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Modeling tourism: A fully identified VECM approach

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Abstract

System-based cointegration methods have become popular tools for economic analysis and forecasting. However, the identification of structural relationships is often problematic. Using a theory-directed sequential reduction method suggested by Hall, Henry and Greenslade [Hall, S. G., Henry, S., & Greenslade, J. (2002). On the identification of cointegrated systems in small samples: A modelling strategy with an application to UK wages and prices. *Journal of Economic Dynamics and Control, 26*, 1517–1537], we estimate a vector error correction model of Hawaii tourism, where both demand and supply-side influences are important. We identify reasonable long-run equilibrium relationships, and Diebold–Mariano tests for forecast accuracy demonstrate satisfactory forecasting performance.
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1. Introduction

System-based cointegration methods, and their dynamic counterpart vector error correction models (VECMs), have become popular tools for economic analysis and forecasting. Cointegration analysis addresses the problem of spurious regressions among non-stationary time series. Estimation in a system context may shed light on important interrelationships among series, while reducing the risk of endogeneity bias.[3]

However, system methods introduce additional challenges, chief among them being the problem of identifying individual structural relationships. In a system with cointegrating rank r, Pesaran and Shin (2001) show that exact identification requires r restrictions in each of the r cointegrating vectors. The

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[3] See Banerjee, Dolado, Galbraith, and Hendry (1993) for a discussion of finite sample endogeneity bias in error correction models.

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popular Johansen (1988, 1991, 1995) method uses a statistical approach to achieve the needed restrictions. Pesaran and Shin (2001) and Pesaran and Smith (1998) criticize this approach as a pure mathematical convenience, and instead advocate a theory-based approach. Hall, Henry, and Greenslade (2002) argue that the different identification methods proposed in the literature are almost impossible to implement in practice, due to the limited sample sizes typically available for empirical research. As an alternative, they suggest testing and imposing theory-based weak exogeneity assumptions at the earliest stage of the model reduction process. In this paper, we apply the Hall et al. (2002) strategy to the problem of estimating a structural econometric model of Hawaii tourism, where both demand and supply-side influences may be important.

There exists a large body of empirical literature on modeling and forecasting tourism flows. Nearly all existing studies focus solely on the demand side of the market, attempting to model either the demand arising from alternative source-country markets for a particular tourism destination, or the allocation of outbound travel demand to alternative destinations.[4] The application of cointegration analysis and the associated error-correction dynamic specifications to tourism demand modeling began in the mid-1990s, and is now relatively common. In many cases, single-equation methods have been used with little or no consideration of potential endogeneity problems (see for example Gonzalez & Moral, 1995; Kim & Song, 1998; Song, Romilly, & Liu, 2000; Vogt & Wittayakorn, 1998). When system approaches are used (for example Dritsakis, 2004; Gangnes & Bonham, 1998; Kulendran & King, 1997; Kulendran & Witt, 2001, 2003; Lim & McAleer, 2001; Song & Witt, 2003), identification is obtained exclusively using Johansen's reduced rank regression technique, and identified cointegrating relationships are often simply assumed to represent demand functions.[5]

The identification problem in tourism systems has been noted by some researchers and addressed in various ways, none of which are fully satisfactory. For example, Song and Witt (2003) note the difficulty of interpreting multiple cointegrating relationships, and omit from consideration cases where more than one relationship is found. Citing Kulendran and Witt (2001), Muscatelli and Hurn (1992) select vectors for which the estimated parameters conform to demand theory. Without testing, De Mello and Nell (2005) impose identifying restrictions implied by the AIDS model.

Our VECM approach explicitly allows for endogeneity and permits the identification of relationships governing both demand and supply (pricing) behavior. Hawaii is a particularly apt case for such analysis, because tourists from two markets – the United States and Japan – represent a dominant 85% of the total market. Clearly, in this case demand parameters cannot be estimated reliably without regard to supply constraints and potential price responses. And of course, a knowledge of supply-side behavior is of interest in its own right. Our identified model describes relatively long-run equilibrium relationships governing tourism demand and visitor accommodations pricing in Hawaii, and the forecasts compare favorably with those of three competing models according to the Diebold and Mariano (1995) tests of forecast accuracy.

The organization of the paper is as follows. Section 2 derives the visitor demand and room price equations, and identifies the variables to be used in the modeling exercise. Section 3 outlines our estimation methodology. Section 4 presents the empirical results of the Hawaii tourism model. Section 5 evaluates the forecast performance of the model. Section 6 concludes.

2. Tourism model specification

There is a relatively small body of theoretical literature on tourism economics, and no single unifying conceptual framework. Some early perspectives

[4] There are a number of comprehensive reviews of tourism demand modeling and forecasting, including Crouch (1994a,b), Li, Song, and Witt (2005), Lim (1997, 1999), Song and Li (2008) and Witt and Witt (1992, 1995). Methodology overviews include Archer (1994) and Frechtling (2001).

[5] In recent years, hybrid versions of error-correction models have appeared in the tourism literature, including a time-varying parameter ECM (Li, Wong, Song, & Witt, 2006), a linear AIDS–ECM approach (De Mello & Fortuna, 2005; Durbarry & Sinclair, 2003; Li, Song, & Witt, 2004), and a combination of the two (Li, Song, & Witt, 2006).

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