AN ANALYSIS OF SOUTH AFRICAN SAWMILLING COMPETITIVENESS

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The South African sawn timber market supply and demand are in equilibrium and significantly associated with the local residential construction market. During the Great Financial Crisis (GFC), the local residential construction market contracted. This caused a reduction in sawn timber demand, price and margin. Subsequently, the competition between sawmillers increased and led to the closure of 41 mills. This study included a sawmilling competitiveness analysis for South African sawmills taking part in the Crickmay Intermill comparison from 2004 to 2017. The Crickmay Intermill comparison assumes that net margin is the measurement for competitiveness. Spearman correlation tests were used to compare performance measurements with net margin. This study and other studies found significant associations between the implementation of value-adding strategies and competitiveness. Sawmills that effectively create more value from the raw material tend to be more competitive. In contrast with other studies, it was determined that people costs are significantly associated with competitiveness. However, like other studies, it was confirmed that labour productivity is not associated with competitiveness. It is argued that South African sawmillers can increase competitiveness by implementing

value-adding strategies, implementing competitive remuneration policies and increasing the sawn timber usage intensity in South Africa.

KEYWORDS:

value recovery, volume recovery, productivity, people costs

1. INTRODUCTION

A sawmill is a complex system that operates within a physical and natural world that is an even more complex system (Morua & Marin, 2016). To provide customers with a valuable product or service in this environment, sawmills utilise technologies to convert raw materials into valuable products. Effective management decision making is key to sawmilling competitiveness and decision biases (overconfidence, chasing unprofitable customers, escalation of commitment, organisational silos, project selection bias and keeping things as they are) can have a significant negative impact on the sawmill (Judd & Charles, 2008). Sawmills compete for similar resources, technologies and customers. For sawmills to survive and grow in this environment, they must remain competitive. Competitiveness, innovation and productivity are interconnected (Carayannis & Grigoroudis, 2014). For sawmills from Australia, Canada, Chile, Norway and the USA it was found that innovativeness is significantly positively correlated with firm performance, firm size is positively associated with innovativeness, process and product innovativeness both equally influence firm performance and have a higher impact than business systems innovativeness (Hansen *et al*., 2011). Thus, for sawmills to remain competitive, they must innovate and improve their productivity.

In South Africa sawn timber is primarily utilised in the construction industry (the correlation between square meterage residential construction and sawn timber sales from 1993 to 2016 is moderately positive at 0.61), for example roof trusses. Less than 10% of sawn timber used in South Africa is imported and less than 10% of South African produced sawn timber is exported (FAO, 2019). This indicates that the local market supply and demand is approximately in equilibrium.

Insert Figure 1

A sawmill converts logs, that differ in diameter, length, shape, density, moisture content and quality, into lumber that must behave in a predictable manner. This is achieved by utilising measuring, sorting, transporting, cutting, grading, drying, combustion, transferring, storage and optimisation technologies in combination with the organisation of human resources. The competitiveness of sawmills is influenced by various aspects including raw material costs, technologies utilised, target markets, operational costs, marketability of by-products and conversion effectiveness. Being able to identify, manage and predict the competitiveness of sawmills is important for potential investors, shareholders, managers and competitors. It ensures the sustainability and prosperity of a specific mill. This research aims to identify whether it is possible to use correlation testing to identify quantifiable predictors of competitiveness in the South African softwood sawmilling industry.

South African sawn timber sales and actual annual production have varied with time and since 2005 the number of processors reduced with 31%. After 2007 the average industry

margin for sawmills reduced from more than 20% to 10% and reached a minimum in 2011 where after it gradually improved to 9% in 2016 (**Figure 2**) (Allpass, 2018).

Insert Figure 2

The reduction in margin was mainly driven by the reduction in sawn timber sales. The change in average industry margin follows the trend in sawn timber sales (**Figure 3**) (Godsmark, 2017). Residential construction (measured in square meterage) reduced during the Great Financial Crisis (GFC) (Grusky DB *et al*, 2011) (the economic downturn from 2007 to 2009) and almost halved from 2007 to 2011. This sudden change in demand increased competition among sawmillers and those that could not remain competitive were pushed out of production. From 2011 to 2016 residential construction increased and subsequently sawn timber demand increased, allowing producers to increase their production capacities and improve sales.

Insert Figure 3

The producers that survived the GFC were then in the position to capitalise on increased demand by increasing their production capacities through efficiency improvements, additional machinery and new technologies (**Figure 4**) (Godsmark, 2017). From 2010 to 2016 sawn timber sales grew by 37%, but the average sales per mill grew by 60%. Thus, there were proportionally more of the smaller mills that did not survive the aftermath of the GFC. They also improved the real value of their products and their volume recovery (**Figure 5**) (Allpass, 2018).

Insert Figure 4 and Figure 5

In 2017 the average sawn timber usage in South Africa was 0,0319 $m^3person^{-1}$. A similar analysis was performed for a sample of 179 countries and it was found that South Africa was rated the 72nd most intensive sawn timber user per capita. The top 50 most intensive sawn timber users used six times more wood per capita than South Africa (**Figure 6**).

Insert Figure 6

This comparison indicates potential to increase the demand for sawn timber in South Africa by increasing the intensity of utilisation per capita to similar levels experienced by the top 50 countries. Within the United Kingdom the market share of new timber frame houses increased from 14.1% (2001) to 24.5% (2008) (Carpenter, 2013). This was achieved through the implementation of policies that promoted use of low carbon building materials and subsequently adopting building legislation to enable this (Jonsson, 2009). If this is not achievable, South African sawmillers will remain dependent on the local supply and demand equilibrium. During economic downturns, when residential construction reduces, sawmillers will again face reduced margins.

2. MATERIALS AND METHODS

Due to the local supply and demand equilibrium experienced in South Africa the local sawmilling industry is very competitive. The number of sawmills in South Africa reduced from 111 in 2004 to 75 in 2016. To know what drives competitiveness in the sawmilling

industry would allow one to predict future competitiveness of a specific sawmill and assist managers in prioritising aspects that have the highest impact on competitiveness.

The competitiveness of sawmills in South Africa is measured on a quarterly basis and compared on a quarterly and annual basis. Approximately 30 sawmills take part in the Intermill national benchmarking exercise performed by Crickmay & Associates (Crickmay & Allpass, 2010). This represents 40% of sawmills in South Africa and includes mostly the larger producers. Thus, this analysis is biased towards larger sawmills and will not be fully representative of the whole industry. The report includes a relative benchmark of the following performance measurements (the unit of measurement is R m^{-3} unless a ratio or percentage is calculated):

1. Earnings before interest and taxes (EBIT)
2. Net margin (earnings after all costs have been deducted from revenue)
3. Net margin with industry average sawlog costs applied
4. Margin on net timber sales
5. Net timber sales
6. Delivered average selling price (ASP)
7. Roundlog cost multiplier (the ratio of log costs to net timber sales)
8. Roundlog delivered cost
9. Chip contribution (percentage of chips produced compared to log intake)
10. Production costs excluding administration
11. Total costs, excluding sawlog cost and administration
12. Maintenance costs
13. Kiln drying costs
14. Administration costs

15. People cost multiplier (ratio of net timber sales to people costs)
16. Recovery efficiency (ratio of actual volume recovery to theoretical volume recovery)
17. Labour productivity (m^3 of lumber produced per shift)

The Intermill comparison assumes that net margin is the measurement of overall competitiveness. Net margin is calculated by subtracting total costs from total sales, adding stock movements and dividing it by total production. The Intermill comparison only lists the rankings of the various mills for each performance measurement considered but does not perform correlation tests to determine whether there is a relationship between various performance measurements and overall competitiveness. For this article, the various performance measurements in the Intermill comparison were correlated with overall competitiveness. Subsequently, the performance measurements that correlated the best with overall competitiveness were identified. Correlations that had a P-value of more than 5% were excluded.

The research methodology included Spearman correlation tests. The Intermill comparison only provides the rank position for each mill, making it impossible to perform Pearson correlation tests with the data. The names of the mills are kept confidential and are replaced with numbers. Since the mills' identities are confidential, the correlation tests were simple correlation tests and could not include control for location, size, source of logs or ownership. This is an inherent limitation of this analysis and could possibly be further investigated in a follow up study that explores the relationship between specific cost items and the aspects not considered here. The objective of this analysis was to determine what aspects have the most significant impact on overall competitiveness and, thus, if mills in a specific location, of a specific size or of a specific owner were more

competitive. The impact should be measurable in terms of at least one of the performance measurements. Thus, it is assumed that lack of control over these aspects should have a limited impact on the results.

Each correlation test in this analysis was performed as if a hypothesis was tested. The hypotheses testing in this research was performed to determine whether the null hypothesis (H0) can be rejected. The null hypothesis assumes that the alternate hypothesis (H1) is false (Page & Meyer, 2005). The hypotheses tests were performed to determine whether there were significant simple linear regression correlations (positive or negative) between two ordinal variables. To test whether a hypothesis was significant, the P-value for each correlation was determined. It was assumed that if the P-value were less than 5%, the null hypothesis could be rejected and that the test was significant (Page & Meyer, 2005). If the P-value were more than 5%, it was assumed that the null hypothesis could not be rejected and therefore the test was non-significant (Page & Meyer, 2005). The hypothesis testing for all the variables thus entailed the following:

H0: There is no significant positive/negative correlation between variable “A” and variable “B”.

H1: There is a significant positive/negative correlation between variable “A” and “B”

For all the tests variable “B” was replaced with net margin and variable “A” was replaced by the applicable performance measurement. Secondary data from the Crickmay Intermill Comparison – Fourth Quarter 2004 (Crickmay, 2005) to the Crickmay Intermill Comparison – Fourth Quarter 2017 (Allpass, 2018) was used.

3. RESULTS

The Crickmay report included 29% of sawmills in South Africa during 2004 but grew its representativeness to 40% in 2017. Considering that the number of mills in South Africa reduced by 31% but that the number of mills taking part in the Crickmay report only reduced from 32 to 31, it can be assumed that in general the mills that take part in the Crickmay analysis are more competitive. The gate price of lumber increased 7.75% per year, but total production costs increased with 8.3% per year for the period. This caused a reduction of gate price margin from 15% in 2004 to 8% in 2017 (**Table 1**).

Insert Table 1

Correlation with net margin

The results of the correlation testing illustrate that for most periods there was a significant positive correlation between net margin and margin on net timber sales, net margin with industry average sawlog costs applied, people cost multiplier, roundlog cost multiplier and production costs excluding sawlog and administration costs. (**Table 2**)

Insert Table 2

Margin on net timber sales and net margin with industry average sawlogs costs applied are good estimators of net margin and for this reason a significant correlation should have been expected and the results support these assumptions. The reduced correlation of net margin with industry average log costs applied does, however, indicate that the playing

field is not completely the same for all mills. Some mills do pay higher for the same logs than other mills. Availability and ownership of logs differ between mills. Some mills only use logs from their own plantations while other mills use logs from plantations that supply multiple mills in the same region and use a competitive bidding process to determine the log price. Mills that compete for logs in a competitive bidding process tend to pay higher log prices.

People cost multiplier is a ratio of people costs to net timber sales. It is thus a labour efficiency measurement and quantifies the value people generate compared to their costs. For 13 of the 14 periods there were significant positive correlations between people cost multiplier and overall competitiveness. On average, the correlation was also more than 0.5 which indicates that there was a strong correlation.

Roundlog cost multiplier is the ratio of log costs to net timber sales. It is thus a raw material efficiency measurement and quantifies the value that was generated compared to the costs of raw material used. For 12 of the 14 periods there were significant positive correlations between roundlog cost multiplier and overall competitiveness.

Production costs, excluding administration costs, had a significant positive correlation with overall competitiveness for 11 of the 14 periods. Total costs, excluding sawlog cost, and administration costs and recovery efficiency also correlated well with overall competitiveness.

The results indicate that for a sawmill to be competitive, it needs to utilise its raw material and people in a way that generates the most value compared to the costs vested in these

two aspects. During 2017 sawmills' average log cost per m^3 produced (57.8%) and people costs (17.6%) were the two highest cost items and in combination accounted for 75.4% of total production costs. Thus, mills should either focus on reducing the costs of these two items while keeping their gate price consistent, utilising these aspects to improve their gate price or a combination of these two. Other aspects also have an influence on competitiveness, but their impact is less than these two.

The significance and level of correlation between various factors and net margin varied over time. This suggests that the competitive environment of sawmills changes with time.

People costs and productivity

People costs is a significant part of the overall production costs of most sawmills. For this reason, an analysis was performed to determine whether there is a correlation between people cost per cubic meter produced and net margin. Labour productivity is also an important measure and for this reason, labour productivity was compared to people costs. A limitation of this study is that the Crickmay Intermill comparison only compares people costs on a quarterly basis. Thus, in this study the 4^{th} quarter's people costs were compared to the 4^{th} quarter's net margin. The labour productivity for the full year was correlated with the 4^{th} quarter's people costs. Thus, the time period for the second analysis was not the same, but it is a reasonable assumption that labour productivity for a full year is approximately the same as that of one quarter within the same year.

The results indicate that for 10 of the 14 periods considered there were significant positive correlations between people costs and overall competitiveness (**Table 3**). This was

especially true for the period of 2008 to 2013 during which there were significantly strong positive correlations for every year. This relationship also indicates that the correlation between production costs, excluding administration costs and net margin, is mostly influenced by people costs since the other cost items do not correlate well with net margin.

Insert Table 3

The results also indicate that there were only two periods during which there were significant positive correlations between people costs and labour productivity. This illustrates that labour productivity does not necessarily lead to reduced people costs or to increased competitiveness.

4. DISCUSSION

To consider how the results of this study compared to similar studies, a summary of the latter is provided below.

Swedish sawmilling companies implemented different production strategies that can be divided into a combination of three categories: (1) value-adding, (2) size and (3) labour productivity. For these companies value-adding had a significant impact on profit margin, while the same was not applicable for size and labour productivity (Roos *et al*, 2001).

In another study, 13 Sweden sawmills were evaluated for the period of 2002 to 2005 to determine whether a cost efficiency strategy (increasing capacity, lowering unit costs and

competing in a commodity market), a value added in the primary sawmill strategy (product differentiation and upgrading) or a forward integration strategy (laminates, building elements and trading as wholesalers) was associated with profitability. It was concluded that generally a cost efficiency strategy was not associated with profitability, but that a value added in the primary sawmill strategy and a forward integration strategy was positively associated with profitability (Brege *et al*, 2010).

A comparative study between specialty mills (mills typically producing high value products through secondary processing and generally smaller in scale) and commodity mills (mills typically producing low value products with only primary processing where economies of scale has a significant impact on competitiveness) were performed. The study concluded that specialty mills are more resilient than commodity mills during economic downturns. It was argued that this was mainly due to their flexibility, product diversity, ability to produce high value products and their ability to sort the latter into many different grades. Commodity mills do not have these attributes and subsequently could not adapt during the GFC, which led to the closure of many mills (Pinkerton & Benner, 2013).

Companies in the forestry sector should develop adaptive leadership skills that will enable them to develop competitive advantages. In recent history, improving value recovery instead of focusing on volume production, proved to be a better strategy. Wood manufacturing companies that continued a commodity-based strategy risked being overthrown by lower cost producers, while companies that developed mass customisable production facilities had a greater chance of success (Panwar *et al*, 2012).

Uslu & Teeter (2017) evaluated the forest products industry of Alabama (USA) to determine what the primary reasons were for the closure of production facilities. They concluded that the increase in variable costs and not the decrease in demand was the primary reason for closures. They also concluded that the cost of raw material had a higher impact on the profitability of mills than the cost of labour. They argued that this possibly occurred because an increase in people costs is often compensated for by an increase in labour productivity.

Lähtinen *et al* (2009) evaluated the empirical association between resources and financial performance of the company for 16 large- and medium-sized sawmills in Finland. The study concluded that personnel, collaboration, technology know-how, reputation and services, raw material and geographical location had a significant association with a sawmill's financial performance. The study also included other resources: labour, factory and machinery, finance strategy, management and organisational culture.

Value and volume recovery at a sawmill are influenced by various factors (Steele, 1984) including log properties (Berglund *et al*, 2013, Fredriksson, 2014), sawing technology (Lin *et al*, 2011, Maness & Lin, 1995, Wade *et al*, 1992) and decision making (Penfield *et al*, 2014, Todoroki & Rönnqvist, 1999, Wessels, 2009a, Wessels, 2009b, Wessels *et al*, 2011). By optimising decisions relevant to operations, technology selection and raw material selection, the value and volume recovery of a sawmill may be improved and subsequently its relative competitiveness.

The results from these studies indicate that mills that focus on value-adding strategies like value added products, forward integration, speciality/customised products, value

recovery, optimisation and lowering variable costs, performed better than mills that followed a commodity based strategy aimed at reducing per unit costs. For South African mills, roundlog cost multiplier correlated well with competitiveness. Thus, the competitiveness of South African mills is also positively influenced by value added strategies. However, unlike international studies, the competitiveness of South African sawmills also correlates well with people costs even though (like the international studies) it does not correlate well with labour productivity. This study did not aim to identify how remuneration policies differ between South African sawmills and how specific policies related to competitiveness. Remuneration data is generally considered to be confidential and thus it will most likely be difficult to perform such an analysis. However, this study does confirm that, in South African sawmills, remuneration policies are significantly associated with competitiveness and is thus a critical aspect to be considered.

5. CONCLUSIONS

The South African sawn timber market is significantly associated with the residential construction industry. Historically, the local market demand has been in equilibrium with the local supply. Thus, when local demand for sawn timber reduced, the local sawn timber price reduced, margins got smaller and competitiveness between local mills increased. The increase in competitiveness during the GFC led to the closure of several local sawmills (especially smaller sawmills). This study aimed to determine what differentiated competitive sawmills from mills that suffered financial distress.

As in other studies, it was found that the implementation of value-adding strategies is significantly associated with competitiveness. Roundlog cost multiplier (Crickmay's

measurement of value recovery efficiency) correlated well with competitiveness. Thus, mills that follow a value-adding strategy is more likely to survive during periods of economic decline and prosper during periods of economic growth. This study only correlated the overall value recovery efficiency of mills with competitiveness and did not intend to correlate specific value recovery strategies with competitiveness. Future studies could focus on the success of specific value-adding strategies within the South African sawmilling industry.

Unlike other studies, it was found that people costs are significantly associated with competitiveness. However, as in other studies, it was found that labour productivity is not significantly associated with competitiveness. This might indicate that there are significant differences between the remuneration policies of different South African sawmills.

Compared to other developed and developing countries there is potential to increase the intensity of sawn timber utilisation per capita in South Africa. In doing so, it might be possible to change the market supply and demand equilibrium. This increase in demand might attract investment in local sawmills and subsequently ensure the sustainability of local sawmillers. The increased adoption of mass timber construction or timber frame housing might assist herein. Future studies that specifically focus on developing strategies to increase the sawn timbers usage in South Africa should benefit most local sawmillers.

6. ACKNOWLEDGEMENTS

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8. TABLES AND FIGURES

Figure 1: South African sawn timber flow (FAO, 2019)

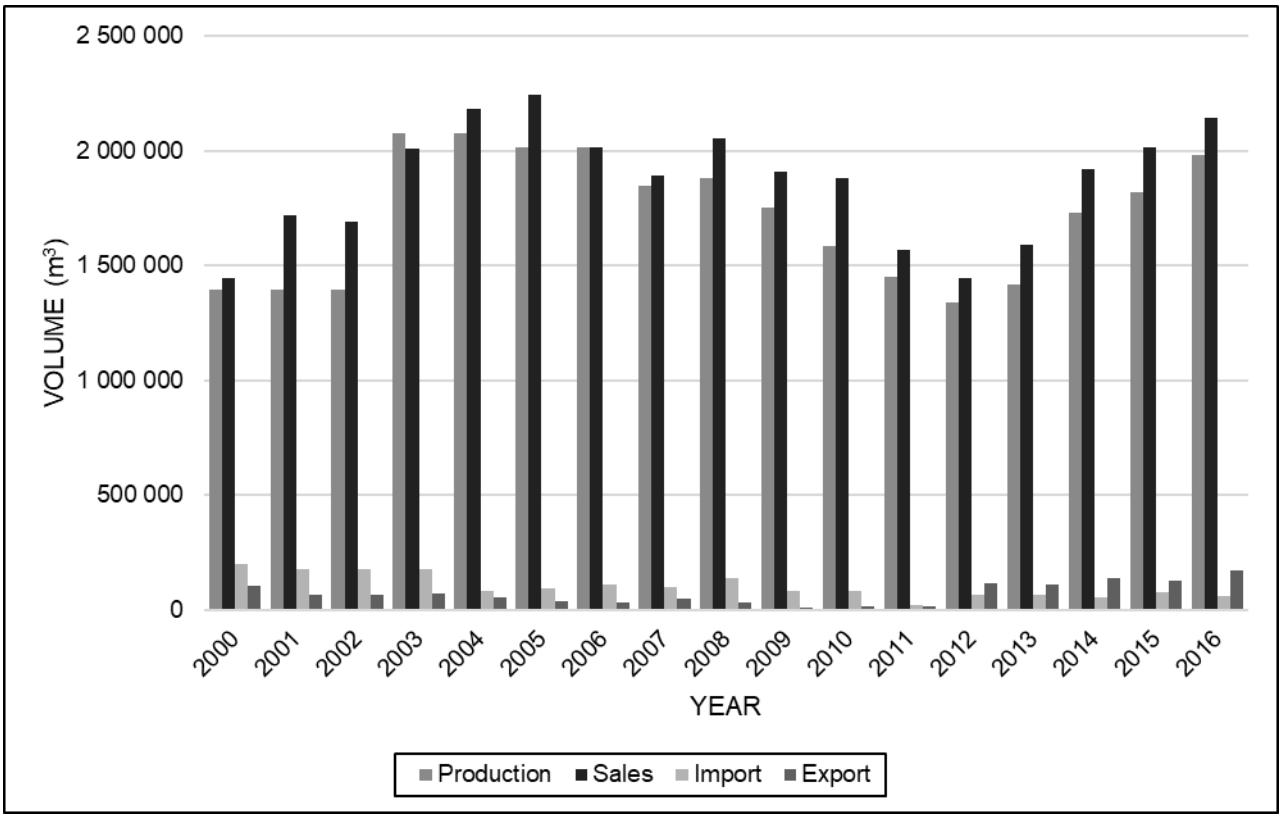

Figure 2: Gate price, production costs and margins of sawmills from 2004 to 2017

(Allpass, 2018)

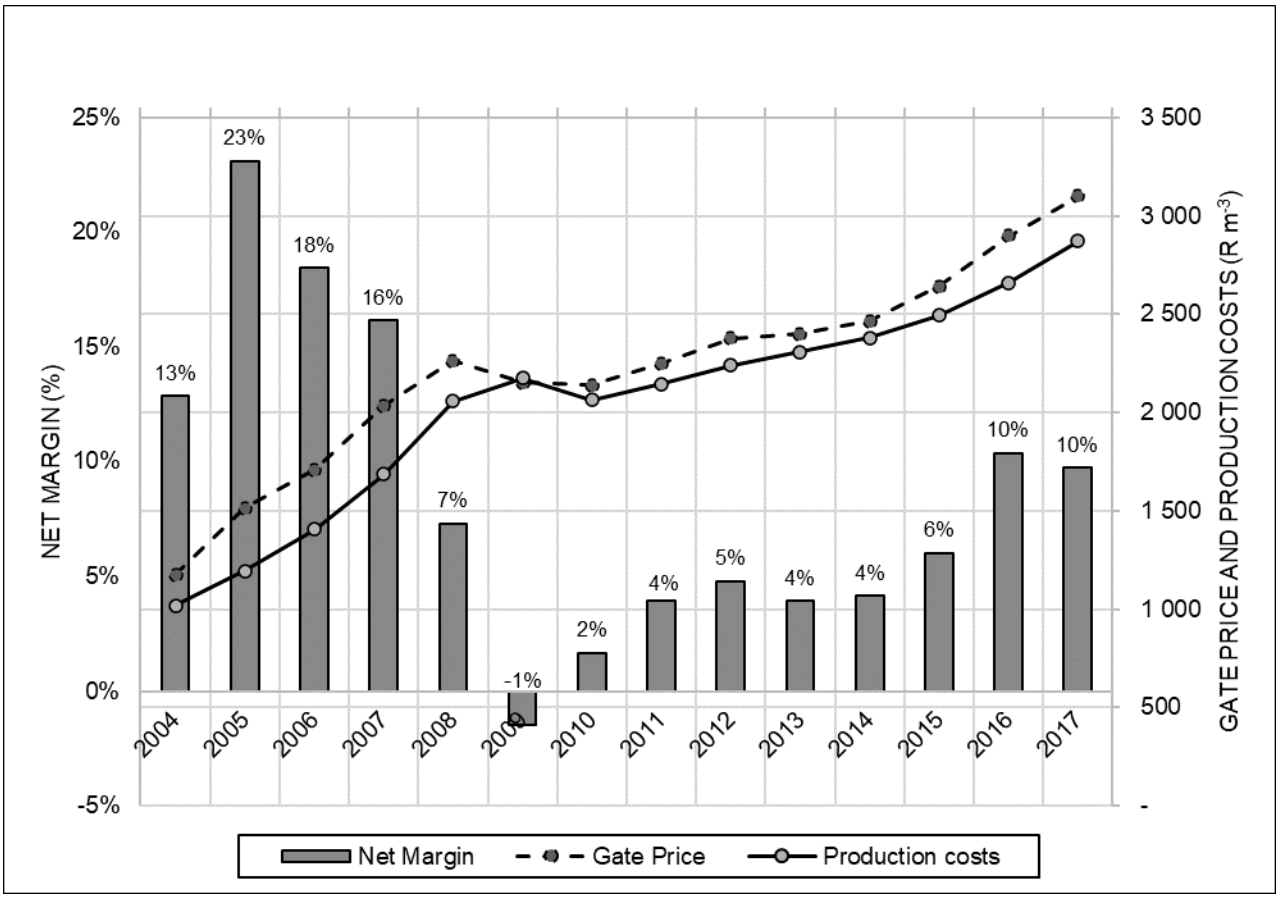

Figure 3: South African sawn timber sales per year (Godsmark, 2017)

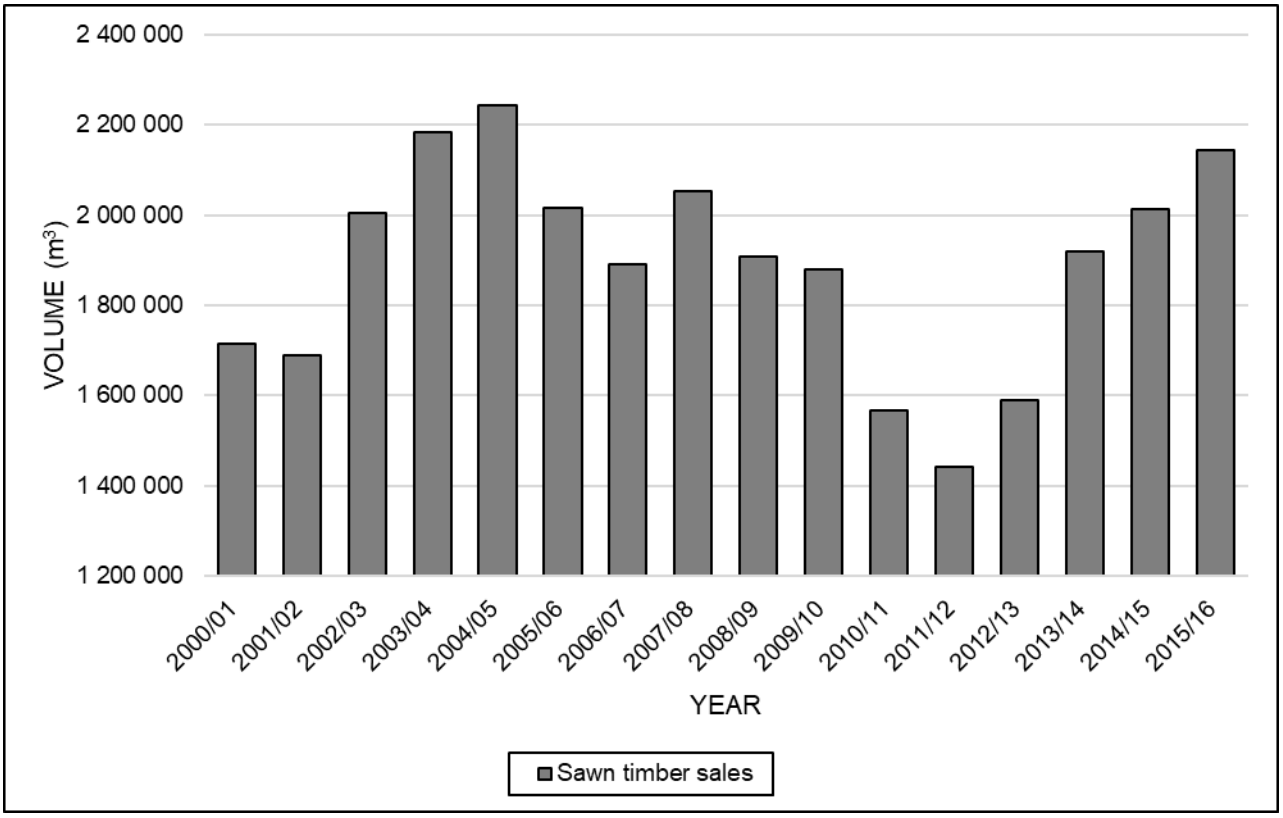

Figure 4: Number of solid wood producers and sales per mill from 2000 to 2016

(Godsmark, 2017)

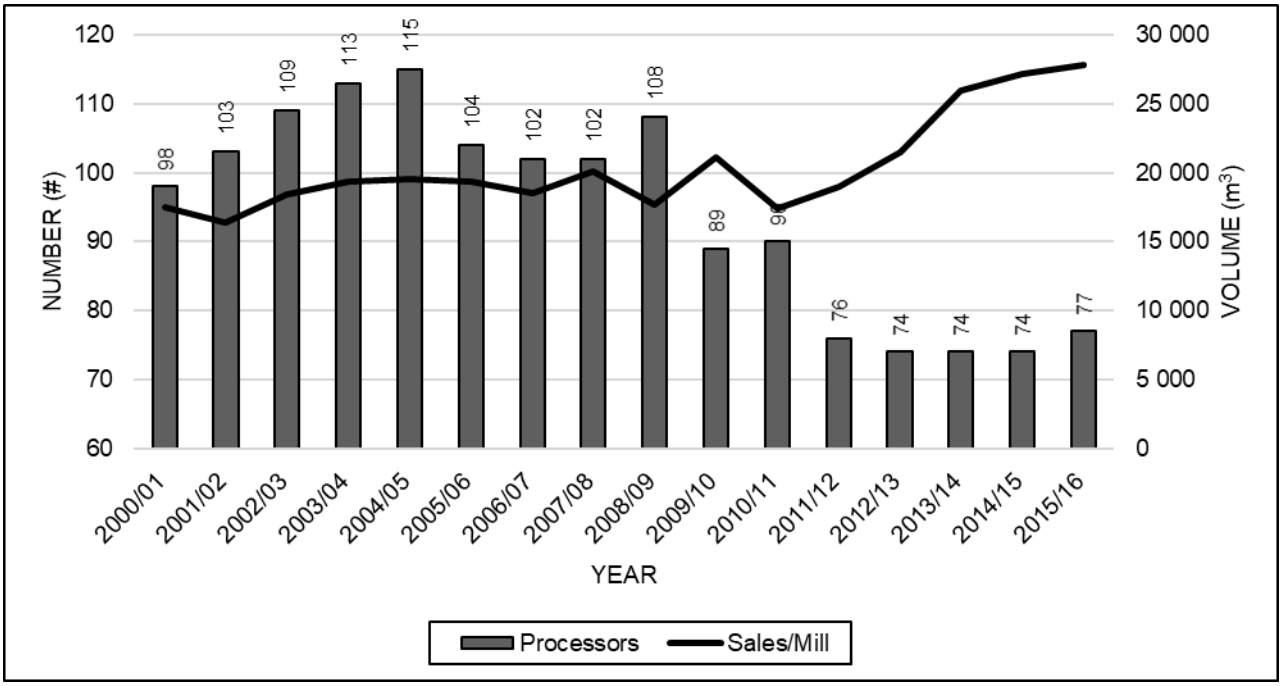

Figure 5: Theoretical volume recovery, actual volume recovery and volume recovery efficiency from 1993 to 2017 (Allpass, 2018)

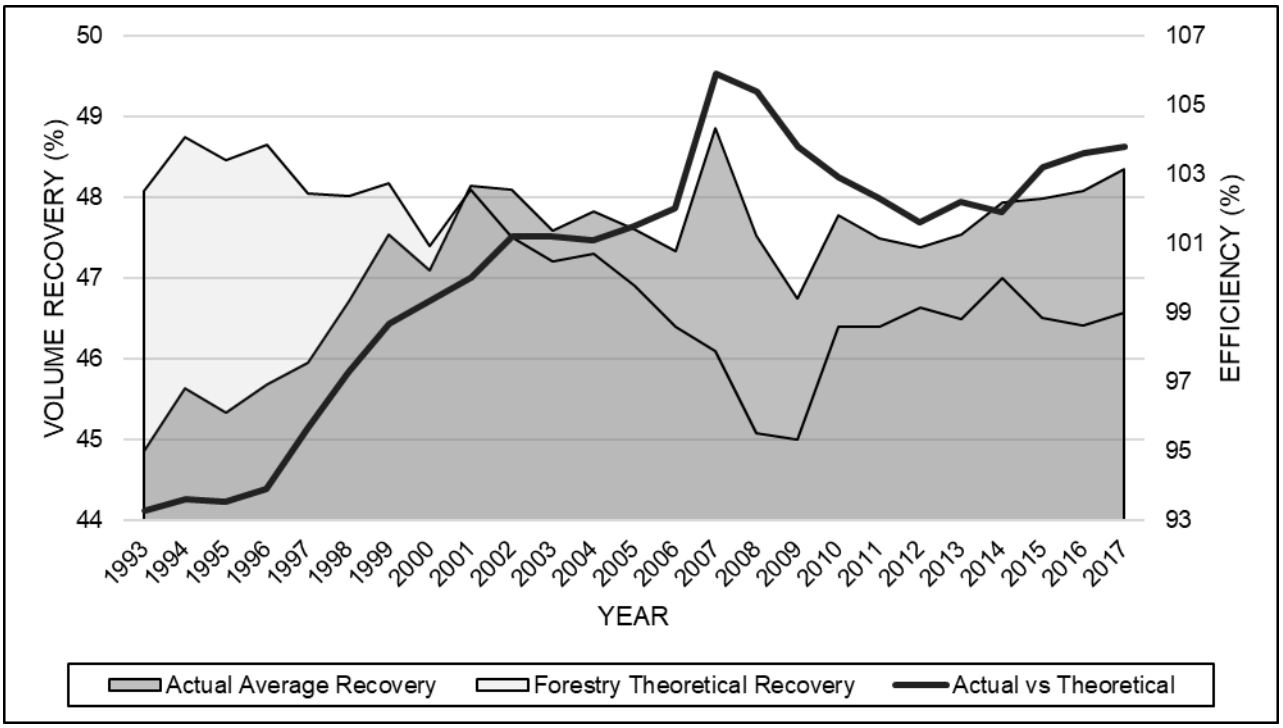

Figure 6: Sawn timber usage per country per capita compared to South Africa (FAO, 2019, World Bank, 2019)

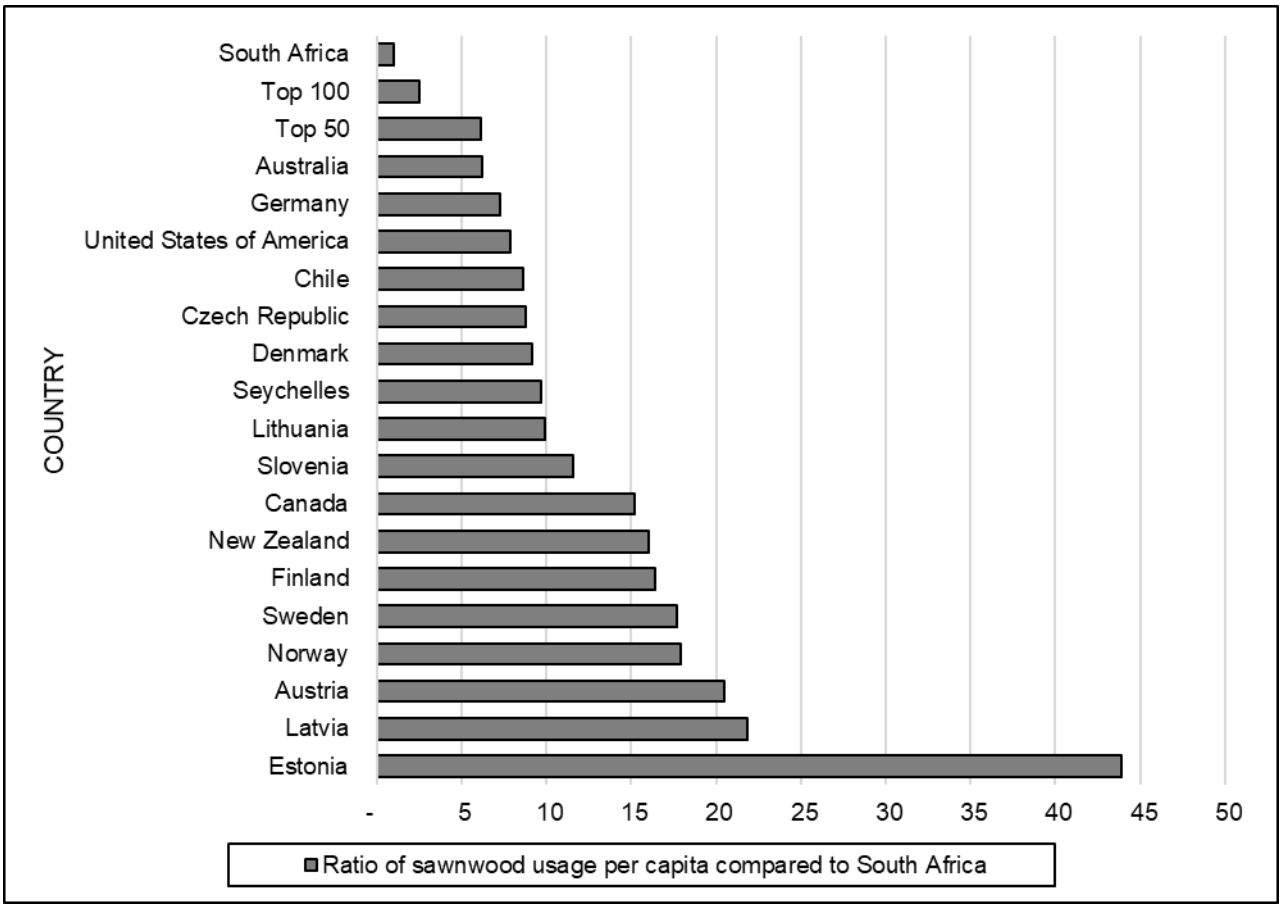

Table 1: Key indicators from 2004 to 2017 (Allpass, 2018)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
Number of mills in South Africa	111	113	102	100	100	106	87	88	74	72	72	72	75		-3,21%
Number of mills included	32	37	34	30	31	30	30	31	31	31	33	32	30	31	-0,24%
Percentage included	29%	33%	33%	30%	31%	28%	34%	35%	42%	43%	46%	44%	40%		2,77%
Gate Price	1 175	1 513	1 708	2 034	2 264	2 153	2 138	2 251	2 377	2 400	2 464	2 639	2 896	3 099	7,75%
Year on Year change on Gate Price		29%	13%	19%	11%	-5%	-1%	5%	6%	1%	3%	7%	10%	7%	
Average net margin	134	284	266	283	154	-32	35	85	109	91	98	150	272	275	5,69%
Year on Year change on average net margin		112%	-6%	6%	-46%	-121%	-209%	143%	28%	-17%	8%	53%	81%	1%	
Production costs excl. admin	949	1 115	1 318	1 596	1 948	2 044	1 961	2 208	2 120	2 197	2 274	2 377	2 535	2 736	8,49%
Year on Year change on Production costs		17%	18%	21%	22%	5%	-4%	13%	-4%	4%	4%	5%	7%	8%	
Admin costs	69	81	87	91	111	131	103	119	121	112	105	118	125	135	5,30%
Year on Year change on admin costs		17%	7%	5%	22%	18%	-21%	16%	2%	-7%	-6%	12%	6%	8%	
Total production costs	1 018	1 196	1 405	1 687	2 059	2 175	2 064	2 327	2 241	2 309	2 379	2 495	2 660	2 871	8,30%
Gate Price margin on Total production costs	15%	27%	22%	21%	10%	-1%	4%	-3%	6%	4%	4%	6%	9%	8%	

Table 2: Summary of correlation test results

Factor	Number of years included	Number of years for which there was a significant correlation	Percentage of years	Average correlation	Variation of correlation
Margin on net timber sales	14	14	100%	0,98	0,0002
Net margin with industry average sawlog costs applied	5	5	100%	0,78	0,0002
People cost multiplier	14	13	93%	0,54	0,0165
Roundlog cost multiplier	14	12	86%	0,48	0,0118
Production costs excluding administration	14	11	79%	0,51	0,0458
Total costs excluding sawlog cost and administration	5	3	60%	0,22	0,0421
Recovery efficiency	14	8	57%	0,39	0,0440
Maintenance costs	14	3	21%	0,23	0,0244
Roundlog cost (delivered)	14	3	21%	0,16	0,0407
Administration costs	14	2	14%	0,21	0,0192
Kiln drying costs	14	2	14%	0,18	0,0380
Chip contribution	14	1	7%	0,17	0,0135
Labour productivity	14	1	7%	-0,11	0,0246
Delivered ASP	5	0	0%	0,23	0,0144
Net timber sales	5	0	0%	0,22	0,0154

Table 3: Labour productivity and costs

	Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average	Periods of significance
People Costs vs Net Margin	Spearman	0,43	0,11	0,36	0,39	0,63	0,64	0,70	0,50	0,60	0,69	0,27	0,58	0,16	0,08	0,44	
	Significance	0,01	0,50	0,04	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,13	0,00	0,41	0,67		71%
Labour Productivity vs People Costs	Spearman	0,08	-0,05	0,32	0,26	0,10	0,19	0,34	0,21	-0,14	0,22	0,39	0,33	0,55	0,12	0,21	
	Significance	0,65	0,79	0,07	0,17	0,57	0,31	0,06	0,26	0,46	0,23	0,02	0,06	0,00	0,51		14%