The impact of operating scale and exchange rate on the profitability of some major wood processing options – analysis using the WoodScape model

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Abstract

The WoodScape model was used to analyse the effect of changes in exchange rate and operating scale on the profitability of a range of conventional primary and secondary wood processing options. Exchange rate volatility is a significant factor affecting profitability of wood processors involved in the export market, with some processes being more heavily impacted than others. The amount of variation in Return on Capital Employed (ROCE) due to forex changes was found to be related to a factor derived from the capital cost of the plant, the production volume and product price. The original WoodScape study found that plants processing larger volumes were more profitable than smaller operations. This topic was re-examined with fixed feedstock costs, and with feedstock costs adjusted upwards for larger plant to account for greater transport costs (associated with larger point volume demand and longer average transport distances for feedstock). Economies of scale gave advantages to larger volume operations, which were generally sufficient to overcome the increasing cost of longer transport distances. However this issue is complex and site-specific, as it is related to the size of the resource and its density around a specific processing location.

Kawerau pulp mill log yard

Introduction

In 2012, in response to the difficulties being faced by the wood processing industry in New Zealand, the WoodScape project developed a model for analysis of the profitability of a wide range of wood processing options operating in this country (Jack et al., 2013). It was developed in conjunction with FPInnovations (Canada) and had substantial industry input to ensure its relevance to the New Zealand forest industry. The original model had 39 separate wood processing technologies, with 63 options when scale variations are included. The costs were based on new plant on a greenfields site, so results may differ from those for an existing operation. Much of the underpinning data in the model was confidential.

The model compares the ROCE (expressed as a percentage) of a range of sawmilling, pulp and paper, remanufacturing, engineered wood products and reconstituted wood panel operations, along with a number of bioenergy and emerging wood processing technologies. ROCE is a financial ratio that measures a company's profitability and the efficiency with which its capital is employed. It is calculated as: ROCE% = earnings before interest and tax (EBIT)/capital employed.

The current version of the model contains all of the original process and calculations, but has additional technologies, data and calculations. Log prices and costs are updated regularly. The model now has 51 wood processing technologies, including bioenergy, with 85 options when scale variations are included.

The major findings of the original WoodScape study (Jack et al., 2013) were: increasing scale (volume of wood processed and converted into product) improves ROCE (assuming that the necessary wood resource is reasonably available to fit with the scale of the operation); and for processors exposed to the export market, exchange rate, which affects product price in export markets, was a substantial influence on ROCE.

At the time of the first published analysis, the NZ$:US$ foreign exchange rate (forex) was approximately 0.82 and the impact of variations in exchange rate were identified as having a significant impact on ROCE; the range of exchange rates tested was from $0.94 to $0.70. Since the original WoodScape analysis was done the NZ dollar has fluctuated between 0.8697 and 0.6334 (monthly average, Reserve Bank, 2015) and was ~0.65 to 0.66 at the time of this analysis (November 2015). Exchange rate data were obtained from the Reserve Bank of New Zealand website (Figure 1). The variation in exchange rates covered in this analysis are NZ$1 buys between US$0.850 and US$0.65 (0.625 is close to the post-float long-run average).

In the model, changes in exchange rates only affected product price and some input costs (imported chemicals and fuel). Capital cost did not change with the exchange rate, as the mill is assumed to be built at a fixed cost.

The impact of scale on profitability has been reported to vary with the type of operation, with pulp and paper mills showing a greater response than solid wood processing such as sawmills (Sutton, 1972). Stier (1985) also found that pulp and paper operations benefited from economies of scale. In a study of the Swedish sawmilling industry, Brege et al. (2010) found that there were no strong correlations between size and profitability. However the mills analysed were all in excess of 250,000 m^3 p.a. of product out (~400,000 m^3 p.a. of log in), which makes them large by New Zealand standards. Mansson (2003), also studying Swedish sawmills, did find evidence of economies of scale in sawmilling in that country and identified the optimal size (160,000 to 170,000 m^3 p.a. log infeed). This size of the mill is much smaller than many mills in Sweden (Brege et al., 2010). Mansson's report also identified a number of other studies that found varying results, with some countries and regions (Tasmania, Mexico) showing large effects from economies of scale and others none (Interior British Columbia).

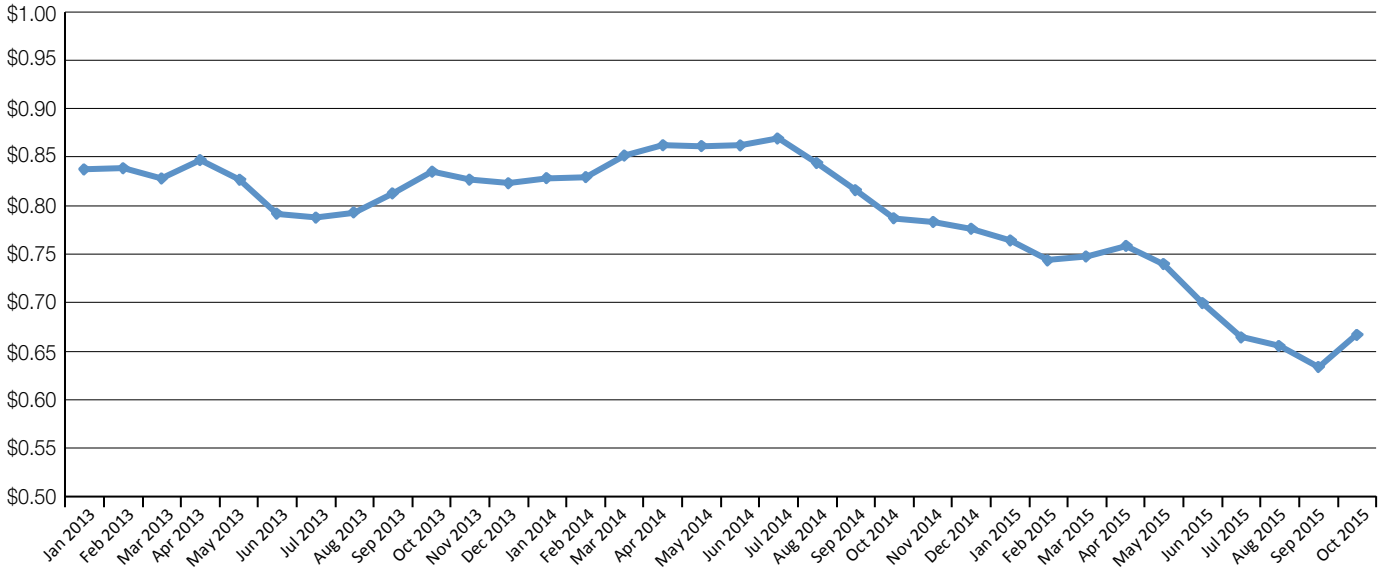

Figure 1: NZ$ versus US$ exchange rate January 2013 to December 2015. Source: www.rbnz.govt.nz/statistics/tables/b1/

The aims of the analysis reported here were to: examine the effect of the exchange rate on wood processing profitability and interpret why some processes are more heavily affected by exchange rate volatility than others; and to look at the effect of scale on profitability, with the effect of increasing volume demand reflected in the feedstock costs. Feedstock cost is a significant driver of wood processing costs, being between 30% and 70% of the ex-mill product cost depending on the processing option.

Methods

This analysis is focused on mainstream wood processing options: sawmilling, engineered wood products (plywood, laminated veneer lumber (LVL)), pulp and paper; and remanufacturing and reconstituted panel products (medium density fibre board (MDF), particle board and oriented strand board (OSB).

Log price data used in the model were derived from Agrifax/AgriHQ monthly log price database reports (NZ average $ per tonne delivered to wharf or mill). Log prices used in the base case analysis were the average from January 2013 to October 2015 (Table 1). There have been substantial fluctuations in log prices during this period. The WoodScape model assumes that logs appropriate to the process are used, e.g. S1 and S2 for a structural sawmill and pulp logs for Kraft pulp and OSB etc.

Table 1: Log prices – $ per tonne delivered

	$ per tonne (46 month average)
P1	147
P2	122
Export P	141
S1 & S2	107
S3	94
Industrial	79
L 350	93
A	98
K	94
KS	90
KI	85
Pulp logs	51

The impact of operating scale was based on an initial assessment where the increasing scale of the operation did not affect the delivered cost of wood, and then the feedstock costs were altered for larger mills based on an assumed increase in delivered feedstock costs by transport distance. This increase in transport costs by volume was based on volume by distance curves developed in Scion's Biomass supply model (Hock et al., 2012) with two scenarios: the Central North Island (CNI) – high volume and concentration of forest; and Southland – moderate volume and lower concentration of forest (Hall et al., 2010). These volume estimates are based on the National Exotic Forest Description (NEFD) (MPI, 2015) and are for the period 2010 to 2015.

Product prices were derived from a range of sources including industry contacts and *Random Lengths*, a US-based weekly wood products price newsletter covering lumber, reconstituted wood products and engineered wood products.

The list of technologies included in this analysis (a subset of all those in the model) is presented in Table 2. This list covers a range of traditional wood processing options. OSB is included as the model has this option at three different scales, which makes it useful in terms of the scale analysis, and while it is not a product commonly made in New Zealand it is an option to consider. In Table 2, the process (technology) name is followed by two numbers in brackets, which indicate the plant operating scale (the amount of product out/the amount of feedstock in). Amounts are typically in cubic metres (m^3) but pulp product is in air dry tonnes (adt). The ROCEs are included, based on an exchange rate of US$0.65, which gives ROCEs that are significantly higher than those in the original WoodScape study, where the base case scenario had an exchange rate of US$0.82.

Different plant utilisation rates were assumed for some operations; for the large complex processes (e.g. pulp and MDF mills) they are assumed to operate for up to 96% of the time, with minimal shuts. Other less complex operations, which are easier to shut down (sawmills and remanufacturing plants), are assumed to have lower levels of plant utilisation in the modelling. This is a reflection of the reality of sawmilling operations in New Zealand, where the sawmill and remanufacturing options frequently operate for around half the hours potentially available, i.e. 80 hours per week versus 168 total.

Kinleith pulp mill

Table 2: Technologies (14) and scale variants (29) included in the analysis and their ROCE

Process	Scale	ROCE% forex at US$0.65
Appearance sawmill	(50k m³/90k m³)	20.9
Appearance sawmill	(100k m³/180k m³)	20.2
Appearance sawmill	(200k m³/360k m³)	24.6
BCTMP	(300k adt/0.795M m³)	5.3
Cross laminated timber	(30k m³/35k m³)	24.2
Industrial sawmill small	(15k m³/25k m³)	19.9
Industrial sawmill	(210k m³/400k m³)	21.1
Industrial sawmill dry	(210k m³/400k m³)	25.8
Kraft pulp	(200k adt/1.0M m³)	10.3
Kraft pulp	(300k adt/ 1.6M m³)	13.2
Kraft pulp	(1.0M adt/4.54M m³)	23.5
Liner board	(470k adt/0.5M adt)	3.5
LVL	(30k m³/50k m³)	15.5
LVL	(110k m³/200k m³)	24.0
MDF	(400k m³/1.0M m³)	3.8
Newsprint	(0.3M adt/0.84M m³)	8.9
OSB	(200k m³/344k m³)	17.2
OSB	(450k m³/765k m³)	24.7
OSB	(750k m³/1.25M m³)	27.1
Particle board	(91k m³/200k m³)	2.1
Particle board	(180 k m³/400k m³)	6.1
Plywood	(120k m³/200k m³)	27.7
Plywood	(350k m³/640k m³)	35.3
Remanufactured appearance	(23k m³/31k m³)	16.2
Remanufactured untreated	(32k m³/37k m³)	–4.6
Structural sawmill	(25k m³/45k m³)	7.7
Structural sawmill	(200k m³/360k m³)	22.1
Structural sawmill	(425k m³/750k m³)	29.4
Structural sawmill	(700k m³/1,200k m³)	36.1

Results and discussion

Impact of foreign exchange rate (forex) on ROCE

The capital cost of the plant is set for the assumed time of modelling/plant construction and does not vary with the forex rate. Domestic log prices are also independent of the forex rate.

The impact of forex (NZ versus US dollar) changes on ROCE is shown in Figure 2. Only those technologies from Table 2 that have a ROCE high enough (>15%) to make them potentially attractive investments are included. When the inputs of forex movements are considered (covering the range of forex rates over the last two years) the results change substantially. At forex rates of over 0.8 many of the options are no longer attractive as a new investment.

Ordering of the processes in Figure 2 is on the ROCE of the forex base case of NZ$1:US$0.65. Some processes are more affected than others by changes in forex (Figure 2). For example, most of the sawmilling and plywood options have high ROCE variation (range due to forex changes) and others (Kraft pulp, LVL and CLT) have a much lower variation.

This variation in ROCE (the range expressed as a value) is shown in Figure 3, where the variation between the highest and lowest ROCE by technology across the exchange rates used are presented (ROCE variation = ROCE(forex 0.65) minus ROCE(forex 0.85)). It is possible that part of the variation is from the different levels of plant utilisation assumed in the modelling.

As the measure used to compare the operations (ROCE) is based on the full capital associated with operating the plant, it is expected that plants with lower plant utilisation have lower ROCE, but this is complicated (and sometimes masked) by a range of other factors.

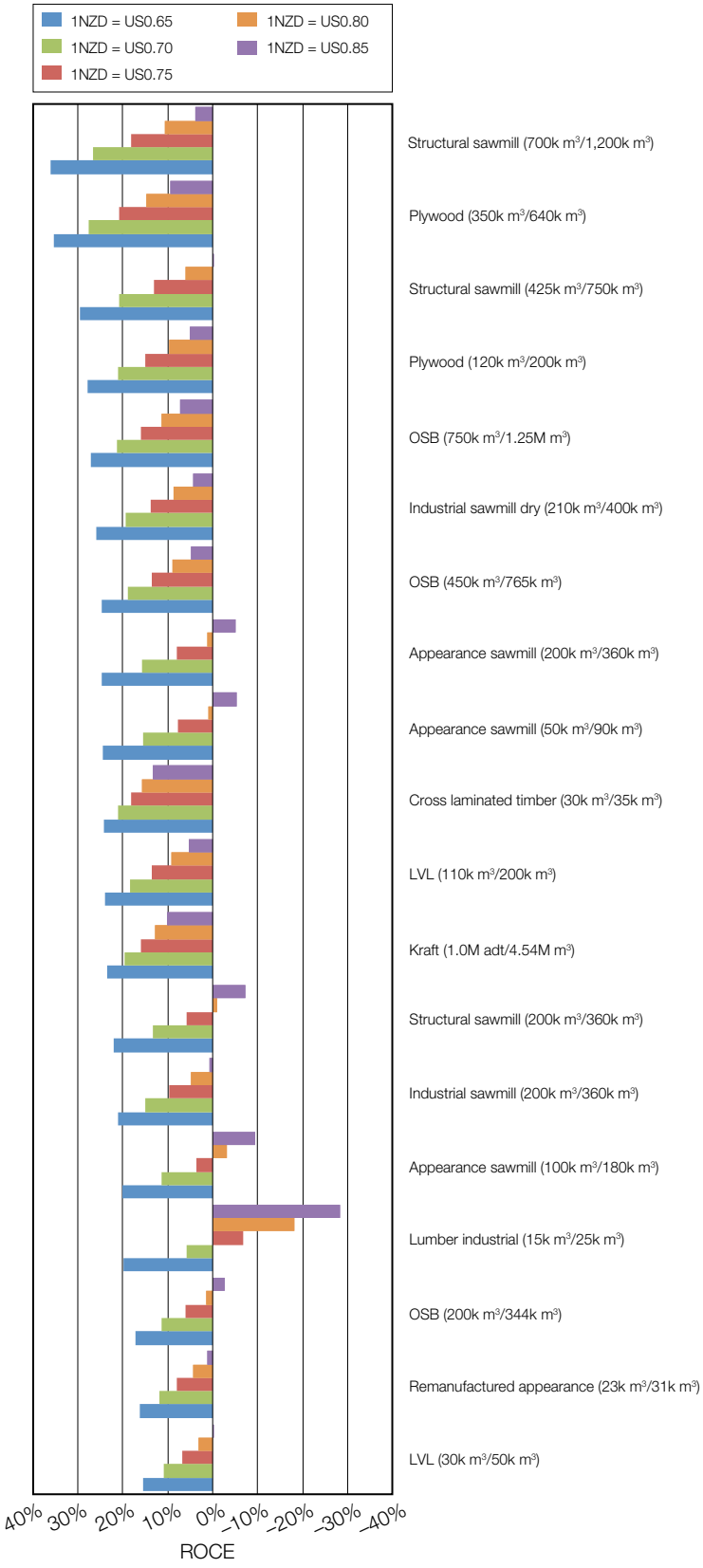

Figure 2: ROCE by exchange rate for a range of wood processing technologies

Waipa sawmill

Kawerau wood processing site

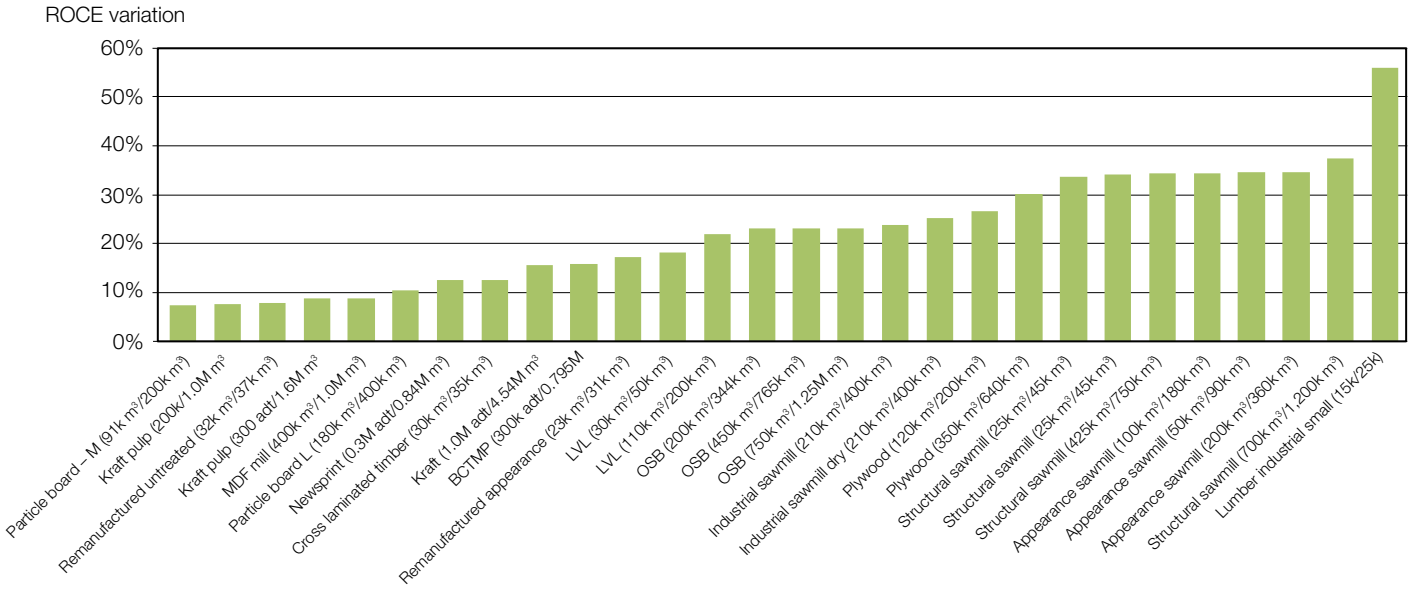

Figure 3: ROCE variation by wood processing technology

Figure 4 shows the relationship between variation in ROCE due to forex changes and plant utilisation. This relationship is weak (r^2 0.38).

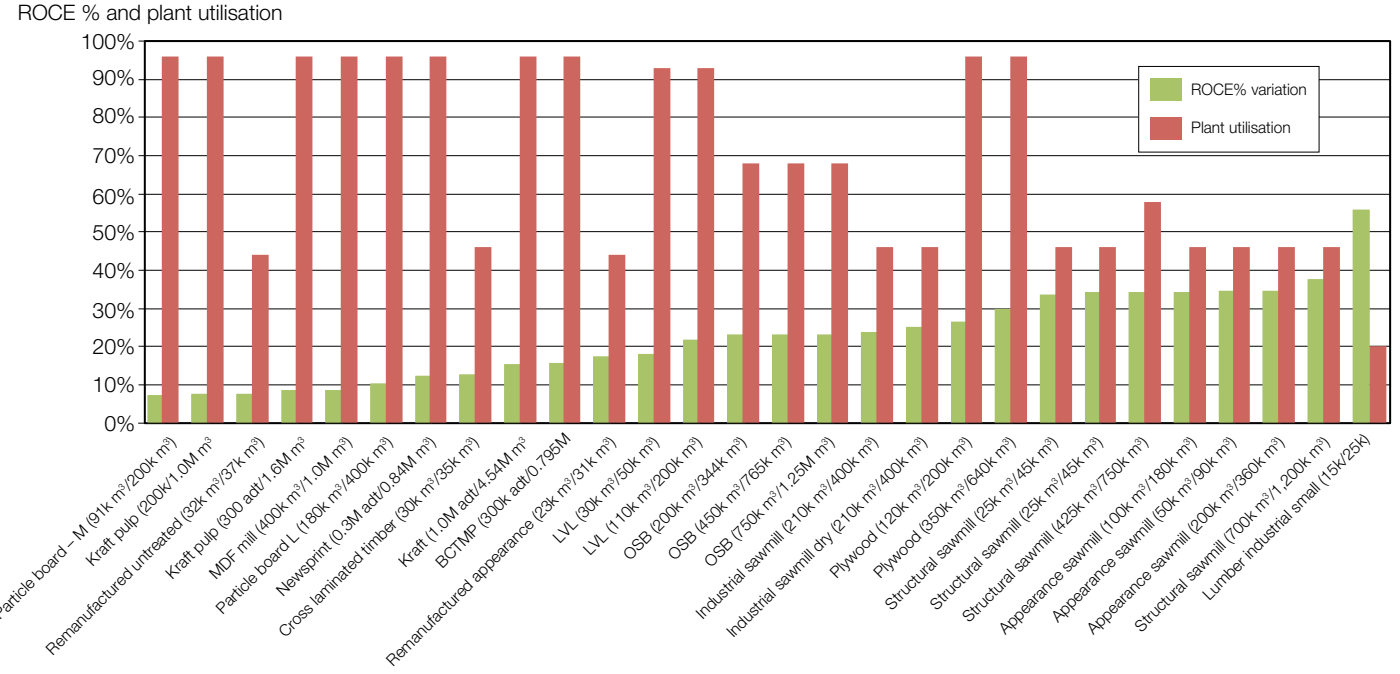

Figure 4: Variation in ROCE due to forex changes versus plant utilisation

Figure 5 shows the relationship between the variation in ROCE and a factor derived from capital cost, production volume and product price (Capex/gross revenue). The higher the resulting factor, the lower the ROCE variation. Product price (ex-mill) is affected by the foreign exchange rate. Figure 5 shows low ROCE variation where there is a high capital to earnings ratio and high ROCE variation where there is a low ratio.

Impact of scale of operation on ROCE

In the original WoodScape analysis, the ROCE of larger plants of the same type was found to be higher than that of smaller plants (Jack et al., 2013), which is in line with general expectations. Plant scale has to fit within the limits of reasonably available biomass supply. This analysis shows that this finding still holds across

a range of technology options: structural sawmills, OSB plants and Kraft pulp mills. Figure 6 shows the trends of scale and ROCE for all the technology options in this study at an exchange rate of 0.65.

Effect of increasing feedstock supply costs on ROCE

One of the other major influences on ROCE of any wood processing operation is the cost of feedstock. This cost is affected by transport distance with larger plants that require greater volumes of logs impacted by higher transport costs included in the average feedstock cost. Figure 7 shows cumulative volume of pulp log supply in the CNI (delivered to Kawerau) and Southland (delivered to Mataura). The volume available at ~$51 per tonne is indicated by the vertical arrow at ~90 km on the x axis.

At the national average delivered cost ($51/tonne), the CNI has ~950,000 m^3 p.a. of pulp logs potentially available. For Southland, the equivalent volume is ~330,000 m^3 p.a. For plants with a demand greater than this, the extra cost of transporting from a greater distance would have to be reflected in the delivered cost. Table 3 shows the impact on ROCE of increasing plant scale where the increasing cost of supply is taken

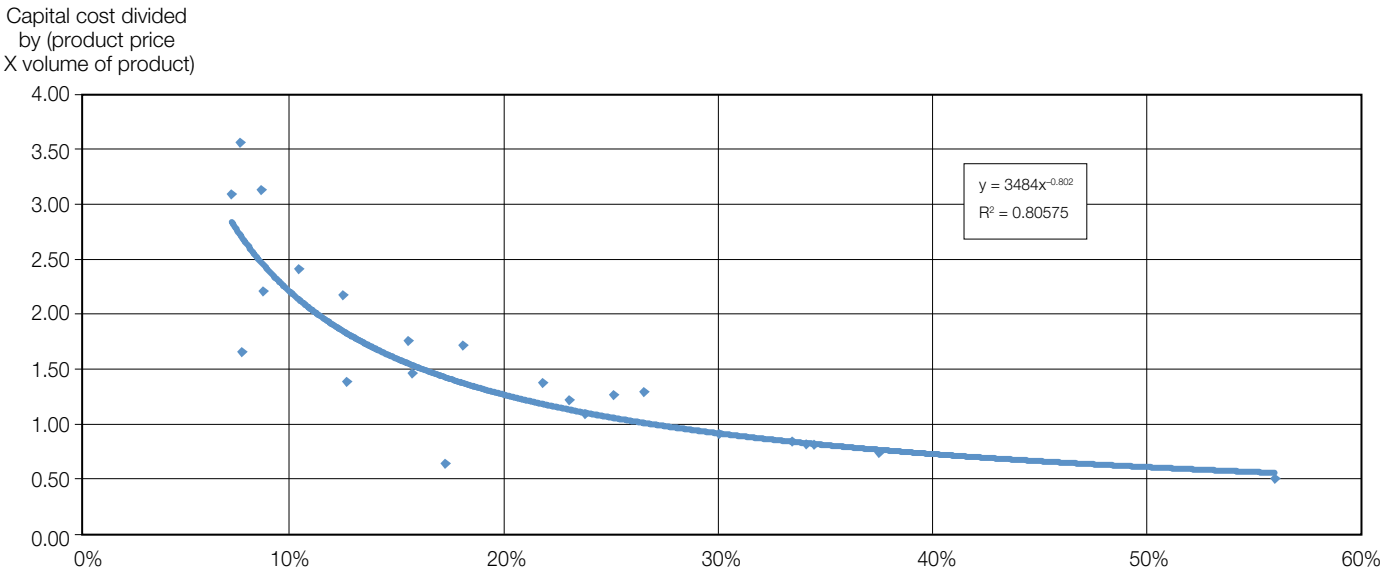

Figure 5: Variation in ROCE due to forex changes versus capital cost divided by production volume multiplied by product price

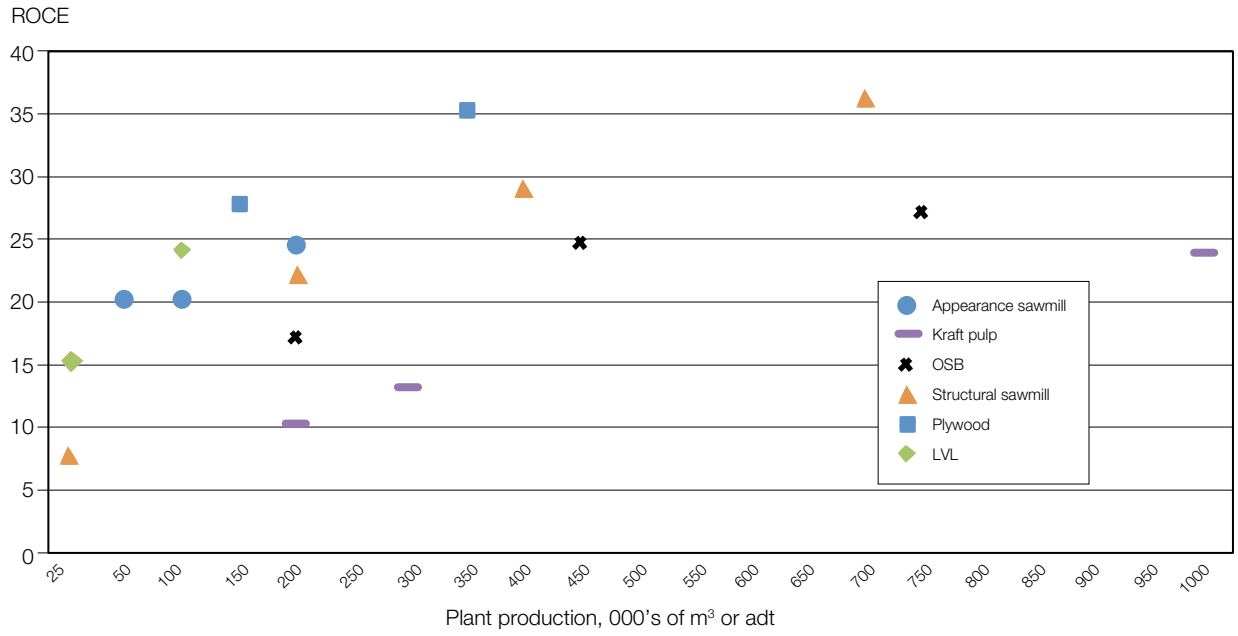

Figure 6: ROCE by plant production for a range of technology options

into account. For the ROCE figures in Table 3, the figure in brackets is the ROCE if a fixed cost of $51 per tonne is used regardless of the plant size. The figures in Table 3 indicate that for the example shown the ROCE advantage of the larger plants is reduced, but still present, even with the higher delivered log cost associated with larger plants.

Pulp mills derive a large proportion of their feedstock from sawmill chip and this is factored into the modelling; sawlog chip has a higher cost than pulp logs, and supply by distance is also affected by the scale of the mill demand and the transport distance. It should be noted that the mill with the 4.5M m^3 of log or log equivalent demand is a very large mill, and it would be very difficult to achieve this level of supply to a single site in New Zealand, even in the CNI. Large expansion of the solid wood processing industry would be required to supply a substantial volume of sawmill chip as the volume of chip logs from forest harvest would be insufficient to meet this demand.

Conclusions

Wood processors selling into export markets are heavily affected by forex rates, and the variation seen in the last two years is sufficient to move an operation from profit to loss in some instances.

Some plants have a much greater response in ROCE to variations in foreign exchange rates than others (sawmills are high, pulp mills are low). This response is a reflection of earnings versus capital cost and can be described by capital cost/gross revenue.

Plant utilisation is a factor in the variation between how much an operation is affected by forex changes. Operations with lower plant (capital) utilisation are somewhat more affected.

Above and below: Kawerau wood processing site

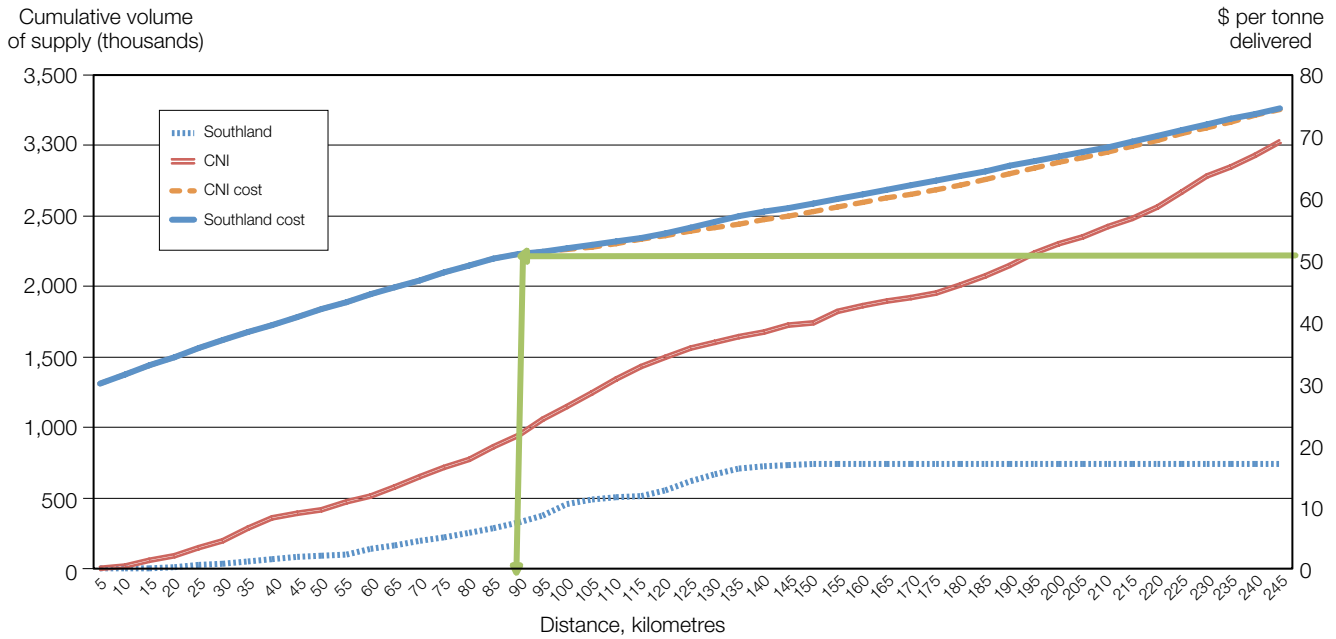

Figure 7: Supply volume and cost by distance, pulp logs in the CNI and Southland (2015)

Table 3: Impact of feedstock cost changes due to increasing cost of supply due to increasing plant feedstock demand

	Southland		CNI	
Plant type & log demand	**Weighted $/t feedstock**	**ROCE**	**Weighted $/t feedstock**	**ROCE**
OSB 344k	52	16.9 (17.2)	40	21.5 (17.2)
OSB 765k	61	21.0 (24.7)	50	25.1 (24.7)
OSB 1250k	–	–	53	26.5 (27.1)
Kraft 1.0M	–	–	53	10.1 (10.3)
Kraft 1.6M	–	–	55	12.3 (13.2)
Kraft 4.5M	–	–	85	16.2 (23.5)

Note: blank cells for Southland indicate that there is insufficient pulp log derived from local forests for a plant of this size

Economies of scale give larger plants higher ROCEs; this advantage is decreased, but still present, when log prices are increased to account for greater transport costs associated with delivering larger volumes of logs to a single demand point.

The use of data derived from GIS-based supply modelling along with the WoodScape model would enable the optimum-sized plant for a given location to be determined.

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