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Stumpage prices in Sweden 1909–2012: Testing for non-stationarity

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ABSTRACT

The price of timber stumpage is one of the few natural-resource rents that can be directly observed as a market price. Rules for optimal timber harvesting under uncertainty have been found to depend on whether the timber rent price is non-stationary or stationary. In this study we extend previous research by Hultkrantz (1995) that tested for unit-root with an exogenous break point in Swedish stumpage prices from 1909 to 1990, employing data up to 2012, hence for 104 years, and unit-root tests with endogenously selected break points. We find support for a structural level break at the end of WW2 and that non-stationarity can be rejected. We show that this is a robust conclusion. There is thus no sign of a new break in the extended recent time period and no signal of a secular increase of timber resource scarcity.

Introduction

Stumpage price is the price for a right to harvest a unit of standing timber for which the buyer will bear the cost of felling and transportation. It represents timber rent and is one of the few natural-resource rents that can be directly observed as a market price. Much attention is paid in the natural-resource and forestry management literature to the features of the dynamic process of rents, especially to whether it is non-stationary, but due to low statistical power empirical investigation requires longer time-series than what usually can be found. In this study we extend previous research by Hultkrantz

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(1995) that tested for unit-root with an exogenous break point in Swedish stumpage prices from 1909 to 1990, employing data up to 2012, hence for 104 years, and unit-root tests with endogenously determined breaks.

The natural-resource rent, or scarcity rent, has a central role in natural-resource economic theory, building on traditions emerging from works by Ricardo, Jevons, Wiksell, Fischer, Hotelling and others. In forest economic theory, the properties of the dynamic process of timber rent have two important implications. First, if it includes a positive trend component, this provides an additional source of value growth, and therefore enhances the profitability of silvicultural effort and prolongs optimal rotation periods. Second, the decision criterion for choosing the time to cut (the stopping rule) depends on the order of integration of the price process. For instance, if the net price follows a random walk (geometric Brownian motion) a myopic optimal stopping rule will not depend on the current price, while if it is stationary (mean reverting) it does so. In practical terms, this means that forest management may benefit from allowing for a high degree of flexibility in the timing of felling in adaptation to price changes.

Empirical studies of pure natural-resource rents are rare because most natural-resource prices include compensation for the cost of extraction. For instance, Barnett and Morse (1963) in the classic study of the long-term development of scarcity of natural resources in the US could not make a direct test of the hypothesis of increasing rents in production of extractive products (such as agricultural products, minerals, forest products and fish) as they did not have any measure of rents. However, a possible exception to such lack of data is timber because there are markets for harvesting rights for standing timber, i.e., for stumpage, where the price can be directly interpreted as a rent.

Stumpage price data is more difficult to gather than information about roundwood prices that often is publicly announced. However, stumpage price information can be held from forest-company records. Based on data collected from 1909 to 1955 by Streyffert (1960) and subsequently by the Swedish Forest Agency, Hultkrantz (1995) analyzed times-series data for Swedish stumpage prices from 1909 to 1990. The Swedish Forest Agency terminated its collection of stumpage price data in 2002, but for this study we have been able to update the time series up to 2012, using data held from a stumpage-broker firm (Rotpostmäklarna AB). Perron (1989) showed that the unit-root tests advanced in the pioneering work by Dickey and Fuller (1979) may be misleading if there has been a structural break in the studied time series and suggested a test for the case when there is one known break point. This Perron test was used by Hultkrantz (1995), who found that after accounting for a structural break at the end of WW2, the null hypothesis of unit root for the Swedish stumpage prices could be rejected. The motives for re-doing the analysis are threefold. First, there are few other data series showing the development of a natural-resource rent over a very long time. The extension of the stumpage price data with 22 years up to 2012 makes it possible to see whether recent development deviates from the historical pattern. Second, during the more than twenty years that have passed since Perron's contribution, the literature on unit-root testing on data with possible breaks has progressed, in particular by development of methods for endogenous search of a break point, while the Perron test required that such a break point was exogenously assumed. Third, these new methods also allow for search of more than one possible break point. We conduct a search for break points here with critical values, and therefore the power of the unit root tests, that are generated by a Monte Carlo simulation. Our main result is that the finding in Hultkrantz (1995) is supported, thus the annual stumpage prices exhibit stationary attributes when a break point at the end of WW2 is accounted for. Interestingly, there is no sign of a new break after 1990.

The paper is organized in the following way. The next section provides a brief background on how variation over time of timber price (net of costs) is thought to affect timber harvesting, i.e., the timber supply. As this depends on the nature of the price process, this section provides the basic motivation for our study. Section "Stumpage prices in Sweden 1909–2012" then presents the stumpage-price data for the period 1909–2012 and speculates on the role of structural breaks connected to the major technological shifts in timber harvesting. Section "Testing for unit root" reviews statistical methods that can be used to test for unit root in time series that possibly contain structural breaks and motivates our choice of approach for the test. The test results are presented in the same section. The study is rounded up with a discussion in the "Discussion" section and some brief conclusions in the final section.