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SCIENCE DIRECT®
Energy Economics 27 (2005) 337–350
Energy Economics
www.elsevier.com/locate/eneco

Transmission of prices and price volatility in Australian electricity spot markets: a multivariate GARCH analysis

Andrew Worthington*, Adam Kay-Spratley, Helen Higgs

School of Economics and Finance, Queensland University of Technology, G.P.O. Box 2434, Brisbane, Qld 4001, Australia

Available online 19 December 2003

Abstract

This paper examines the transmission of spot electricity prices and price volatility among the five regional electricity markets in the Australian National Electricity Market: namely, New South Wales, Queensland, South Australia, the Snowy Mountains Hydroelectric Scheme and Victoria. A multivariate generalised autoregressive conditional heteroskedasticity model is used to identify the source and magnitude of price and price volatility spillovers. The results indicate the presence of positive own mean spillovers in only a small number of markets and no mean spillovers between any of the markets. This appears to be directly related to the physical transfer limitations of the present system of regional interconnection. Nevertheless, the large number of significant own-volatility and cross-volatility spillovers in all five markets indicates the presence of strong autoregressive conditional heteroskedasticity and generalised autoregressive conditional heteroskedasticity effects. This indicates that shocks in some markets will affect price volatility in others. Finally, and contrary to evidence from studies in North American electricity markets, the results also indicate that Australian electricity spot prices are stationary.

JEL classification: C32; C51; L94; Q40

Keywords: Spot electricity price markets; Mean and volatility spillovers; Multivariate GARCH

* Corresponding author. Tel.: +61-7-3864-2658; fax: +61-7-3864-1500.
E-mail address: a.worthington@qut.edu.au (A. Worthington).

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doi:10.1016/j.eneco.2003.11.002

1. Introduction

The Australian National Electricity Market (NEM) was established on 13 December 1998. It currently comprises four state-based (New South Wales (NSW), Victoria (VIC), Queensland (QLD) and South Australia (SA)) and one non-state based (Snowy Mountains Hydroelectric Scheme (SNO)) regional markets operating as a nationally interconnected grid. Within this grid, the largest generation capacity is found in NSW, followed by QLD, VIC, the SNO and SA, while electricity demand is highest in NSW, followed by VIC, QLD and SA. The more than 70 registered participants in the NEM, encompassing privately and publicly owned generators, transmission and distribution network providers and traders, currently supply electricity to 7.7 million customers with more than $8 billion of energy traded annually (for details of the NEM's regulatory background, institutions and operations, see NEMMCO (2001, 2002), ACCC (2000) and IEA (2001)).

Historically, the very gradual move to an integrated national system was predated by substantial reforms on a state-by-state basis, including the unbundling of generation, transmission and distribution and the commercialisation and privatisation of the new electricity companies, along with the establishment of the wholesale electricity spot markets (Dickson and Warr, 2000). Each state in the NEM initially developed its own generation, transmission and distribution network and linked it to another state's system via interconnector transmission lines. However, each state's network was (and still is) characterised by a very small number of participants and sizeable differences in electricity prices were found. The foremost objective in establishing the NEM was then to provide a nationally integrated and efficient electricity market, with a view to limiting the market power of generators in the separate regional markets (for the analysis of market power in electricity markets, see Brennan and Melanie (1998), Joskow and Kahn (2001), Wilson (2002) and Robinson and Baniak (2002)).

However, a defining characteristic of the NEM is the limitations of physical transfer capacity. QLD has two interconnectors that together can import and export to and from NSW, NSW can export to and from the SNO and VIC can import from the SNO and SA and export to the SNO and to SA. There is currently no direct connector between NSW and SA (though one is proposed) and QLD is only directly connected to NSW. As a result, the NEM itself is not yet strongly integrated with interstate trade representing just 7% of total generation. During periods of peak demand, the interconnectors become congested and the NEM separates into its regions, promoting price differences across markets and exacerbating reliability problems and the market power of regional utilities (IEA, 2001; ACCC, 2000; NEMMCO, 2002).

While the appropriate regulatory and commercial mechanisms do exist for the creation of an efficient national market, and these are expected to have an impact on the price of electricity in each jurisdiction, it is argued that the complete integration of the separate regional electricity markets has not yet been realised. In particular, the limitations of the interconnectors between the member jurisdictions suggest that, for the most part, the regional spot markets are relatively isolated. Nevertheless, the Victorian electricity crisis of February 2000 is just one of several shocks in the Australian market that suggests spot electricity pricing and volatility in each regional market are still potentially dependent on pricing conditions in other markets. These are, of course,