory variable.

The vector error correction model is estimated and the results are as follows:

$$\Delta y_t = \begin{bmatrix} -0.0025 \\ -0.004 \end{bmatrix} + \begin{bmatrix} -0.5874 & -6.3214 \\ -0.068 & 1.0729 \end{bmatrix} \Delta y_{t-1} + \begin{bmatrix} -0.8099 & -2.4531 \\ -0.0593 & 0.3154 \end{bmatrix} \Delta y_{t-2} + \begin{bmatrix} -0.1662 \\ 0.0702 \end{bmatrix} ecm_{t-1} + \begin{bmatrix} \hat{\varepsilon}_1 \\ \hat{\varepsilon}_2 \end{bmatrix}$$

$R^2_Y=0.748$，$R^2_X=0.912$，$Adj.R^2_Y=0.658$，$Adj.R^2_X=0.881$

F-statistic=29.139 Log likelihood= 104.8527，AIC=-9.085，SC=-8.388

The result of vector error correction model shows the value of R^2 and F are big, which proves that the linear equation is significant; the coefficient is -0.1662, which shows that the change of GDP in the first t phase will increase -16.62% of the non-equilibrium error of the previous period in case of population flow unchanging; the coefficient is 0.0702, which shows that the change of population flow in the first t phase will increase7.02% of the non-equilibrium error of the previous period in case of GDP unchanging. From the absolute value of the error correction term coefficient, the speed of adjustment of population flow is faster than the speed of adjustment of

economic growth when the variables deviate from the long-term equilibrium.

f. Granger Causality Test

The above analysis shows that there is long-term equilibrium relationship between population migration and economic development in northeast of China, but the co-integration test can't explain whether there is causal relationship between the two variables, only shows the possibility of the granger causality. The granger causality test is made in order to further confirm whether there is a causal relationship between population migration and economic development in northeast of China. The result of test is below:

Table 3 The Result of Granger Test

Null Hypothesis	Lags	F-Statistic	Prob.	Conclusion
Y does not Granger Cause X X does not Granger Cause Y	1	2.7106 0.092	0.1161 0.765	Rejection Rejection
Y does not Granger Cause X X does not Granger Cause Y	2	1.3469 0.1362	0.288 0.8736	Rejection Rejection
Y does not Granger Cause X X does not Granger Cause Y	3	0.6198 0.4372	0.6145 0.7301	Rejection Rejection

The result of test shows that in the lag period of 1-3 years, population growth is granger reasons of economic growth, economic growth is also granger reasons of population growth, that is, there is a causal relationship between economic growth and population growth.

6. Conclusion and Recommendations

The paper studies the dynamic effect and interaction between population growth and economic growth, which shows that there is a long-term equilibrium relationship between the two variables, using the VAR and vector error vector model in 1990 to 2014. From the impulse

response, when shock is given to economic growth the population outflow will appear rapidly; when shock is given to population growth its impact on the economic growth isn't obvious; the population crisis is caused by inside trusting. From the variance decomposition analysis, population growth has a little contribution to the economic growth; the stable and sustained economic growth will contribute to the population growth, the contribution rate is about 20%.The following suggestions are put forward to effectively deal with the current population outflow in the northeast of China:

1. Releasing of population mobility restriction and actively guiding the trend of population movements. According to the analysis, when the shock is given to population growth, the economic growth will decline at first and gradually return to stability later, indicating the population flow will not lead to large fluctuation in economic growth, the contribution of population growth to economic growth is essentially zero. At the same time, population flow is the result of the optimal allocation of market resources, so it should be appropriate to reduce restriction on population flow and actively guide the reasonable quantity of population migration.
2. Economic development is an effective way to avoid population crisis in northeast of China. The quantitative analysis in the paper shows that when the economic development is hit, it will quickly lead to the population outflow, so the cause of population crisis is weak economic growth. To effectively solve the population crisis, northeast of China should vigorously develop economy and rely on its own economic growth to attract population.
3. Establish population monitoring system to monitor the population migration effectively. Accounting the impact of economic development on the population flow, the weak economic growth can't be solved in short term, the population outflow will continue in a long period, so it is necessary to establish population monitoring system to monitor the population migration.

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Biography of Author

1. LI Xialing

Date of Birth:1977.07 Gender: Female

Doctoral Candidate of Shanghai University; Lecturer of Jiangsu University of Technology

Research Area: Foreign Direct Investment

Postal Address:No.1801 Zhongwudadao, Changzhou City, Jiangsu Province

Email Address:xialing_li@126.com Telephone: +86-13401526066