6. SOME PRICING ISSUES OF LONG-TERM CONTRACT LOG SALES IN TROPICAL NORTH QUEENSLAND, AUSTRALIA

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Two main pricing issues arise when long-term log contracts are considered: sale price at the stump (stumpage), and price adjustment methods for adjusting the sale price through the duration of the contract. Efficiency in determining the log price at the stump is requisite for optimal price adjustment. While price adjustment mechanisms are addressed in this paper, the main emphasis is on the determination of the log price at the stump using Queensland Commercial Plantation forests as a case study. With one large single supplier of logs in Queensland and a few favourably-located buyers it is considered that a bilateral monopoly model is appropriate for analysing price outcomes, rent sharing and volumes supplied in the market. Prices are not determined through the market but are negotiated by the parties supplying and buying the logs.

INTRODUCTION

Log sales in both northern and southern hemisphere countries are usually negotiated through a number of processes which include spot market sales at the stump or delivered to the mill gate, and short-term contracts over one to two years, or long-term contracts between supplier and buyer for terms between 15-25 years are common. Contracts normally stipulate the terms and conditions for supply including estimated volume of timber on the harvestable tract of forest, species, price per unit volume, contract duration, and on-sale arrangements. Long-term contracts also include conditions for adjusting price through the duration of the contract to maintain the real price value of timber at the sale date.

The process of selling logs, including the type of contract and the duration, vary across countries. In the Scandinavian countries, the USA and New Zealand, log markets are considered structurally competitive and spot market sales and short-term contracts are the norm.¹

Structurally competitive markets are expected to yield cost minimisation and efficient prices that signal resources should be allocated to the industry to the point where resource returns equal their opportunity cost. Structural competition normally implies that many buyers and sellers in the market produce the competitive forces that ensure that prices reflect efficient costs of production. Any departure from structural efficiency or competitive behaviour will result in a misallocation of resources, a distortion in prices from minimum costs and poor signalling for attracting resources to the industry for investment purposes. Consequently, market structure is considered important for efficiency for market price determination.

Structurally competitive markets are apparent in those countries that sell logs principally on the spot or through short-term contract markets. Finland, Sweden and Norway have a large number of smaller sized forest growers who sell their logs at ‘roadside prices’, at delivered

¹ The New Zealand log market is highly competitive and structurally efficient. Logs are offered for sale through one of three options: Lump Sum Sale, Stumpage Sale, or Prepared Log Sale. Lump Sum Sales involve sale of the forest tract at a specified price which could be higher or lower than the log price at the mill, stumpage sales pass the responsibility of the price setting to the owner, while prepared log sales pass all responsibilities to the owner for cutting and delivery.
prices or at the stump to cutting contractors. Log markets that are more competitive in nature also operate in the mountain states of western USA where a large number of smaller log suppliers prevent concentration on the supply side of the market, while the New Zealand market has become highly competitive over the past 20 years with private small-scale operators commanding more than 20% of the supply side of the market.

Apart from Haile’s (2001) work on auctions for log sales from the US forest service and on-selling to other retail markets, little has been written on competitive log sales and price determination. Lohmander (1987), Thompson (1992) and Washburn and Blinkley (1993) were concerned with the impact that log prices have on resource managers’ decisions about the time to cut the forest. These models were based on the a priori assumption of information efficiency in competitive markets. However, much of this work has been in relatively competitive market environments and little attention has been paid to log sales in markets that are structurally uncompetitive with a high degree of concentration on either the supply or the demand side of the market or both.

Two issues concerning pricing of logs arise in this context: log price determination in a market that is highly concentrated on both the seller and buyer sides of the market, and the adjustment process of that price over the term of the contract. Non-competitive prices emerge in these market environments and the prices achieved for the log resource do not necessarily reflect the opportunity cost of the resource. Market failure may also arise in plantation forest sales due to externalities arising from carbon sequestration benefits, conservationism and other social benefits. With the emergence of and encouragement of small-scale forest farming, there seems little evidence that other market structures represent the current market profile of log sales in far north Queensland and the south-east region. Specifically, the timber market in Queensland is analysed to explain price outcomes for log sales in highly concentrated markets and the ramifications of adjusting these prices over time. These market characteristics are apparent in tropical north Queensland and affect the sale and pricing of logs from the region.

QUEENSLAND LOG SALES IN PERSPECTIVE

Australian forests cover some 42 M ha with native forests representing 97% of this area. Commercial softwood and hardwood plantations in Australia account for approximately 1.2 Mha and are primarily located on the eastern seaboard States of Queensland, New South Wales, Victoria, Tasmania and South Australia (ABARE 1999).

The area of softwood plantations is much greater than that of hardwood plantations in the eastern states of Australia, with New South Wales the largest having 293,000 ha and Queensland 173,000 ha (Bureau of Rural Sciences 2002). Hardwood plantations cover a much smaller area in these states; only 13% of the plantation estate in New South Wales is hardwood plantings, while in Queensland only about 20,000 ha of hardwood plantations have been established (Venn in press).

Public ownership of commercial plantation forests in both New South Wales and Queensland is high. The Queensland Department of Primary Industries – Forestry (DPI-F) still owns and controls 89% of commercial forest plantations in the state while the State Forests of New South Wales controls approximately 70% of commercial plantation forests in use. For all eastern states in Australia public ownership of commercial plantation forests remains at about 66% of the forest estate, despite a strong move in the 1990s towards privatisation and corporatisation of state forest authorities. While Tasmania traditionally has had high levels of private ownership it was not until 1995 that Victorian commercial plantations become predominately privately owned. The Victorian Plantation Corporation sold its holding of plantation forests to the private sector. Nevertheless, the states of Queensland and New South Wales have retained high levels of public sector control and ownership over the resource.
Queensland plantations are predominantly located in the south-east (SE) and northern districts of the state, covering an estimated 178,000 ha, with the majority of this area still under government ownership and control. The south-east district is the largest plantation area in the state with 148,000 ha. Exotic softwood species *Pinus elliottii* and *P. caribaea* predominate but the native *Aracauria cunninghamii* accounts for 28% of the commercially-planted forest area in Queensland. It is estimated by DPI-F that *Aracauria cunninghamii* has the potential to expand to an area of 58,000 ha over the next 20 years. Commercial plantations of hardwoods have a smaller presence in Queensland. This is probably the result of historically relatively large harvests of hardwood timbers from native forests, which are now declining as logging is being phased out in these forests. However, in New South Wales commercial hardwood plantations cover an estimated 44,500 ha and the state has a capacity to double this area within 20 years.

The high concentration of plantation ownership in public hands is a result of the enactment of the *Softwood Forestry Agreement Act 1967, 1972, 1976 and 1978* (Walker et al. 1998). Active policies were pursued to establish large tracts of plantation forests to replace native forests as a source of timber. Log prices were controlled to encourage investment and employment in value-adding timber processing industries. Processing mills were encouraged to locate close to these plantations for access to the timber resource. As high yields, high employment and industry expansion objectives were sought through controlled pricing of logs, elements of market failure emerged at a structural level in the Queensland log producing industry.

Most log sales in Queensland follow the propositional call method. DPI-F as the major supplier of logs identifies those forest tracts that are approaching maturity and estimates the volume per hectare likely to be harvested, and a reservation price is set for the timber. If a number of tracts are expected to be ready for harvesting over a number of rotational periods, a long or short-term contract may be offered in the sale description of the timber. DPI-F then calls for expressions of interest from potential buyers for closed bid price for the forest tract timber. It is these bids that are called propositional calls. Typically only one and usually no more than two propositional calls are received for any forest tract. The propositional call system is not an open-auction competitive bidding system nor is it a closed tender system where a number of buyers offer tenders for an advertised forest tract of timber. Rather, the propositional call system collapses into a negotiated sale agreement between a single buyer (usually located advantageously to the state forest) and a single monopolist supplier (DPI-F). It is through this system that stumpage prices are determined. Reservation prices, on the other hand, are set by the supplier and based on a number of economic and financial criteria - including production costs, rate of return, employment creation and industry development targets - which suggests that prices other than those that are market-related are being pursued.

Contract prices are adjusted on a quarterly, half-yearly and yearly basis, using an established formula and through negotiations.

**Market-based Pricing**

When the factor input market for logs and the final output commodities market for processed timber are highly or perfectly competitive, profit maximising firms will demand more log inputs to the point where the productive value of the last cubic metre of logs equates with the additional revenues those additional factors earn in the production and sale of the final output. In other words, the value of the marginal product of logs (VMP) equates with the marginal revenue product (MRP) derived from log inputs, symbolically
\[ VMP = MRP = MPP \times MR \]

where \( MR \) = the log price in the commodity market;  
\( MPP \) = marginal physical product of the log input; and  
\( MR \) = marginal revenue from sale of processed log.

However, when firms are imperfectly competitive or monopolistic in the commodities market, the \( MR \) is less than the price so that less is paid for factor inputs (logs in this case) than their marginal product value. For a monopsonist firm (only one large buyer) in the market for the factor inputs of logs, the demand for the logs equates with the MRP of the logs not the VMP. In this case the supply curve of the factor input has a positive slope: as the monopsonist increases the use of the factor input (logs) he has to pay a higher price for the additional logs which places the monopsonist’s marginal expenditure curve above its average expenditure curve, which is the supply curve of logs. This marginal expenditure curve is denoted as the ME curve in Figure 1. The firm will be in equilibrium when it equates the marginal expenditure on the factor (ME) with its MRP, which is its demand for the factor input (here logs).

**Bilateral Monopoly**

When a monopsonist is the only buyer of the factor input and there is only one supplier of the factor in the market, a bilateral monopoly exists. Under bilateral monopoly market conditions a precise market price for the factor input is not determined: only the upper and lower limits of the stumpage price range is determined by the market leaving the final settled price to be determined from bargaining between the parties (Koutsoyiannis 1987). The eventual price for the factor depends on the bargaining skills of the parties involved and political and economic considerations may play a role in the process of arriving at an agreed price.

The monopsonist will express a demand for the factor input in accordance with the MRP of the factor (its demand curve) and will choose to employ that level of the factor where the marginal expenditure outlays on additional factor units (logs) equates with the MRP or demand for the factor. The price that the buyer is offering for the quantity of logs at this volume level is determined by the supply curve (average expenditure) for logs for that volume, not from the ME curve. Consequently, the buyer wants a larger quantity of the factor input and wants to pay a lower average price for the quantity. This result is illustrated in Figure 1.

![Figure 1. Price indeterminancy in the a bilateral monopoly input market: the case of logs sales in Queensland](image-url)
The supply of logs facing the monopsonist buyer is the upward sloping supply curve $S$ being the marginal cost curve of the supplier. As the supplier is aware that its marginal revenues are derived from the demand curve for logs, its marginal revenue curve is expected to be lower than the demand curve for logs. These relationships are illustrated in Figure 1. The supplier therefore sets their price in accordance with the rule that it will supply logs to the point where its marginal revenue from the last sale equates with its marginal cost (supply curve). Price is negotiated from this level determined from the corresponding point off the demand curve.

In Figure 1 the supplier in a bilateral monopoly situation prefers to supply $L_s$ volume of logs at a price of $p_t$, setting the upper limit to the price negotiations, and the buyer sets the lower limit price level by demanding a larger volume of logs at a lower preferred price of $p_b$. Bargaining between the two parties results in a price between $p_t$ and $p_b$. The economic rent from the resource is shared between supplier and the buyer.

The Queensland Case

Bureau of Rural Sciences (2002) estimated that for the year 2001 softwood plantation ownership in Queensland was 89% held by the public sector (DPI-F), making this a monopolist in softwood log supply in the factor input market. By the end of the year 2000 there were 23 long-term contracts between 15 and 25 years still operating in Queensland. A number of these contracts had been won by the same processing plants mainly located in the south-east corner of the state; in total 17 processing and milling plants held supplier contracts for timber logging. These plants are distributed along the Queensland coast and are advantageously positioned near large DPI-F plantations. Normally, only a few plants locate near each plantation to guarantee continuous and adequate log supplies to the buyer to sustain large processing throughput facilities. There are only 32 mills in Queensland that cut exclusively plantation softwood, and most are located in the south-east region. Only six of these mills process log throughput levels of 50,000 m$^3$ of timber per year. In tropical north Queensland there is only one fixed hardwood processor and two processes that handle both hardwoods and softwoods (DPI-F 1998, pp. 39-41). Some of these buyers are large in size taking all offered logs, others are smaller in size and specific in processing requirements demanding only thinnings, preferring a smaller size log. These regionally located plants are monopsonist buyers and DPI-F is a monopoly input supplier. With remote location and high transport costs, single-buyer single-seller characteristics prevail. The bilateral monopoly model applies to price striking for contracts on logs from softwood plantations.

In the propositional call system, expressions are called for logging rights and stumpage payment for tracts of plantation forests approaching maturity date. DPI-F sets a reserve price and a preferred monopolist price for the logs and attempts to bargain for a high price. The buyer bids a price as low as possible, but one that would meet the seller’s minimum acceptable price. Negotiated prices on the contract are set as a compromise between the upper and lower price limits of $p_t$ and $p_b$ as shown in Figure 1.

The hardwood plantation estate in Queensland is small compared to softwoods and comprises only 11% of the total plantation estate. Of this the public sector owns only 2% of hardwood plantations with the remainder in private ownership. More competition exists in this market but the market size of Queensland supplied timber is small.

Adjusting Long-Term Contract Prices

Medium and long-term contracts for logs sales normally include price adjustment clauses. Even though the price setting arrangements may result in less than competitive prices, price adjustment procedures are deemed necessary to maintain the real value of the contract throughout the term of the contract. Traditionally, a simple Wholesale Price Index or the
Consumer Price Index (CPI) has been used as a price adjustment tool designed to maintain the real value of the contract. Buyers of logs who commit to take specified annual volumes of timber from a plantation over a number of years claim they were disadvantaged when a price adjustment system using the CPI method was applied. It was argued that even during periods of inflation log prices remained at a constant real value whereas revenues earned by the processors buying the logs was susceptible to the vagaries of the construction and building cycles in the economy. This created the situation of revenues by the buyers fluctuating over the building cycle but being subject to constant real input prices for logs. This situation is shown in Figure 2 below.

![Figure 2. Revenue and input costs for log processors in Queensland](image)

The argument that lies behind this analysis is that the timber processors (the buyers of the logs) incur a cash flow problem. While their revenue flows vary across the building cycle, their major input cost (log prices) remain constant, creating a cash flow crisis across the cycle. It was argued by the processors that a price adjustment mechanism that reflected the revenue flow of timber products in the final markets would be more appropriate for adjusting log prices to harmonise movements in both input and output prices. A weighted price index of final sales of structural timber and plywood was conceived to replace the CPI as a price adjuster in log contracts.

DPI-F adopted the wood weighted index (WWI) after a trial with some of its buyers in 2000. Quayle and Cox (1999) provided a rationale and a justification for using a downstream market composite index rather than a general price index adjuster such as the CPI. However, due to cost considerations, instead of creating a weighted price index across a number of final outputs, only structural timber was selected as the price adjuster. The WWI became a major component for adjusting existing log prices to determine prices that would apply in the immediate future period of the contract. This relationship is expressed in Equation 1.

$$ P_{t+1} = P_t * \text{WWI} $$

where $P_{t+1}$ = log prices in the immediately future period;  
$P_t$ = current log prices; and  
WWI = Wood Weighted Index.

In 1998, State Forests of New South Wales commissioned a pricing and market trends survey of 93 timber wholesalers in New South Wales, Queensland and Victoria. Prices and
percentage price movements for a number of processed timbers were estimated. Price changes for a number of product lines including F5, F8 structural softwood timbers, panelling, decking, and fencing timbers were measured\(^2\). Average price levels and price movements for each grade of timber are shown for All Regions and Queensland in Table 1.

<table>
<thead>
<tr>
<th>Product (radiata pine)</th>
<th>Average price 1998</th>
<th>Average price 1997</th>
<th>Weighted % price change</th>
<th>Product (hoop pine)</th>
<th>Average price 1998</th>
<th>Average price 1997</th>
<th>Weighted % price change</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5 Structural</td>
<td>383</td>
<td>367</td>
<td>5.51</td>
<td>F5 Structural</td>
<td>520</td>
<td>502</td>
<td>3.45</td>
</tr>
<tr>
<td>F8 Structural</td>
<td>429</td>
<td>412</td>
<td>5.7</td>
<td>F8 Structural</td>
<td>554</td>
<td>534</td>
<td>3.36</td>
</tr>
<tr>
<td>Flooring (Cypress)</td>
<td>584</td>
<td>566</td>
<td>5.1</td>
<td>Flooring (Cypress)</td>
<td>589</td>
<td>551</td>
<td>2.84</td>
</tr>
<tr>
<td>Plywood</td>
<td>765</td>
<td>766</td>
<td>0.099</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MDF</td>
<td>450</td>
<td>451</td>
<td>-0.92</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>


Weighted averages of the price movements were estimated by using proportional volumes of each product type as the weight. Weighted average percentage price changes between 1997 and 1998 were estimated for All Regions and Queensland. The hoop pine price increases in Queensland during this period was 3.34%, and price increases for all softwoods in Queensland and All Regions were 5.22%, and 5.47% respectively. The results from the Timber Market Survey also validated variations in price movements across product types and regions. These results supported the concept that the broad CPI adjuster should be replaced with a weighted price index based on processed timber prices. It was expected that such an index should reflect the demand and supply conditions in the downstream timber markets and therefore would be appropriate as a shadow price adjuster in the upstream factor input log market. However, Queensland opted for a simple price adjustment mechanism based on price movements in structural timber sales only.

**The Factor Adjustment Mechanism**

The other component of the price adjustment model includes the concept of a Factor Adjustment System (FAS). The FAS was designed to be a composite construct of a number of variables that could be interpreted as a subjective element of the pricing adjustment mechanism. This component is constructed from a number of economic and financial variables which include actual and predicted growth rates in GDP, actual and expected movements in interest rates, actual and expected employment levels, building approvals and the construction of house and unit starts. These variables are interpreted to gauge the expected future direction in the economy and growth in those industries demanding processed timber. This in turn affects the derived demand for logs. It is on this basis that the FAS was included in the price adjustment model as illustrated in Equation 2.

\(^2\) The survey also covered price movements in hardwood processed timbers for the F11, F14, F17, flooring and decking product range.
P_{t+1} = P_t \times (\text{WWI} + \text{FAS}) \tag{2}

where: \text{FAS} = \text{Factor Adjustment System}

Negotiation of price levels for the next period in the log contract is dependent on the objective WWI measure and the subjective predictive values of the FAS. It is in this manner that future shadow prices for log inputs were to be estimated, based on downstream processed timber price movements and general economic indicators. Given the subjective nature of the FAS, the FAS component of the price adjustment mechanism has been less readily accepted by buyers in the market.

**Residual Input Price Adjustment**

Two shortcomings of the proposed price adjustment model are evident. First, by relying on price movements in products from downstream processed timbers, productivity gains in downstream activities are being used to value resources in upstream industries. Second, the subjective interpretation of the importance of each of the FAS factors gives a degree of price variation at a personal negotiating level. Further, the established price for logs negotiated in a long-term contract in structurally uncompetitive markets is market indeterminate and a shadow price needs to be estimated.

It has been suggested that an alternative price adjustment mechanism that relies on the traditional residual pricing methodology could be applied. This method values the finished timber products and deducts all the known inputs (except log values) and returns to capital in the processing industries. After transport costs and cutting costs are accounted for the residual value is deemed to be the value of the log input to the timber processor. O’Reagan and Bhati (1991) illustrated that the residual pricing mechanism approach is also fraught with methodological danger because it leads to inefficient prices in the log market. Nevertheless, changes in input prices other than logs could be used as a proxy guide for adjusting log prices on contracts rather than relying on downstream industry price movements to give guidance for price change in the input log market.

**CONCLUSIONS**

It has been argued that when the price and demand for a factor of production is being considered, this price depends upon the characteristics in both the end-product commodity market (timber sales) and the factor input market (log market). A firm with monopolistic power in the commodities market that faces a competitive log input market will maximise profit by employing that volume of logs where \( \text{MRP}_\text{L} = \text{MC}_\text{L} \) (the St rate in Figure 1), where \( \text{MRP}_\text{L} \) is less than \( \text{VMP}_\text{L} \). Where both the input supplier and the input buyer are monopolist and monopsonist respectively, the buyer maximises profit by setting \( \text{ME}_\text{b} \) with that of \( \text{MRP}_\text{b} \) (demand curve); and the supplier sets price by satisfying the condition that the \( \text{MR}_\text{s} \) equals to the \( \text{MC}_\text{S} \).

Under these conditions with monopoly power present on both sides of the market, the market does not produce an optimal stumpage price and price is indeterminate. Consequently, market power does matter. Moreover, it is shown that for the case of Queensland, there are a small number of dominant processors that are advantageously located near large plantations owned by a public sector authority that controls the supply side of the market. These conditions generate classic bilateral monopoly price outcomes that determine upper and lower price bounds from which an agreed price is achieved through bargaining and negotiation. The share of the rent from the log resource is determined by the bargaining power of each party as quoted by Pindyck and Rubinfeld (1989, p. 357) ‘monopsony power and monopoly power will tend to counteract each other’, monopsony power will push price closer to marginal cost, and monopoly power will price closer to marginal value. Efficient
market pricing of logs in Queensland remains unachievable when asymmetrical market power is present on either side of the market. Little improvement can be expected in this market until more competitive pressures are exerted. This can only be achieved by creating more suppliers (plantation owners) and more processors on the buyer side of the market.

Terms and conditions of long-term contracts are determined at the commencement of a log allocation contract. Prices are determined within a bilateral negotiating environment and the method for adjusting prices until the next review period are set in the contract. The WWI and the FAS elements of the pricing mechanism are used to adjust prices through this period. Equal weight is given to each component and both elements relate to downstream activities. Difficulties arise in applying this formula for adjusting contract prices because the WWI is reliant on a singular price movement of structural timbers only and could be misleading for the value of logs for use in other processing activities. Similarly, the FAS is mainly a subjectively interpreted component and personal judgements are made in the pricing decision calculus.

An alternative residual input price movement adjuster has been proposed. Price movements of other factor inputs into the processing industry could act as an indicator of movements in the shadow price of logs sold in the Queensland market. Further research into this option is a logical extension for refining and validating downstream timber product prices as a measuring rod for adjusting price in upstream input markets.

The success of the newly adopted price adjustment method, which includes a WWI component and a FAS factor, for logs supplied from DPI-F in medium to long-term contracts is still to be evaluated. However, DPI-F appears to be satisfied with the implementation of this price adjustment method. Nevertheless, as price review periods draw near both sides in the negotiations will again argue over the importance and role of the FAS component in adjusting log prices. This could lead to price instability and continued inefficiency in price levels for logs in the future.

REFERENCES


