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Fair value of standing timber in the context of IAS 41 implementation: a case study with *Pinus radiata*

Valor justo de madeira em pé no contexto da IAS 41: um estudo de caso com *Pinus radiata*

Eduardo Acuña[I], Antonio Pinto[II], Jorge Cancino[III], Simón Sandoval[IV]

Abstract

Upon seeing the forest valuation in a knowledge-based framework and, although there are studies that indicate how the Chilean forestry companies evaluate their forestry assets, existing information can be inferred only on large and medium-sized enterprises; in the case of small enterprises there are no tangible data to know what the method of valuation of its assets. To provide a critical assessment of the valuation methods commonly used for the valuation of forests, this paper has two objectives. First, to evaluate compatibility of valuation criteria based on the fair value method of the biological assets of forest companies after adopting the International Financial Reporting System (IFRS), and second, to establish a method for the proper use of IAS 41 (International Accounting Standard) in the forestry sector through case studies in Chile. Fair value was determined according to IAS 41, in an immature plantation (eight years) established with *Pinus radiata*, using the "cost approach" and the "income approach". The main findings suggest that the estimation of fair value using the "income approach" valuation method becomes more precise the younger the stand, *i.e.* calculating fair value based on the net present value of the stand, promises more accuracy. Nonetheless, the use of growth and yield simulation software for stands of exotic species, impede widespread use of this method. Results indicate the need to harmonize methodological criteria to measure fair value in crops of forest species.

Keywords: IAS 41; Fair value; Forest valuation; Premerchantable timber

Resumo

Ao ver a valorização da floresta em um quadro baseado no conhecimento e embora existam estudos que indicam como as empresas florestais chilenas avaliam seus ativos florestais, a informação existente pode ser inferida apenas em grandes e médias empresas; no caso das pequenas empresas não existem dados concretos para saber o que o método de valorização de seus activos. Para fornecer uma avaliação crítica dos métodos de avaliação comumente usados para a avaliação de florestas, este artigo tem dois objetivos. Primeiro, avaliar a compatibilidade dos critérios de avaliação baseados no método de valor justo dos ativos biológicos de empresas florestais depois de adotar o Sistema de Informação Financeira Internacionais (IFRS) e, segundo, estabelecer um método para o uso adequado da NIC 41 (Norma Internacional de Contabilidade) no setor florestal por meio de estudos de caso no Chile. O valor justo foi determinado de acordo com a IAS 41, em uma plantação de imatura (oito anos) estabelecida com *Pinus radiata*, usando a "abordagem de custo" e a "abordagem de renda". Os principais resultados sugerem que a estimativa do valor justo usando o método de avaliação "abordagem de renda" se torna mais precisa quanto mais jovem o estande, ou seja, calcular o valor justo com base no valor presente líquido do estande, promete mais precisão. No entanto, o uso de *softwares* de simulação de crescimento e produtividade para áreas de espécies exóticas impedem o uso disseminado desse método. Os resultados indicam a necessidade de harmonizar critérios metodológicos para mensurar o valor justo em culturas de espécies florestais.

Palavras-chave: NIC 41; Valor justo; Valorização das florestas; Madeira pré-comercial

[I] Ingeniero Forestal, Dr., Profesor Asociado en la Facultad de Ciencias Forestales, Universidad de Concepción, Victoria, 631, Barrio Universitario, Campus Concepción, CEP 4030000, Concepción, Chile. edacuna@udec.cl (ORCID: 0000-0002-3029-6805)

[II] Ingeniero Agrónomo, PhD., Profesor Asistente en la Facultad de Agronomía, Universidad de Concepción, Ed. Virginio Gómez 2 piso, Barrio Universitario, Campus Concepción, CEP 4030000, Concepción, Chile. anpinto@udec.cl (ORCID: 0000-0002-3896-7503)

[III] Ingeniero Forestal, Dr., Profesor Titular en la Facultad de Ciencias Forestales, Universidad de Concepción, Victoria, 631, Barrio Universitario, Campus Concepción, CEP 4030000, Concepción, Chile. jcancino@udec.cl (ORCID: 0000-0001-5821-9249)

[IV] Ingeniero Forestal, Dr., Profesor Asistente en la Facultad de Ciencias Forestales, Universidad de Concepción, Victoria, 631, Barrio Universitario, Campus Concepción, CEP 4030000, Concepción, Chile. simonsandoval@udec.cl (ORCID: 0000-0003-0224-0852)

Introduction

Market globalization has produced a significant impact on the contemporary financial reality, driving the adoption of universal financial accounting standards and principles. This has led to the implementation of the so-called International Financial Reporting Standards (IFRS) (IFRS FOUNDATION, 2015).

These standards will create important changes, especially for companies with biological assets such as forest, salmon, and other agricultural products, because companies will have to measure the growth of such assets at market values with direct impact on the income statement. For example, the growth of forest exploitation generates profits, even though such exploitation may only occur many years later. Other affected industries are dairy and livestock, though to lesser extent. Mining and fishing, however, will not be affected (IFRS FOUNDATION, 2015).

In the forestry sector, companies that implement the IFRS must estimate and recognize the changes in their forestry assets. To estimate such assets, the *fair value* of the standing timber - the disclosure of information about them and their assumptions - could become a viable method (PWC, 2009). Indeed, the *fair value* method is required with the standard IAS 41 Agriculture for valuation of assets (IFRS FOUNDATION, 2015).

Valuation of assets for the forestry sector, especially the valuation of standing timber, allows observing the actual economic accessibility of a forest and, hence its production potential. For valuating forest assets, soil and trees serve as basic capital for estimation, as selling them generates most of the company's incomes (DAVIS *et al.*, 1987). Thus, stands are the main asset and key valuation element of a forest company, together with annual yielding results.

Yield or economic performance measure for the forestry sector correspond to the "cost of formation" or "current replacement cost" for pre-commercial stands(CORTÉS; CONTRERAS, 1977) and the "residual value of standing timber" (GREGORY, 1972; NAUTIYAL *et al.*, 1995; BULLARD; STRAKA, 2011). The formation cost is the most common stumpage value at a given age. The method consists of estimating the present value for the forest establishment cost, at a fixed interest rate, discounting all incomes earned either by thinning or any other activity (CORTÉS; CONTRERAS, 1977). If expenses and income records are available, determining the value of the stand represents no problem with this methodology.

Residual value of standing timber came into use in 1914 by the United States Forest Service (NAUTIYAL *et al.*, 1995). According to Gregory (1972) and Bullard and Straka (2011) the selling price should be established for manufactured products and from this price all manufacturing and raw material costs must be subtracted, leaving a residual value. This value corresponds to the maximum value payable for the respective raw materials. In this sense, the valuation itself requires careful consideration, due to the inherent complexities and sensitivity to relatively small changes in the assumptions and, consequently, in the cash flow of the company. Hence the importance of defining and establishing the most adequate method to value the stands.

This work has two objectives: i) to evaluate the comparability degree of the valuation criteria based on the *fair value* for the biological assets after adopting IFRS, and ii) to establish a method for the correct use of the IAS 41 in the forestry sector, using case studies.

Material and methods

To understand the *fair value* approach for the standing timber, a case study examines the IAS 41 proposal. Two different methods are used to determine the *fair value*: income approach and cost approach for an established plantation of eight years. Additionally, the discount rate to value the stands is estimated.

Income approach

The IAS 41 requires that biological assets such as forest plantations are presented in the Statement of Financial Position in their *fair value*. Stands are counted by the *fair value* at the "standing timber" level, i.e. discounted all future incomes, harvesting cost and transportation expenses to the selling point, according to long-term harvesting programs and optimal harvesting age. Biological assets are recognized and measured by their *fair value* separate from the land.

Cash flows consider estimations of both gross sale levels and their trends, and future costs. Likewise, accounting involves updated forest inventories to estimate volumes of timber available for harvest and their growth rates. Values should be periodically revised to ensure effectiveness and representativeness.

Fair value (*FV*) of the stands is estimated based on local market prices at optimal age (*T*). The value for evaluation time *t*, is estimated as the present value before the final value of the logs at optimal age, considering thinning, harvest, utilization, loading, dispatch, and transport of logs. Additionally, all discounted costs of forestry and administration activities should be subtracted as part of biological assets. Equation (1) presents the *fair value* estimated under the income approach.

$$FV_t = \frac{\sum_{i=1}^{n}(P_i \times V_i) - VT \times (HC + CD) - \sum_{d=1}^{m}\sum_{i=1}^{n}(V_{id} \times CT_{id})}{(1+r)^{T-t}} + \\ + \frac{\sum_{i=1}^{n}(P_{iR} \times V_{iR}) - VT_R \times (HC_R + CD_R) - \sum_{d=1}^{m}\sum_{i=1}^{n}(V_{iRd} \times CT_{iRd})}{(1+r)^{R-t}} + \\ + \sum_{t=2}^{T}\frac{F_t + CM_t + P_t + A_t}{(1+r)^{T-t}} \qquad (1)$$

in which: FV_t is the *fair value* of the standing timber ($ ha^{-1}) at the time of harvesting (*t*); P_i is the price of the *i-th* product ($ m^{-3}); V_i, *VT*, *HC* and *CD* are the volume of the *i-th* product (m^3 ha^{-1}), total volume of the stand (m^3 ha^{-1}), harvesting cost ($ m^{-3}) and costs of dispatch ($ m^{-3}) at the optimal harvesting time (*T*), respectively; V_{id} and CT_{id} respectively represent the volume (m^3 ha^{-1}) and cost of transport ($ m^{-3}) of the *i-th* transported product to the *d-th* destination, obtained at the optimal harvesting time at thinning time *R*; P_{iR} is the price of the *i-th* product obtained ($ m^{-3}); V_{iR} the volume of the *i-th* product (m^3 ha^{-1}); VT_R the total volume of the stand (m^3 ha^{-1}); HC_R the harvesting cost ($ m^{-3}); CD_R costs of dispatch ($ m^{-3}); V_{iRd} the volume of the *i-th* product (m^3 ha^{-1}) transported to the *d-th* destination; CT_{iRd} the cost of transport of the *i-th* product transported to the *d-th* destination ($ m^{-3}); F_t, CM_t, P_t, y A_t are costs of fertilization, weed control, pruning and administration in the *t-th* year ($ ha^{-1}), respectively; *r* is the discount rate (%), *n* the number of potential timber products and *m* represents the number of destinations for each type of product.

Cost approach

In this case, *fair value* refers to the capitalization of all production costs at a specified interest rate (equation 2). This represents the amount that would be required at present to substitute the service capacity of an asset, in this case, the replacement of the original plantation.

$$FV_k = (ST_0 + R_0 + PP_0 + CE_0) \times (1+r)^k + \\ + \sum_{t=1}^{k} (FA_t + A_t + FI_t) \times (1+r)^k + \\ - \sum_{t=1}^{k} (MI_t) \times (1+r)^t \qquad (2)$$

in which: FV_k is the *fair value* of the standing timber or the formation costs for a given year k (\$ ha^{-1}); ST_0, R_0, PP_0 and CE_0 signify respectively costs of soil tillage, ripping, purchasing of the plants and establishment at year zero (\$ ha^{-1}); FA_t are the forestry activities (e.g. replanting, weed control, lagomorphs control, pruning, thinning to waste and others) (\$ ha^{-1}); A_t are administration costs (\$ ha^{-1}); FI_t fire insurance (\$ ha^{-1}); MI_t are middle incomes (\$ ha^{-1}).

Discount rate

The discount rate was calculated using the Capital Asset Pricing Model (CAPM) (SHARPE (1964), which estimates the return rate in function to risky assets and their covariance for a market portfolio. The CAPM model assumes that investors are risk averse, that there is an absence of market costs related to information anomalies, availability of unlimited loans at risk free rate, and that financial assets show perfect divisibility and marketability (MEGGINSON, 1997; COPELAND *et al.*, 2005).

Active Beta (β) is a measure of the covariance estimated using a simple linear regression between the returns of the interest assets and the returns of the market indices (FRANCIS; ARCHER, 1979; COPELAND *et al.*, 2005). This value corresponds to a coefficient of systematic risk that represents the non-diversifiable risk and therefore bears relevance for decision makers. Thus, the expected return rate on a forest investment can be expressed as:

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f] \qquad (3)$$

in which: R_i is the expected return on the forest asset; R_f the rate devoid of market risk, R_m the return on the market portfolio; $[E(R_m)-R_f]$ signifies the market risk insurance prime, because this represents the return on the risk rate required by investors.

To determine the CAPM, an indirect estimation was conducted, which considered averages of active assets in quarterly periods for the standing timber as asset of interest (WASHBURN; BINKLEY, 1990). In this case, from the quarterly average prices of the value of logs and pulpwood of *Pinus radiata* (\$ m^{-3}) recorded from the first quarter of 1995 to the fourth quarter of 2017 (INFOR, 2018). The market portfolio was represented by the quarterly average of the General Price Index of Shares in the Santiago Stock Exchange (IGPA) that reflects the economic activity of the country. Furthermore, for the risk-free rate the average quarterly rate of Monetary Policy of the Chilean Central Bank was used. This rate is the interest rate for both inter-bank operations and monetary policy.

Case Study

As a real case study, a forest farm located 23.5 km from the city of Cauquenes (Chile) was selected (35°46'26''S, 72°20'41''W). This farm has a paved access road of approximately 11.3 km, extending into another 17 km of gravel road, passable throughout the year. The farm possesses 145 ha planted with 8-year-old *Pinus radiata* and a 32.54 m site index.

To plan the forest inventory, color images of the farm were taken in digital format with a resolution of 36.15 megapixels and a pixel size of 28.50 cm, providing an average scale of 1: 7,000. The inventory was focused on quantifying density and characteristics of the individuals (diameter at breast height, total height, pruning height, and stem quality) to project the development of the stand at harvest time, providing information for economic valuation. A systematic sampling was used, covering the whole planted surface, with a sampling intensity distance of 3 ha between each plot and a sample error not exceeding 10%. The selected sampling unit was conventional and circular, with 250 m^2 of surface.

Logs' destinations were defined in function to their demand in the local market. A total of six (6) destinations were defined: 3M and Santa Elena Sawmill in the city of Constitución, Santa Elena Sawmill in Longaví, Leon Forest Company in Coelemu, Leonera Forest Company in Ránquil and Itata River Timber Plant in Trehuaco.

The National Growth Simulator for *Pinus radiata* of the Universidad de Concepción, "Insigne Simulator version 31.455'', was used to project the yield in forest products. Data input corresponded to the then status of the stands, this is: dominant height, plantation density, basal area, quantity, intensity or severity of pruning and thinning, and the characteristics of the desired products after harvesting and bucking. Simulating growth and bucking for each stand produced a table of log products that allowed to identify volume per lower diameter class and per type of product (Table 1). Four degrees of quality were defined, according to a survey conducted at the consumption centers near the farm. The products were classified -according to domestic markets (regional) for *Pinus radiata*- into:

1. Pruned sawlog: Piece of 2.65 m length, free of branches and defects, with 26 cm or more in flawless diameter.

2. Industrial sawlog: Piece of 3.39 m length, 16 cm or more flawless diameter, cylindrical, without final pruning or defects.

3. Commercial sawlog: Piece of 3.30 m length, 16 cm and more of diameter, flawless, without pruning or defects.

4. Pulpwood: Piece of 2.44 m length, with diameter 8 cm or more, without pruning, with or without stain.

Table 1 – Products defined by utilization priority and price according to destination

Tablela 1 – Produtos definido pela prioridade de utilização e preço em função do destino

Smaller diameter of utilization (cm)	Sawlog price ($ m^{-3})				Pulpwood price† ($ MR^{-1})
	Pruned (Itata River)	Industrial (Constitución and Longaví)	Commercial (Constitución)	Commercial (Longaví)	
8					28.00
10					28.00
12					28.00
14					28.00
16		41.00	37.00	38.00	
18		43.00	40.00	41.00	
20		47.00	44.00	44.00	
22		50.00	47.00	47.00	
24		52.00	50.00	49.00	
26	63.69	55.00	52.00	51.00	
28	69.64	57.00	54.00	54.00	
30	75.60	58.00	55.00	56.00	
32	81.55	60.00	57.00	57.00	
34	88.50	62.00	59.00	58.00	
36	94.46	63.00	60.00	60.00	
38	100.41	64.00	61.00	61.00	
40	105.37	64.00	61.00	61.00	
42	110.34	64.00	61.00	61.00	
44	114.31				
46	116.29				
48	117.28				

Source: Authors (2020)

Where: MR = meter wood piles (Metro Ruma, see HUSCH *et al.* (2003) page 203; † Log price at road edge.

To define the relevant harvesting and loading costs, outsourcing companies were surveyed. Table 2 summarizes the main forestry activities and related costs.

Table 2 – Forestry activities and costs

Tabela 2 – Atividades de silvicultura e custos

Forestry activity	Year	Cost (by June 13, 2015)	Unit
Fire	0	258.45	$ ha^{-1}
Plantation (1250)	0	133.99	$ ha^{-1}
Replanting	1	17.96	$ ha^{-1}
Weed control	2	118.59	$ ha^{-1}
Sanitary control	3	51.07	$ ha^{-1}
Pruning 1 (750)	5	79.04	$ ha^{-1}
Pruning 2 (750)	6	56.12	$ ha^{-1}
Pruning 3 (750)	7	51.17	$ ha^{-1}
Thinning to waste (750)	5	28.26	$ ha^{-1}
Commercial thinning (450)	10	7.22	$ m^{-3}
Harvesting	24	9.30	$ m^{-3}
Loading	24	1.12	$ m^{-3}
Dispatch	24	0.16	$ m^{-3}
Transportation of log without pruning	24	8.86	$ m^{-3}
Transportation of pruned log	24	10.70	$ m^{-3}
Fire insurance	1-24	5.40	$ ha^{-1}
Administration	1-24	15.00	$ ha^{-1}

Source: Authors (2020)

Note: Number of trees in brackets.

The transportation costs were estimated using a costing polynomial function, which includes estimation of average distances, categorized by type of pavement. This is because a fee per transported cubic meter applies, differing per type of pavement. Distances were calculated considering type of pavement as in the road digital layer of the Chilean Ministry of Public Works (Table 3).

Table 3 – Average distances per type of pavement and destination sawmill

Tabela 3 – Distâncias médias por tipo de pavimento e serraria de destino

Destination	Distance (km)			
	Asphalt	**Gravel**	**Dirt**	**Total**
3M Sawmill, Constitución	42.5	29.0	2.1	73.6
Santa Blanca Sawmill, Constitución	42.8	29.0	2.1	73.9
Santa Blanca Sawmill, Longaví	90.2	12.8	0.0	103.0
León Forest Company, Coelemu	97.3	19.8	1.2	118.3
Leonera Forest Company, Ránquil	107.7	19.8	0.8	128.3
Itata River Timber Plant, Trehuaco	89.3	19.8	0.8	109.9

Source: Authors (2020)

Moreover, for the calculation of the fair value of the standing timber, the price of a mechanized harvesting task based on the characteristics of the stand was used. All revenues and costs are denominated in US dollars ($).

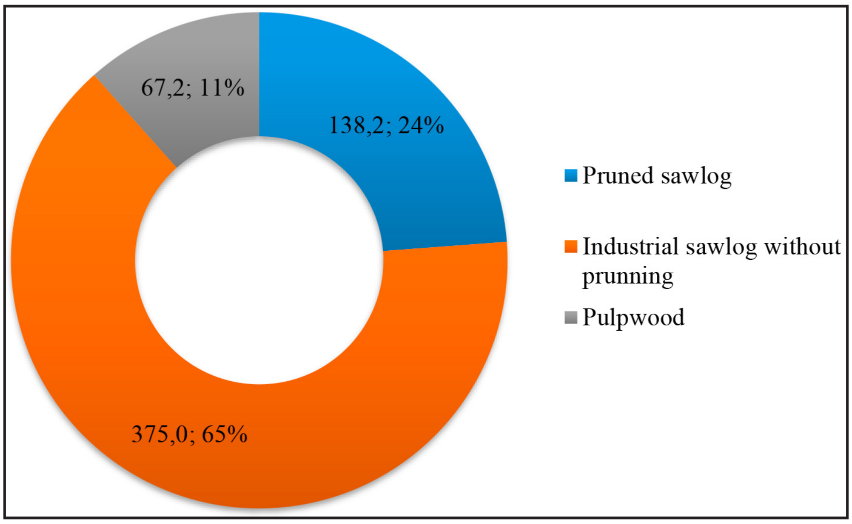
Results

Volume per type of product

According to the protocol to determine the sawlog quality of forestry inventory, the simulator optimized three (3) products at the optimal harvest age of 24 years: i) Industrial sawlog without pruning, ii) Commercial sawlog without pruning, and iii) Pulpwood. The commercial sawlog without pruning was partially produced due to the good characteristics of the stems, which were classified as industrial sawlog. Figure 1 presents the percentage of each product obtained using Insigne Simulator.

Figure 1 – Product participation in m³ ha⁻¹ according to inventory at harvesting time (24 years)

Figura 1 – Participação do produto em m³ ha⁻¹ de acordo com o inventário na época da colheita (24 anos)



Source: Authors (2020)

Discount rate

For the calculation of the risk-free rate (R_f), the rates of monetary policy were quarterly averaged for the period from the first quarter of 1995 to the fourth quarter of 2017, obtaining average value of 0.003747% (R_f = 0.003747%). The progress of the market portfolio (R_m) was described by historical behavior of the IGPA in the same period of analysis of the risk-free rate, and their quarterly yield reached 0.006981 (R_m = 0.006981%).

The slope Beta, β coefficient of the CAPM was calculated by the function $\beta_i = \mathrm{cov}(R_i, R_m)/\mathrm{var}\ (R_m)$, obtaining 1.409616. This value measures the systematic asset risk, and the higher the value the greater the systematic risk. This Beta is positive and higher than 1, implying that investments in forestry have a greater volatility than in the financial market.

The value of the discount rate obtained with the CAPM method was 0.1044 per year, which corresponds to the opportunity cost of the estimated capital. Its calculation is obtained from Equation (3) as follows:

$$CAPM_{quarterly} = 0.003747 + 1.409616 \times [0.006981 - 0.003747] = 0.008306$$

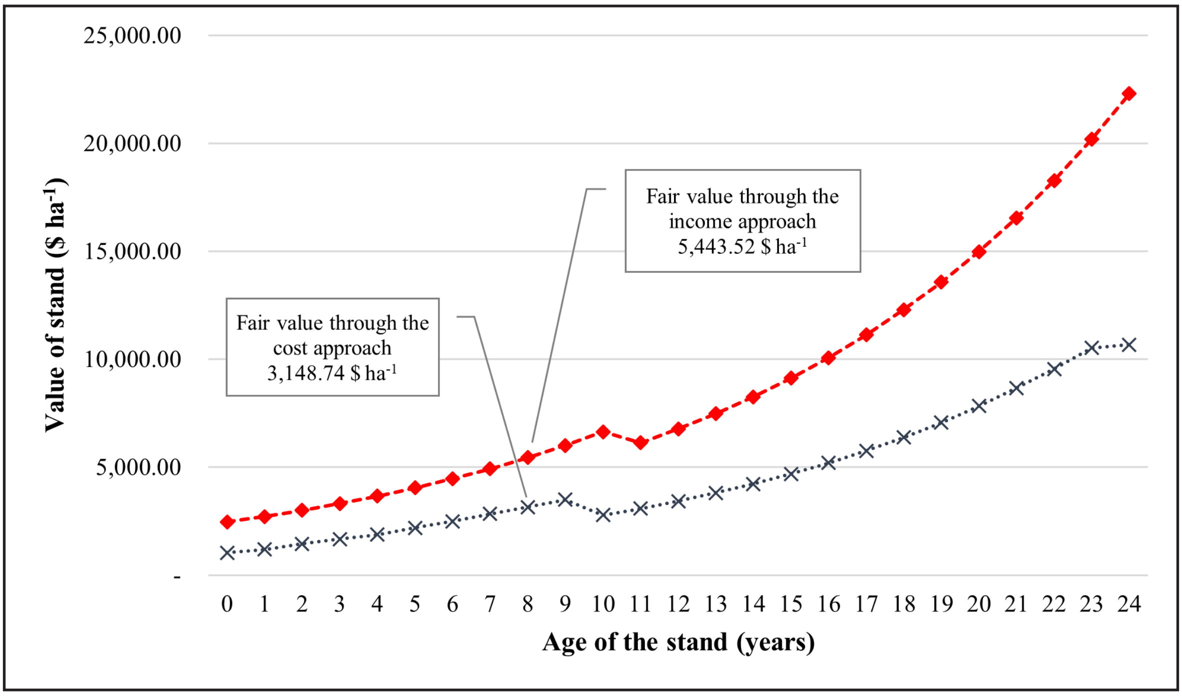
$$CAPM_{annualy} = 0.1044$$

Fair value

The calculation of the standing timber value was evaluated by both approaches and their results are presented in Figure 2. Figure 2 compares the results of the behavior of both approaches for each year throughout the crop rotation. The top-down income approach (dashed line) shows discounted harvest income year-on-year, with an increase of this in the year 10 because of commercial thinning revenues. By contrast, the bottom-up cost approach (dotted line) shows the capitalized costs year by year plus the new forestry costs. Like the income approach, year 10 shows a decrease in costs, because of revenue from commercial thinning.

Figure 2 – Value of the standing timber per hectare and type of approach. Crosses and dotted line represents the cost approach and the squares and dashed line the income approach

Figura 2 – Valor da madeira em pé por hectare e tipo de abordagem. Cruzamentos e linha pontilhada representa a abordagem de custo e os quadrados e linha segmentada a abordagem de renda



Source: Authors (2020)

By income approach, at the age of eight years, the stand has a *fair value* of 5,443.52 \$ ha^{-1} while 3,148.74 \$ ha^{-1} using the cost approach, making for 2,294.78 \$ ha^{-1} of difference between both approaches. This difference may arise because the cost approach ignores the expected incomes at the optimal rotation age, represented for the opportunity cost of the land used in forest production. According to Figure 2, at eight years, the stand with *Pinus radiata* established in 2009 has a *fair value* of 5,443.52 \$ ha^{-1}, equivalent to 789,310.4 \$ for the 145 hectares.

Discussion

In the context of the biological assets, obtaining a fair value and their reliability is compelling. In January 2003, the first standard of accountability, IAS 41 (agriculture) focusing on biological assets, entered into force. Until then, such assets were accounted for by their cost, changing their reasonable value with biological changes over time. The concept of *fair value* tends to show a value with greater economic relevance and its implementation can be very complex -in the case of biological assets- because in many cases biological resources are considered assets without effective active market. This characteristic impact directly in the reliability of the reported values, so economic evaluation models are required to value this asset.

Reliable prices based on the market for standing timber are scarce and therefore the market approach does not allow to obtain reliable values in Chile. This conditions the method to be used to value biological assets. In this case, the value of the assets was estimated through the cost-income method. Using the cost approach, the evaluation only considers the expenses included by establishing the plantation (replacement cost). However, performing an evaluation via the income approach, all future losses and gains obtained are considered (ARIMANY *et al.*, 2013).

In general, the younger the stand, the more precisely the "cost approach" estimated the value of investment. Nevertheless, this method produces low estimations of the replacement value because it underrates the real costs involved in the stand's production. This value is affected by the sunk cost of establishing the stand and the opportunity cost of maintaining the land to grow trees (BULLARD; MONAGHAN, 1999). According to Straka and Bullard (1996) this value is intrinsic and equals the cash flow discounted of waiting for future harvests in their first year. Thus, PWC (2009) and (PWC, 2011) recommends valuing the cost of establishing the plantations in its first year, which is equal to fair value at that date.

The application of the income approach requires important assumptions, such as the rotation age, price of the products, forestry costs, growth rate of the stand and discount rate in the calculation of the *fair value* of the forest assets. The discount rate becomes relevant because changing it even marginally may have significant effects on the valuation, leading to mistaken decisions, even though the cash flow of the project performs well. According to Pasalodos-Tato *et al.* (2009), high discount rates originate in a low post-pruning optimal basal area; an effect which becomes significant as the stand matures.

The use of the income method also involves valuing future performances according to the assumptions made and, consequently, modify the patrimony of the companies (ARIMANY *et al.*, 2013; GIERTLIOVÁ *et al.*, 2017). This circumstance will make it necessary to adjust tax and insurance mechanisms. Companies could face taxes on values not yet performed, and which may never perform, if any change in the assumptions occurs. On the other hand, the change in value would also influence the insurance primes related to the new value of the patrimony. The results of the empirical study, according to the method used, differences of 2,294.78 $ ha^{-1}$ in the eighth year were observed. This analysis might occur in the industry, by performing either method, considering especially the implications in the first years of plantation or close to the harvest age. Such undertaking, however, exceeds the scope of the present note, but makes for interesting future research.

According to IAS 41, the tenure of pre-commercial forests poses complexities for their valuation. Those stands have value, but they have no current potential to be converted into timber products. As a result, pre-commercial timber is not commercial in most cases, implying the trees cannot be sold as pulpwood or other commercial products (FOSTER, 1986b; a; KLEMPERER, 1987; VICARY, 1988; STRAKA, 1991; STRAKA; BULLARD, 1996; BULLARD; MONAGHAN, 1999; BULLARD; STRAKA, 2011).

Thus, the valuation at fair value allows to present the forests in the balance sheet at fair value less the estimated sell costs, information that is considerably more relevant to users, in particular, regarding to the long-term expectations of the company and allows us to reflect not only the transformation of biological active forest, but also the impact of market conditions.

The aforementioned, according (MANCINI, 2014), represents a new "paradigm", since it allows determining a book value as a result of financial projection models, with subjective estimation of the variables and recognition of unrealized income, but in all cases they are better represented the expectations of economic benefits of the asset.

Conclusion

To the extent that there are active and relevant markets for the valuation of the standing timber for IFRS purposes, the present net value of the discounted cash flows is considered the best measurement of the *fair value*. The use of the income approach modifies the patrimony of the companies, implying potential adjustments to taxation, as well as the value of the insurance prime.

Along with the tax and insurance issues, within the critical factors for valuing standing timber, the use of simulation and yield of the site-specific stand should be considered. For the latter, the Chilean forest sector counts on simulation software for *Pinus radiata*, *Eucalyptus globulus*, *Eucalyptus nitens* and some species of the genus *Populus*. These exotic species have greater economic projection in the country. However, there is a lack of this type of software that simulates growth of native forest species.

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