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On the Relationship between Estimate and Its *t* Value

Yuji Matsuoka[1], Shigeyuki Hamori[2]

[1]Graduate School of Economics, Kobe University, Kobe, Japan
[2]Faculty of Economics, Kobe University, Kobe, Japan
Email: hamori@econ.kobe-u.ac.jp

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Abstract

It is generally believed that the signs of the estimated coefficient and its *t* value should be the same. This paper, however, shows that there may be an inconsistency in the signs of the estimated coefficient and its *t* value when we use the group mean dynamic OLS estimator developed by Pedroni (2001).

Keywords

***t* Value, Group Mean Dynamic OLS Estimator, Panel Data**

1. Introduction

This paper shows the possibility of inconsistency in the signs of the group mean dynamic OLS estimator and its *t* value. According to basic econometrics and statistics, the *t* value is calculated by dividing the estimated coefficient by its standard error. Because the standard error is always positive, the sign of the *t* value becomes identical to the sign of the estimated coefficient [1] [2].

Pedroni [3] developed the group mean dynamic OLS estimator—a useful technique to obtain an estimator for a dynamic heterogeneous panel model. However, because this estimator is calculated by summing the estimation result of every cross section, there is a possibility of inconsistency in the signs. We provide a very simple example of this phenomenon.

The remainder of this paper is as follows: Section 2 provides the model; Section 3 shows the simulation; Section 4 concludes.

2. Model

We consider the estimation of the following model by using dynamic OLS.

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$$y_{it} = \beta_{0i} + \beta_{1i} x_{it} + \sum_{m=-M}^{M} \delta_m \Delta x_{it-m} + u_{it}, \quad i = 1, \cdots, N, \quad t = 1, \cdots, T$$

where y_{it} is the dependent variable, x_{it} is the independent variable, and u_{it} is the error term. To obtain the group mean dynamic OLS estimator, we separately estimate this equation using every cross section. Then, we calculate the estimator with each estimated coefficient and t value in the following manner:

$$\hat{\beta}_1 = \frac{1}{N} \sum_{i=1}^{N} \hat{\beta}_{1i},$$

$$t\left(\hat{\beta}_1\right) = \frac{1}{N^{\frac{1}{2}}} \sum_{i=1}^{N} t\left(\hat{\beta}_{1i}\right).$$

3. Simulation

3.1. Simulation Design

We show the possibility of inconsistency using a simulation. For simplicity, we assume that N and T equal 2 and 1000, respectively. Furthermore, we drop the lag and lead terms. The model is rewritten as follows:

$$y_{1t} = \beta_{01} + \beta_{11} x_{1t} + u_{1t}, \quad t = 1, \cdots, T$$

$$y_{2t} = \beta_{02} + \beta_{12} x_{2t} + u_{2t}, \quad t = 1, \cdots, T$$

$$\hat{\beta}_1 = \frac{1}{2} \sum_{i=1}^{2} \hat{\beta}_{1i}$$

$$t\left(\hat{\beta}_1\right) = \frac{1}{2^{\frac{1}{2}}} \sum_{i=1}^{2} t\left(\hat{\beta}_{1i}\right)$$

The simulation strategy is as follows. First, we provide the values of β_{01}, β_{02}, β_{11} and β_{12} as
Case 1:

$$\left(\beta_{01}, \beta_{02}, \beta_{11}, \beta_{12}\right) = \left(1, 1, 2, 2\right)$$

Case 2:

$$\left(\beta_{01}, \beta_{02}, \beta_{11}, \beta_{12}\right) = \left(1, 1, -2, -2\right),$$

Case 3:

$$\left(\beta_{01}, \beta_{02}, \beta_{11}, \beta_{12}\right) = \left(1, 1, 2, -2\right).$$

Second, we randomly generate the values of x_{1t} and x_{2t} and u_{1t} and u_{2t} using standard normal distributions. Then, we calculate the values of y_{1t} and y_{2t}. Third, we estimate the above equation and calculate the estimator by using the generated data. This simulation is performed 10,000 times using STATA.

3.2. Simulation Results

Case 1 and Case 2:

In this case, we expect that both cross sections take identical signs. Thus, we do not need to be concerned with the inconsistency. The result also shows consistency: every 10,000 samples take the same signs in the group mean dynamic OLS estimator and its t value.

Case 3:

In this case, the estimation of each cross section is expected to take opposite signs. Then it might be possible that inconsistency in the signs of the group mean dynamic OLS estimator and its t value occurs. **Table 1** presents the result.

Table 1. Results of case 3.

	Coefficient	*t* Value	Sample Size
Consistent	Positive	Positive	2576
	Negative	Negative	2453
inconsistent	Positive	Negative	2488
	Negative	Positive	2483

4. Conclusion

In this paper, we show that there may be an inconsistency in the signs of the estimated coefficient and its *t* value when we use the group mean dynamic OLS estimator developed by Pedroni (2001).

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