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A Nonparametric Estimation on the Effects of Import and Export Trade to Economic Growth in China

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Abstract

Based on the panel data of 31 provinces, municipalities and autonomous regions in China from 1997 to 2008, this paper uses the method of nonparametric local linear kernel estimation to study the relations of physical capital stock, labor capital, export trade and import trade with GDP. The research results are summarized as follows: (a) the above mentioned four factors have positive significant impacts to GDP; (b) the pointwise regression elasticity estimates of export trade and import trade with respect to four factors have both types of "U" and inverted "U" shapes.

Keywords: Nonparametric Estimation; Economic Growth; Export Trade; Import Trade; Panel Data Model

1. Introduction

Since reform and open policy has been taken from 1978, the economic development of China has made great progress. The growth rates of import and export trade have been higher than that of GDP. It is one of the primary factors keeping the national economy growth.

In recent years, many scholars have studied the relationship between import and export trade and economic growth by using economic theory and econometric methods. Many of them proved the "export-led growth" hypothesis considered from theoretical and empirical perspectives. The related literature includes Azomahou et al. (2006), Su and Ullah (2007), Henderson, Carrol and Li (2008), Shan and Sun (1998), Liu and Feng (2007), Zhou (2008) and etc.. We find that most of their used methods are

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parametric methods. Especially, econometric analysis of panel data is always based on the parametric panel model. We know that parametric panel model requires a lot of assumptions which are not easily to be satisfied. However, the assumption conditions for nonparametric panel model are very few; the model is mainly decided by the data of variables and has many advantages. Therefore, we try to use nonparametric method to study the impacts of export and import trade to economic growth in China and hope to find some internal phenomena. As we know that nobody has used such method to do this problem.

2. Methodology

In this paper, we will mainly use the nonparametric panel data model to study the impacts of export trade and import trade to economic growth in China, The general form of nonparametric panel data model is as follows:

$$\ln(GDP_{it}) = \lambda_i + f(\ln(X_{1it}), \ln(X_{2it}), \ln(X_{3it}), \ln(X_{4it})) + \mu_{it} \tag{1}$$

Here GDP_{it} is the gross domestic product of the i-th province at the t-th year; λ_i is individual fixed effects; $X_{1it}, X_{2it}, X_{3it}$ and X_{4it} represent physical capital stock, labor capital, export trade and import trade of i-th province at the t-th year respectively; u_{it} is random error term; f is an unknown smoothing function; $i = 1, 2, \cdots, m, t = 1, 2, \cdots, T$. Let $y_{it} = \ln(GDP_{it})$, $x_{it} = (\ln(X_{1it}), \ln(X_{2it}), \ln(X_{3it}), \ln(X_{4it}))$, by using Taylor expansion at a fixed point $x = (x_1, x_2, x_3, x_4) = (\ln(X_1), \ln(X_2), \ln(X_3), \ln(X_4))$, the equation (1) can be rewritten as

$$y_{it} = \lambda_i + f(x) + (x_{it} - x)\theta(x) + \varepsilon_{it} \tag{2}$$

Here ε_{it} includes the remainder term after partial linearization; $\theta(x) = [\theta_1(x), \theta_2(x), \theta_3(x), \theta_4(x)]'_{4\times 1}$ is a column vector, $\theta_i(x) = \partial f(x) / \partial x_i$ is the output elasticity of variable x_i, $i = 1, 2, 3, 4$.

From equation (2), it is easily to know that

$$y_{it} - \overline{y}_i = (x_{it} - \overline{x}_i)\theta(x) + \varepsilon_{it} - \overline{\varepsilon}_i \tag{3}$$

Here $\overline{y}_i = \sum_{t=1}^{T} y_{it} / T$. The estimate of $\theta(x)$ can be obtained by the local linear kernel estimation method provided by Ullah and Roy (1998). The expression of the estimation of $\theta(x)$ is

$$\hat{\theta}(x) = (\sum_{i=1}^{n}\sum_{t=1}^{T}(x_{it} - \overline{x}_{is})'(x_{it} - \overline{x}_{is})K((x_{it} - x)/h))^{-1}(\sum_{i=1}^{n}\sum_{t=1}^{T}(x_{it} - \overline{x}_{is})'(y_{it} - \overline{y}_{is})K((x_{it} - x)/h)) \tag{4}$$

Here $K(\cdot)$ is a kernel function and h is the window width. According to $\hat{\theta}(x)$, we have

$$\hat{\theta}_i(x) = (0, \cdots 0, 1, 0 \cdots, 0)\hat{\theta}(x) \tag{5}$$

It is the partial derivatives of $f(x)$ with respect to $x_i, i = 1, 2, 3, 4$. We can calculate the nonparametric estimations $\theta(x)$ at the sample mean $\overline{x}$ to obtain the estimates of average elasticity of four factors, where $\overline{x} = (\overline{x}_1, \overline{x}_2, \overline{x}_3, \overline{x}_4)$ and $\overline{x}_r = \sum_{i=1}^{n}\sum_{t=1}^{T} x_{r,it} / nT, i = 1, 2, 3, 4$.

In order to show the advantages of nonparametric panel data model, we will also employ the parametric panel data model to calculate the average output elasticity estimates of four factors. For our problem, the general parametric model can be considered as follows:

$$\ln(GDP_{it}) = \lambda_i + \theta_1 \ln(X_{1it}) + \theta_2 \ln(X_{2it}) + \theta_3 \ln(X_{3it}) + \theta_4 \ln(X_{4it}) + u_{it} \tag{6}$$

Here λ_i is individual fixed effects; u_{it} is independent identically normal distribution with mean 0 and variance σ^2; $\theta_1, \theta_2, \theta_3$ and θ_4 are the elasticity coefficients of physical capital stock, labor capital, export trade and import trade respectively; $i = 1, 2, \cdots, m, t = 1, 2, \cdots, T$.