



## Market structure in U. S. southern pine roundwood

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### Abstract

Time series of commodity prices from multiple locations can behave as if responding to forces of spatial arbitrage, even while such prices may instead be responding similarly to common factors aside from spatial arbitrage. Hence, while the Law of One Price may hold as a statistical concept, its acceptance is not sufficient to conclude market integration. We tested the factors hypothesized as linked to integration of forest products markets by applying a combination of bivariate and multivariate techniques. Bivariate cointegration tests were conducted for price pairs among 21 price regions and were done for both delivered southern pine sawlogs and delivered southern pine pulpwood logs. Multivariate meta-analytic regressions of cointegration test results on hypothesized explanatory factors were run for pulpwood and sawlog markets separately. Cointegration test results offer limited support for the Law of One Price in the South for both products. Results of the meta-analytic regressions show that a proxy for the cost of product transfer between regions is statistically significant and negatively related to the probability that two local market prices are cointegrated for only sawlogs. For pulpwood, the proxy was not significant. The results of the bivariate cointegration tests and the multivariate meta-analyses were used to delineate apparently spatially segmented sub-markets for both products. The maps show overlapping geographical segments, resulting from both spatial arbitrage and possible output dominance for certain firms in those sub-markets. The southern pine sawlog market can be divided into four or five sub-markets, distributed north to south and east to west. The southern pine pulpwood log market can be drawn into three, largely separate sub-markets: a coastal zone that stretches from Texas to Virginia, and two distinct interior zones.

**Key words:** Law of One Price, log markets, meta-analysis, cointegration, pine

**JEL classification:** Q210, D400

### Introduction

Recognition of regional resource characteristics and associated markets is a defining component of forest sector market models. These models, used to project future conditions of the forest and forest product markets, typically are either re-

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gion-specific, modeling the effects of broad market variables on subcomponents within the region, or spatially linked regional models. Region-specific models include the Subregional Timber Supply Model, SRTS (Abt et al. 2000), which is used to project timber supply and demand conditions within the U. S. South. Spatially linked models include the Timber Assessment Market Model, TAMM (Adams and Haynes 1980), which in updated form has been used in successive Resource Planning Act-mandated projections of U. S. national supply and demand conditions for specific regions in the U. S. Another is the Global Trade Model (Dykstra and Kallio 1987), used to model world forest product markets.

A common assumption of forest sector projection models, aside from perfect competition in timber markets, is that all points of production and consumption of the same product are parts of the same market within a region modeled, implying both efficient intra-regional market shock transmission as well as the existence of a single price – i. e., the applicability of the Law of One Price (LOP). However, if markets do not transmit shocks, then prices in one part of the producing market do not respond to price fluctuations in other parts, failing the conditions needed for market integration (Ravallion 1986). In the absence of price shock transmission, sub-optimal marketing and production decisions and wealth transfers can result.

Empirical support for integration of forest product markets is limited. In the lowest stages of forest product output, the results are negative. Nagubadi et al. (2001) have shown that the single market assumption, which they measured with cointegration of multiple series of hardwood stumpage prices, did not apply to southern U. S. hardwood stumpage markets. Prestemon and Holmes (2000) conducted market shock price imprint tests that suggested southern pine stumpage markets are not integrated; bivariate cointegration tests of prices did not support the Southwide applicability of the LOP. Studies of price behavior in markets of forest products in higher stages of production have been used to evaluate both the LOP and, it is sometimes claimed, market integration. Most of these studies supported the LOP. Examples include the causality tests of Uri and Boyd (1990) and the cointegration testing of many others: Jung and Doroodian (1994) and Murray and Wear's (1998) examinations of U. S. softwood lumber markets, Buongiorno and Uusivuori's (1992) evaluation of U. S. pulp and paper exports, Alavalapati et al.'s (1997) study of Canada's pulpwood market, Hänninen et al.'s (1997) analysis of newsprint price behavior in northern Europe and Canada, and Toppinen and Toivonen's (1998) examination of the Finnish pulpwood market.

Cointegration testing has been applied in many of the aforementioned studies and in other commodity markets (e. g., Ardeni 1989; Baffes 1991) as the means for evaluating whether the LOP holds, but cointegration test results often provide limited information about the mechanisms of market integration. McNew and Fackler (1997), who distinguish between market efficiency (as embodied by the LOP) and market integration (as embodied by local market shock transmission), consistent with Ravallion (1986), suggested that cointegration can occur even in

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