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Testing endogeneity of spatial and social networks*

Wei Cheng†, Lung-fei Lee

Department of Economics, The Ohio State University, Columbus, OH, USA

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Abstract

The spatial autoregressive framework (SAR) has been widely used in studying spatial interdependence and social interaction. Previous research have assumed the spatial weight matrix (also known as sociomatrix or adjacency matrix) to be exogenously given. However, ignoring the possibility that adjacency matrices can be endogenous may lead to inconsistent estimates. Therefore, it is desirable to test whether spatial weights are endogenous or not. This paper constructs a Hausman specification test and one simple equivalent test under a general setting. We also provide LM test statistics for two representative SAR models with endogenous spatial/network relationships in the literature. We summarize their testing features and establish their asymptotic properties under the null and the alternative hypotheses. Monte Carlo simulations are conducted to examine the finite-sample performance of those tests.

Keywords: *Spatial autoregressive model, Endogenous spatial weight matrix, Hausman specification test, LM test*

1 Introduction

Spatial autoregressive (SAR) models have been adopted to study spatial dependence as well as social interactions. A spatial weight matrix (also known as sociomatrix and adjacency matrix) is used to represent relationships among agents. In the spatial literature, regions (agents) have predetermined locations, and the spatial weights matrix indicates the strength of influence among regions. In the peer effect or social network literature, an adjacency matrix reflects people's social networks. There have been a growing number of both theoretical investigations and empirical applications on SAR models. However, most studies treat adjacency matrices as exogenously given. This strong assumption has brought much simplicity in deriving estimation methods for SAR models in empirical studies.

Recently, for spatial models, Kelejian and Piras (2014) and Qu and Lee (2015) take a second look at this practice. For social interactions and friendship network models, Goldsmith-Pinkham and Imbens (2013) and Hsieh and Lee (2016), among others, have considered endogenous issues of network formation. The concern is that endogeneity of an

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†Corresponding author at Department of Economics, The Ohio State University, 410 Arps Hall, 1945 N High St., Columbus, Ohio 43210, USA. Email address: cheng.600@osu.edu.