New Zealand Agricultural & Resource Economics Society (Inc.)
NZARES

The use of internal rate of return as a tool for evaluating and comparing investment performance

David Evison

University of Canterbury, N.Z.

Paper presented at the 2014 NZARES Conference
Tahuna Conference Centre, Nelson, New Zealand. August 28-29, 2014

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David Evison
Senior Lecturer, Forest Economics
New Zealand School of Forestry
University of Canterbury

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Introduction

This paper explores the use of consistent metrics for comparing alternative land-use investments, and for evaluating both start-up investments and going concerns. There is currently a confusing array of metrics which hinder comparison between land-use investment options. There is also insufficient commonality between the metrics used to evaluate a new investment (or start-up) and those used to evaluate established businesses via financial statements and other information.

Evison (2008) demonstrated that IRR was a useful metric for comparing the economics of competing land uses, because:

- It allows realised and unrealised gains to be reported separately. In some land uses, unrealised gains in the value of land and improvements are a large part of the total return, and a part that the land owner is keenly aware of.
- It is a reasonably well-understood metric, which is readily comparable to returns on savings held in banks etc. and provides a basis for comparison of investments, in the situation where there is no commonality in the metrics used by experts analysing specific land uses.

The Dairy NZ Economic Survey used IRR in this way in its 2012-13 economic survey of the New Zealand dairy farming industry.

Methods

This paper explores these issues, specifically by investigating

- Calculation of IRR for established investments using financial statement data
- The comparison of returns from a forestry start-up investment with an established forest growing business
- A rationale for greater use of this metric for evaluating and comparing land use profitability

The paper uses financial information from the MPI Farm Monitoring reports and the Annual reports of public companies to show that it is relatively straightforward to calculate IRR from financial statement data.

Then typical forestry cost and revenue data are used to compare returns from a forestry start-up with returns from an existing forestry business. This is done by calculating the IRR of a single hectare bare-land forestry investment with a normal forest (equal area in every age class). The latter can be consider a “going concern” and equivalent to an established farming business.

Results

1. Calculating IRR from financial data

Table 1: income statement, sheep and beef farm, Central North Island

INCOME STATEMENT	
Revenue	
Sheep	351 477
Wool	62 999
Cattle	151 828
Other farm income	2 844
Less:	
Sheep purchases	5 856
Cattle purchases	11 902
Net cash income	**551 390**
Farm working expenses	**276 073**
Cash operating surplus	**275 317**
Interest	39 869
Stock value adjustment	7 302
Minus depreciation	13 128
Farm profit before tax	**229 622**
Taxation	41 383
Farm profit after tax	**188 239**

Source: www.mpi.govt.nz

Note: this income statement does not include farm drawings by the owner (otherwise called 'wages of management') in the calculation of profit after tax. The estimated value ($58,000) is included in the total costs shown in Table 3, and subsequent calculations using these data.

Table 2: Balance sheet, Sheep and beef farm, Central North Island New Zealand

BALANCE SHEET	
Farm, forest and building (opening)	2 921 000
Plant and machinery (opening)	79 719
Stock valuation (opening)	884 376
Other produce on hand (opening)	0
Total farm assets (opening)	**3 885 095**
Total assets (opening)	**3 885 095**
Total liabilities (opening)	579 773
Total equity (farm assets - liabilities)	**3 305 322**

Source: www.mpi.govt.nz

If we assume that we buy the farm one year, generate cash income from the farm and sell it the next year (transaction costs are ignored, and no capital gain is assumed) then the IRR can be calculated as shown below in Table 3.

Table 3: Notional cash flows from CNI farm property over one year

	Asset	Costs	Revenue	Net revenue	Discounted
0	-$3,885,095			-$3,885,095	-$3,885,095
1	$3,885,095	-$334,073	$551,390	$4,102,411	$3,885,095
					$0

The IRR is calculated as the discount rate where the NPV = 0, which in the case shown in Table 3 is 5.59%. It can be shown that this rate is constant, irrespective of the length of time over which the cash flow occurs – the cash-flows shown below in Tables 4 and 5 also have an IRR of 5.59%.

Table 4: Identical annual cash flows from CNI farm property over 5 years (no capital appreciation)

	Asset	Costs	Revenue	Net revenue	Discounted
0	-$3,885,095			-$3,885,095	-$3,885,095
1		-$334,073	$551,390	$217,317	$205,805
2		-$334,073	$551,390	$217,317	$194,903
3		-$334,073	$551,390	$217,317	$184,578
4		-$334,073	$551,390	$217,317	$174,801
5	$3,885,095	-$334,073	$551,390	$4,102,411	$3,125,008
					$0

Table 5: Identical annual cash flows from CNI farm property over 10 years (no capital appreciation)

	Asset	Costs	Revenue	Net revenue	Discounted
0	-$3,885,095			-$3,885,095	-$3,885,095
1		-$334,073	$551,390	$217,317	$205,805
2		-$334,073	$551,390	$217,317	$194,903
3		-$334,073	$551,390	$217,317	$184,578
4		-$334,073	$551,390	$217,317	$174,801
5		-$334,073	$551,390	$217,317	$165,541
6		-$334,073	$551,390	$217,317	$156,772
7		-$334,073	$551,390	$217,317	$148,467
8		-$334,073	$551,390	$217,317	$140,602
9		-$334,073	$551,390	$217,317	$133,154
10	$3,885,095	-$334,073	$551,390	$4,102,411	$2,380,473
					$0

However these cash flow streams have a different interest rate risk (as shown below in Figure 1), although this different interest rate risk is not important for the calculations in this paper.

While IRR can be derived by drawing up a cash flow table and calculating the IRR by trial-and-error or analytical methods (i.e. selecting the discount rate that makes the NPV exactly equal to zero), it can also be calculated directly from financial statement information (as shown in Table 6) as the cash return on assets (defined as follows):

Cash return on assets = (revenue – cash costs) / assets

Figure 1: Sensitivity of NPV from cash flows of different lengths to discount rate

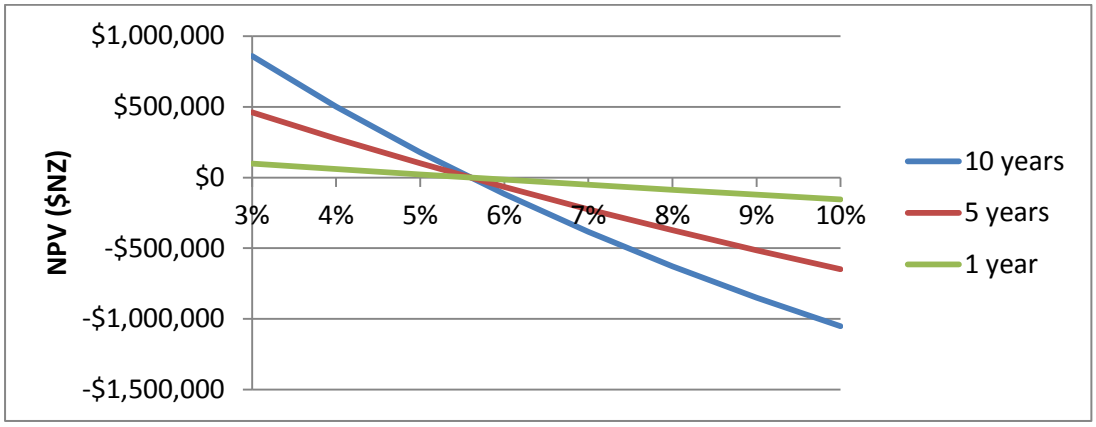


Table 6: Direct calculation of IRR from financial statement data

Revenue (cash only)	$551,390
Costs (cash only)	$334,073
Total assets	$3,885,095
Cash return on assets	5.59%

We can also calculate time series showing the productive return from sheep and beef farming as an IRR (Table 7). The return from capital appreciation can be calculated separately, and is also shown. In this way a clear picture of the total return from a land-based industry can be provided

Table 7: IRR return from farming, and capital gains, national average sheep and beef farm

	Gross farm revenue	Total expenses	Net cash	Total farm capital	IRR	Real total farm capital/ha	Asset value change
						$3,575	
2001/02	$340,143	$207,770	$132,373	$1,930,075	6.86%	$4,362	22.02%
2002/03	$326,594	$217,698	$108,896	$2,411,475	4.52%	$5,103	16.98%
2003/04	$319,729	$222,421	$97,308	$2,704,674	3.60%	$5,578	9.31%
2004/05	$350,326	$244,119	$106,207	$3,373,087	3.15%	$6,543	17.29%
2005/06	$320,766	$246,481	$74,285	$3,846,415	1.93%	$6,708	2.52%
2006/07	$291,114	$244,628	$46,486	$4,252,649	1.09%	$7,127	6.25%
2007/08	$287,803	$214,326	$73,477	$4,468,186	1.64%	$7,233	1.48%
2008/09	$327,481	$254,412	$73,069	$4,976,692	1.47%	$7,220	-0.18%
2009/10	$362,550	$290,082	$72,468	$4,726,181	1.53%	$6,607	-8.50%
2010/11	$461,267	$305,307	$155,960	$4,514,073	3.45%	$6,040	-8.57%
2011/12	$542,965	$339,379	$203,586	$4,658,273	4.37%	$6,028	-0.20%

IRR can be calculated by extracting the same type of information from any annual report – for example, information from the last four year's results for the Chilean forestry company Arauco is shown below in Tables 8 and 9.

Table 8: Cash flows from the Arauco Group of Companies, 2010 to 2013 (year ending December)

Statements of Cash Flows ($US 000)	**y/e Dec 2013**	**y/e Dec 2012**	**y/e Dec 2011**	**y/e Dec 2010**
Receipts from Sales of Goods and Rendering of Services	$5,609,104	$4,704,743	$4,606,542	$3,984,173
Receipts from Premiums and Claims, Annuities and other Policy Benefits	$29,840	$132,983	$270,663	$292,240
Other Cash Receipts from Operating Activities	$408,257	$291,122	$276,650	$172,278
Classes of Cash Payments				
		-	-	-
Payments to Suppliers for Goods and Services	-$4,117,942	$3,862,438	$3,532,728	$2,877,218
Payments to and Behalf of Employees	-$573,538	-$420,885	-$329,158	-$263,151
Other Cash Payments from Operating Activities	-$196,775	-$27,893	-$5,151	-$2,338
Dividends Received		$3,531	$1,720	$6,353
Interest Paid	-$223,571	-$165,854	-$180,046	-$190,351
Interest Received	$18,451	$8,722	$14,009	$6,528
Income Taxes Refund (paid)	-$55,272	-$202,881	-$138,621	$10,964
Other (outflows) Inflows of Cash, Net	-$834	-$2,658	-$1,643	-$2,203
Net Cash Flows from Operating Activities	**$897,720**	**$458,492**	**$982,237**	**$1,137,275**
Cash Flow pre-lending and pre-tax	**$1,176,563**	**$827,227**	**$1,300,904**	**$1,316,662**

Source: Arauco Sustainability Reports, 2014, 2013, 2012, 2011

Table 9: Value of assets, Arauco Group of Companies 2010 to 2013

	$US 000 ye Dec-13	$US 000 ye Dec-12	$US 000 ye Dec-11	$US 000 ye Dec-10
Current Assets	$2,808,321	$2,698,968	$2,477,953	$3,166,224
Non - Current Assets	$11,685,074	$10,852,218	$10,089,518	$9,354,216
Total Assets	$14,493,395	$13,551,186	$12,567,471	$12,520,440

Source: Arauco Sustainability Reports, 2014, 2013, 2012, 2011

Table 10 below compares IRR values calculated from Arauco financial statement data with some other commonly used metrics

Table 10: Summary of common profitability metrics, Arauco 2010 to 2013

	2013	2012	2011	2010
IRR (pre-tax and lending costs)	8.1%	6.1%	10.4%	10.5%
Net profit after tax / equity	5.94%	2.02%	8.83%	10.24%
Net profit after tax / assets	2.9%	1.0%	4.9%	5.6%
Net profit after tax / Sales	8.13%	3.28%	14.19%	18.60%

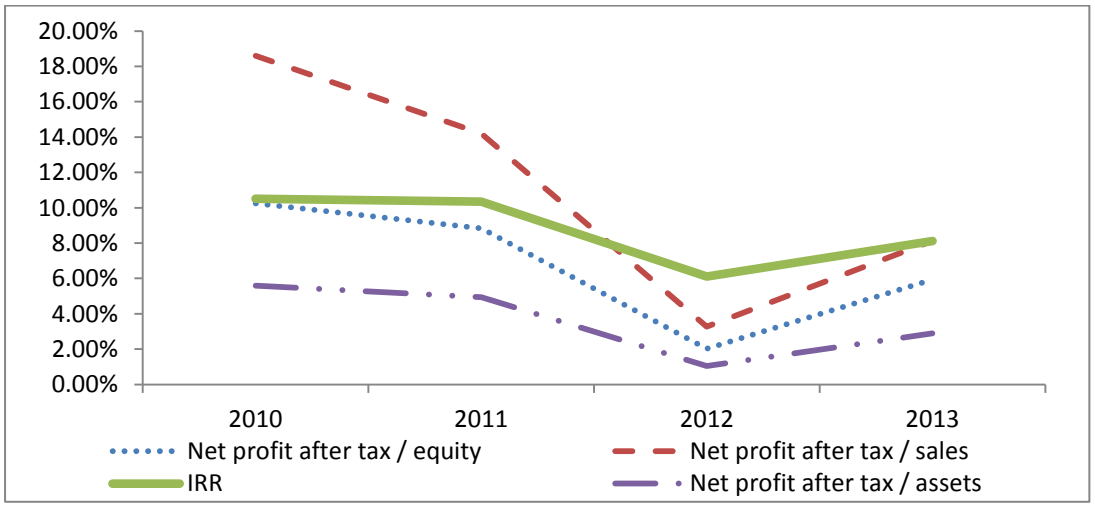
This comparison raises the question as to why IRR isn't used more commonly by financial analysts who use financial statement data as their main information source. There are a number of persuasive reasons for using IRR for established businesses as well as projects:

- A business is the accumulation of a number of projects
- Part of the approval process for these projects is the calculation of an IRR
- Another part of the process is meeting a financial hurdle (also expressed as a rate of return)
- Continuing to use this measure would draw a connection between the projects that are accepted by a company, and the implementation of those projects

Figure 2 below compares the profitability metrics, and shows that net profit after tax /assets show a very similar trend to IRR but at a lower level. Profit/sales and profit/equity follow quite different trends and in general are more volatile.

Above all, the IRR measure is comparable with the projected rate of return for any new project that a company might undertake, and so it is a useful way to compare an existing company's performance with the expected performance of a new project.

Figure 2: Comparison of common profitability metrics, Arauco



Finally, often comparison of land uses is made between an incumbent land use (such as hill country sheep and beef farming) and a competing land use (such as forestry).Sometimes this is done assuming costs for starting up both operations (for example, Ward et al. , 1966). Frequently however (see for example, Evison, 2008) this is done comparing a bare land (start-up) investment in forestry with a going-concern farming operation. It is worth asking the question: "is it valid to compare a bare land (start up) forestry investment with a going concern farming operation?" It could be argued this is appropriate when considering whether to change from hill country farming to forestry. However, if the question is "what is the most profitable land use on a particular piece of land?" then it is appropriate to ensure that each investment is treated on a like for like basis. We can examine this by comparing a start-up forestry operation with a going-concern forestry operation. The per-hectare cash flows for a new investment in forestry are shown in Table 11.

Table 11: Cash flows for illustrative new investment in Radiata pine

						IRR	**5.81%**
Year	**Operation**	**Operations costs**	**Annual costs**	**Revenue**	**Land**	**Net**	**Discounted**
0	Site prep	$294.57			-$2,287	-$2,581.57	-$2,581.57
1	Planting and releasing	$920.00	$84.31			-$1,004.31	-$949.19
2	Releasing	$333.00	$84.31			-$417.31	-$372.76
3	Fertiliser / Dothistroma	$198.60	$84.31			-$282.91	-$238.84
4			$84.31			-$84.31	-$67.27
5			$84.31			-$84.31	-$63.58
6			$84.31			-$84.31	-$60.09
7			$84.31			-$84.31	-$56.79
8			$84.31			-$84.31	-$53.68
9			$84.31			-$84.31	-$50.73
10	Waste thin and fertilise	$1,065	$84.31			-$1,149.31	-$653.60
11			$84.31			-$84.31	-$45.32
12			$84.31			-$84.31	-$42.83
13			$84.31			-$84.31	-$40.48
14			$84.31			-$84.31	-$38.26
15			$84.31			-$84.31	-$36.16
16			$84.31			-$84.31	-$34.17
17			$84.31			-$84.31	-$32.30
18			$84.31			-$84.31	-$30.53
19			$84.31			-$84.31	-$28.85
20			$84.31			-$84.31	-$27.27
21			$84.31			-$84.31	-$25.77
22			$84.31			-$84.31	-$24.36
23			$84.31			-$84.31	-$23.02
24			$84.31			-$84.31	-$21.76
25			$84.31			-$84.31	-$20.56
26			$84.31			-$84.31	-$19.43
27			$84.31			-$84.31	-$18.37
28			$84.31			-$84.31	-$17.36
29			$84.31			-$84.31	-$16.41
30	Logging, roading & transport	$35,403.75	$84.31	$64,145.45	$2,287	$30,944.38	$5,691.29
						NPV	$0.00

If we planted this regime on 30 hectares every year for 30 years we would have a “normal forest” which would produce an equal volume of timber harvest every year, and therefore represents a “going concern” forestry business. It uses the same cost and revenue assumptions as in Table 11.

The profit and loss statement and balance sheet for this forest are shown below in Tables 12 and 13 – the model assumes no lending. To calculate cash return on assets we take timber revenue less total expenses and divide it by the long-term asset value. This ensures the change in forest asset value (which is a material non-cash item) is not included in revenue, and also removes working capital items (short term assets) from the estimate of assets (since the single hectare representation does not include working capital either).

Table 12: Simplified profit and loss statement for normal forest

	2012
Revenue timber	$1,924,363
Gain/(loss) in fair value of forestry asset	$740,003
TOTAL REVENUE	**$2,664,366**
Less expenses	
Contractors	$1,222,457
TOTAL EXPENSES	**$1,222,457**
PROFIT BEFORE TAX	**$1,441,909**
Income tax expense	$403,735
NET PROFIT FOR THE YEAR	**$1,038,175**

Table 13: Simplified balance sheet for normal forest

	2012
Equity	
TOTAL EQUITY	**$11,817,503**
Current liabilities	
Other current liabilities	$195,838
TOTAL CURRENT LIABILITIES	**$195,838**
Non-current liabilities	
TOTAL NON-CURRENT LIABILITIES	**$0**
TOTAL EQUITY PLUS LIABILITIES	**$12,013,341**
Current assets	
Trade and other receivables	$215,242
Inventories	$89,146
TOTAL CURRENT ASSETS	**$304,388**
Non-current assets	
Property , plant and equipment	$2,297,063
Forestry assets (timber)	$9,411,890
TOTAL NON-CURRENT ASSETS	**$11,708,953**
TOTAL ASSETS	**$12,013,341**

The calculated IRR for the data in Tables 12 and 13 is 5.99%, which is very similar (but not identical) to the single hectare value of 5.81%. Further work is required to fully understand the reasons for the difference, however there is one obvious area to explore. The normal forest in this example was valued using discount cash flow analysis assuming a discount rate of 7%. However because the assumed discount rate has a large effect on the calculated forest value, which in turn is a large part of the asset value used to calculate IRR, it is not clear how to make the normal forest estate exactly equivalent to the single hectare model. With different assumptions about the discount rate used for forest valuation however, the IRR will vary markedly (Table 14).

Table 14: Impact of changing discount rate for forest valuation on IRR from normal forest

Forest valuation discount rate	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
IRR	3.32%	3.75%	4.19%	4.64%	5.09%	5.54%	5.99%	6.44%	6.87%	7.30%

Conclusions

The use of IRR to compare land-use profitability is becoming more common in New Zealand

- IRR is commonly used when evaluating bare-land forestry investments using discounted cash flow analysis
- It is becoming more commonly used in agriculture (although annual cash flow or profitability measures are most commonly reported)

There seem to be some persuasive reasons to use IRR as a measure for comparing going concern investments. First it is easy to calculate this value from financial statement data, as a net cash return on assets, and it would allow comparison of required new capital investment returns with the returns on the existing business.

In this paper the investment return from a bare-land forestry investment is compared with a going concern (modelled as a normal forest) and there is no clear evidence that the IRR is materially different. However more work is required to develop strictly comparable models for the single hectare start-up and the normal forest case.

References

Arauco (2014). 2013 Sustainability Report. http://www.arauco.cl/informacion.asp?idq=230&parent=224&idioma=26

Arauco (2013). 2012 Sustainability Report. http://www.arauco.cl/informacion.asp?idq=230&parent=224&idioma=26

Arauco (2012). 2011Sustainability Report. http://www.arauco.cl/informacion.asp?idq=230&parent=224&idioma=26

Arauco (2011). 2010 Sustainability Report. http://www.arauco.cl/informacion.asp?idq=230&parent=224&idioma=26

DairyNZ (2014). *DairyNZ Economic Survey 2012-13.* Dairy NZ Ltd, Hamilton

Evison, D.C. (2008). A method for comparing investment returns from major rural land uses including forestry.*NZ Journal of Forestry*, Vol . 53, No. 3. New Zealand Institute of Forestry, Wellington

Ministry for Primary Industries (2012). Farm Monitoring 2012. Central North Island Hill Country Sheep and Beef. Minstry for Primary Industries, Wellington. ISBN 978-0-478-40410-4 (Online).

Ward, J.T., E.D. Parkes, M.H. Grainger and R.T. Fenton (1966*). An economic analysis of large-scale land development for agriculture and forestry*. Agricultural Economics Research Unit Publication No. 27. Lincoln College, Canterbury.