Comparing the profitability of farming and forestry

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Summary

This paper updates an analysis of returns from major productive land uses in New Zealand carried out in 2008. Trends in profitability over time are shown, and a preliminary investigation of the relationship between land-use change towards forestry (new land planting) and forestry profitability is described.

Key words: Profitability, farming, forestry, land use, land-use change.

Introduction

Profitability is an important driver of land-use change in New Zealand, although it is difficult to find data that measures profitability consistently for all major land uses. The comparison of profitability is also hindered by a lack of common metrics across land uses. This is partly due to the different characteristics of land uses. Agricultural land uses provide annual cash-flows, and the main measure of profitability is gross farm income. Forestry by contrast is a long-term investment and profitability is generally measured using net present value. This paper uses a percentage rate of return to measure profitability consistently across land uses.

New forests will play a major role in meeting New Zealand's international commitments to limit emissions of greenhouse gases in the short and medium term. This has led to renewed interest in new land planting in forestry. Unproductive scrub and hill country sheep and beef land are likely sources of suitable land. This paper documents trends in profitability of hill country sheep and beef farms, and the price of land under this land use. Both of these factors should be expected to influence new forest planting.

Background

The theory of land use change states, in its simplest form, that land owners (or managers acting on behalf of the owners) will change land-use to maximise wealth generated in each land use. Profitability may be calculated as the net present rent at time T for a particular land use over a specific area:

$$R_T = \int_{t=0}^{\infty} (P_{T+t} * Q_{T+t} - C_{T+t} * X_{T+t})\, e^{-rt}\, dt$$

where :

R= net present rent
P= output price
Q= quantity of output
C= vector of input prices
X = vector of input quantities
r = discount rate

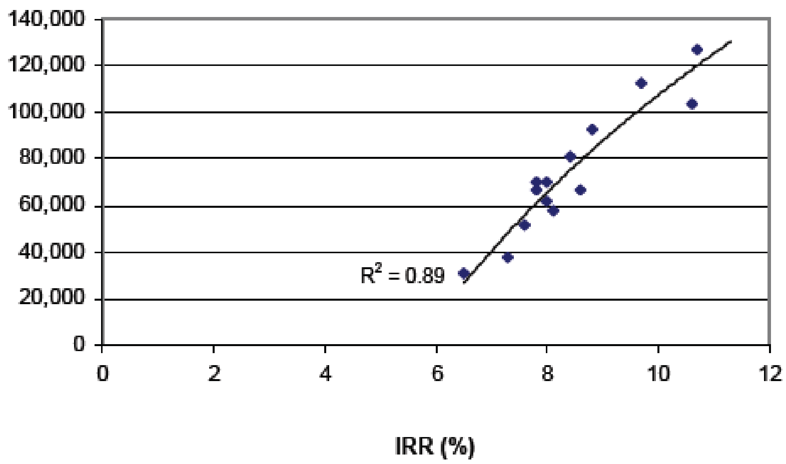
(Adams and Haynes, 2007)

This is equivalent to the Faustmann formula for land expectation value, where all costs are included except the land cost. In this case, R_T provides the maximum land cost that can be paid while still earning the required rate of return, represented by the discount rate r.

This formulation has been widely used, and extended – for example Dhakal et al. (2008) recently proposed a "double hurdle" model where the decisions "whether to plant" and "how much to plant" are treated separately. The model was estimated from survey data which included perceptions of profitability of alternative land uses as well as other decision variables.

A recent MAF report (cited in Maclaren and Manley, 2009) shows a good correlation between rate of return on forestry measured by IRR, and area of new land planted (see Fig 1).

Figure 1: Estimated relationship between new planting and forestry profitability



Source: Smith and Horgan, 2006

The LURNZ model uses measures of profitability of major land uses to estimate changes in the land use shares over time in New Zealand (Hendy et al., 2007).

Data

The analysis of profitability of major land uses reported here uses data from the MAF Farm Monitoring Reports (MAF, 2010, and earlier). Where long term trends in values were examined, data were adjusted for inflation using the Producer Price Index (outputs). There is not currently a forestry monitoring report which provides comparable data, so data from industry sources cited in Evison (2008) were used. Log prices were updated from MAF data, and forestry costs were updated using the Forestry and Logging Producer Price (inputs) deflated by the Producer Price index All Industry Outputs as an index of real changes in forestry costs.

A long term data series of forestry profitability was estimated using these data and a simple discounted cash flow model of a radiata pine clearwood regime, from 1978 to 2009. Land price data was sourced from Quotable Value, and information on planting subsidies from Rhodes and Novis (2002).

Method of analysis

In this analysis, profitability is measured using the internal rate of return. For calculation of a single year return from farming this is equivalent to the return on assets, and can be calculated from as the cash surplus divided by the capital value. For forestry, IRR is calculated using standard discounted cash flow techniques, and is defined as the discount rate such that the net present value equals zero. Using a percent return as the profitability metric also has the advantage that returns due to change in asset value (primarily land) can be compared easily with the returns from the productive land use.

The multiple regression module of the R statistical package was used to investigate the influence of profitability and other factors on new planting rates.

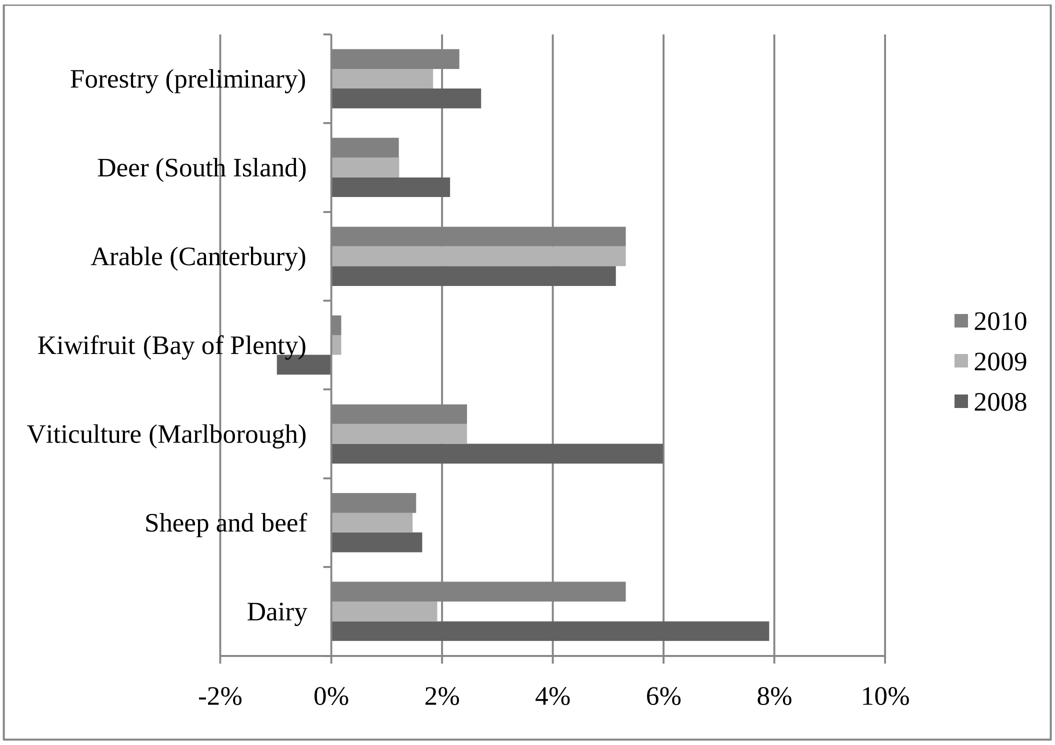
Results

The data used to calculate productive returns are shown in Table 1. Figure 2 shows that sheep and beef, kiwifruit and deer have generally produced low rates of return over the past three years. Forestry returns are possibly somewhat higher (because forestry data used in this analysis were not collected in the same way as the agricultural data, this result should be regarded as preliminary), viticulture has experienced variable rates of return, and arable and dairy generally produce superior returns.

Table 1: Estimated profitability of major land-uses, 2010

Model	Effective area (ha)	Net Cash Income	Working expenses	Management costs	Cash surplus	Capital value	IRR %
Dairy (National average)	138	$931,703	-$492,162	-$83,774	$355,767	$6,687,831	5.32%
Sheep and Beef (National average)	771	$362,550	-$215,082	-$75,000	$72,468	$4,726,181	1.53%
Viticulture (Marlborough)	31	$569,200	-$292,900	-$75,000	$201,300	$8,208,200	2.45%
Kiwifruit (Bay of Plenty)	5	$189,400	-$139,500	-$47,000	$2,900	$1,602,100	0.18%
Arable (Canterbury)	300	$1,012,000	-$597,400	$75,000	$489,600	$9,204,000	5.32%
Deer (South Island)	272	$277,670	-$151,847	-$73,707	$52,116	$4,270,679	1.22%
Forestry	500	$754,983	-$638,831	-$54,929	$61,223	$2,644,000	2.32%

Figure 2: Estimated productive returns from major land uses, 2008-2010



Longer time series (Figure 3), using data from earlier MAF Farm Monitoring reports, show that real asset prices (primarily land) increased from 2002 to 2008; for this entire period the return from asset price increases exceeded the return from farming. Asset prices for sheep and beef farms declined in 2009 and 2010. The trend in land prices is supported by Quotable Value statistics (Figure 4).

Figure 3: Returns from sheep and beef farming, productive return and asset price changes

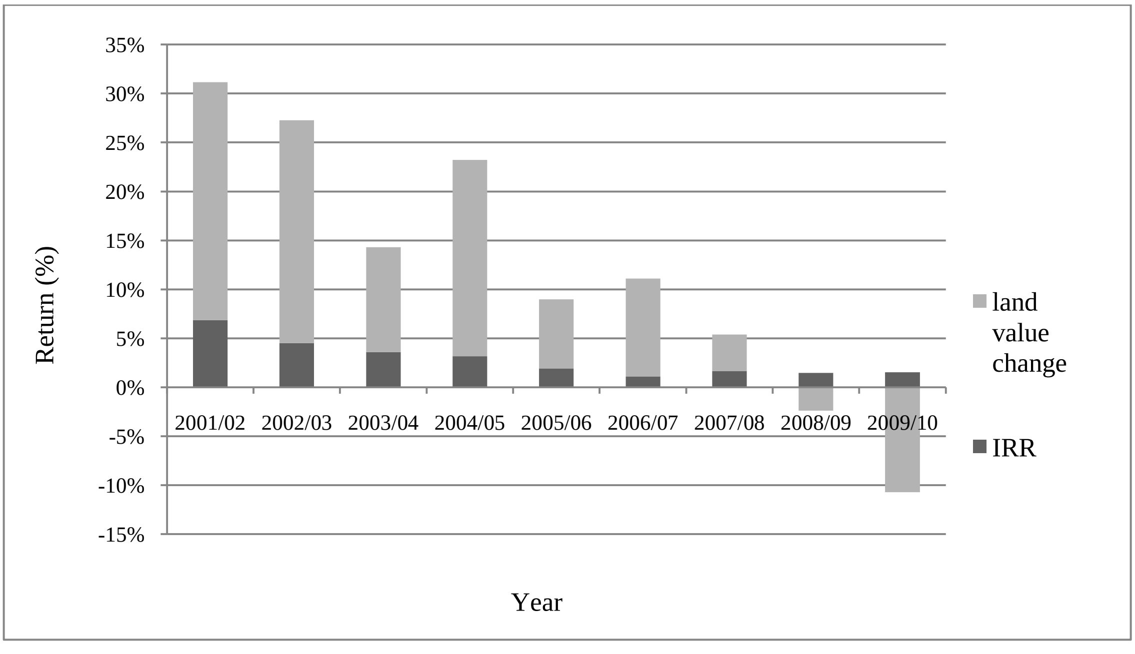
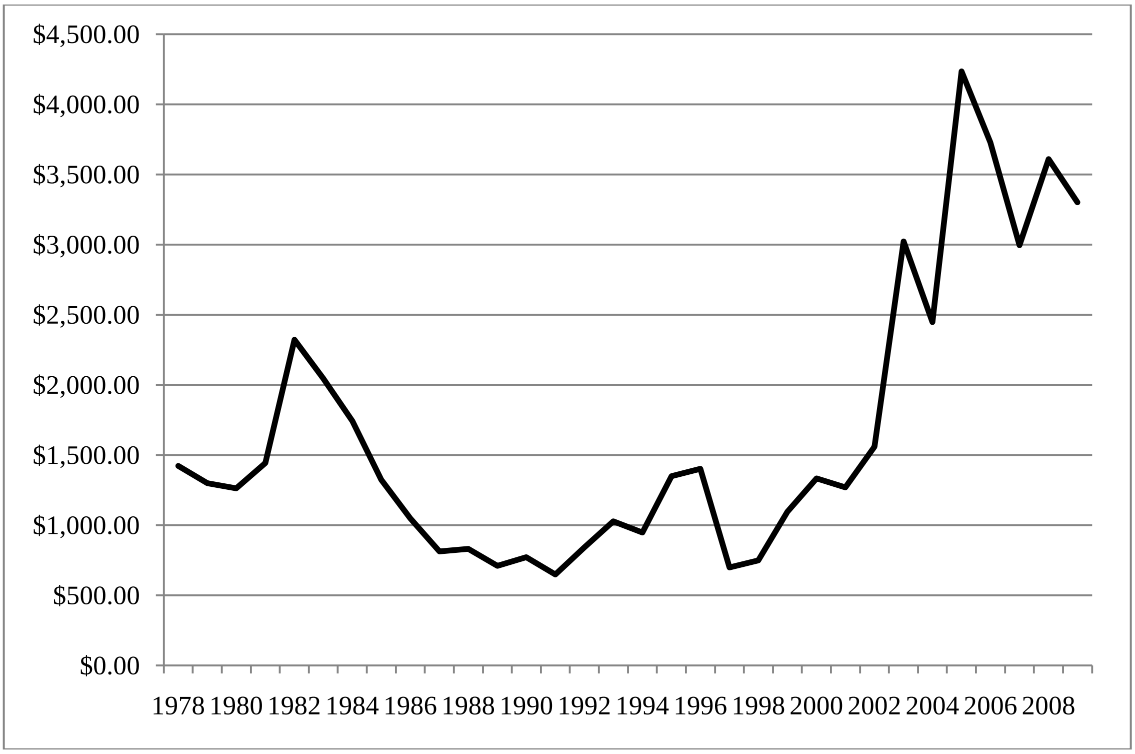


Figure 4: Real price (2010 $NZ/ha) of grazing land (farm units)



Source: Quotable Value

A linear regression model was estimated to test the influence of forestry profitability, land price, and other factors on new land planting. The model is shown below, with model performance (actual versus predicted values) shown in Figure 5. Subsidies were modelled as a value per hectare, using data from Rhodes and Novis (2002). All coefficients have the expected signs, although the coefficient on subsidies was not statistically significant.

$$\text{New planting} = \underset{(5.521)}{41.48} + \underset{(3.466)}{0.004923} * \text{LEV} - \underset{(-1.96)}{0.00694} * \text{land price} + \underset{(0.306)}{0.00163} * \text{subsidies}$$

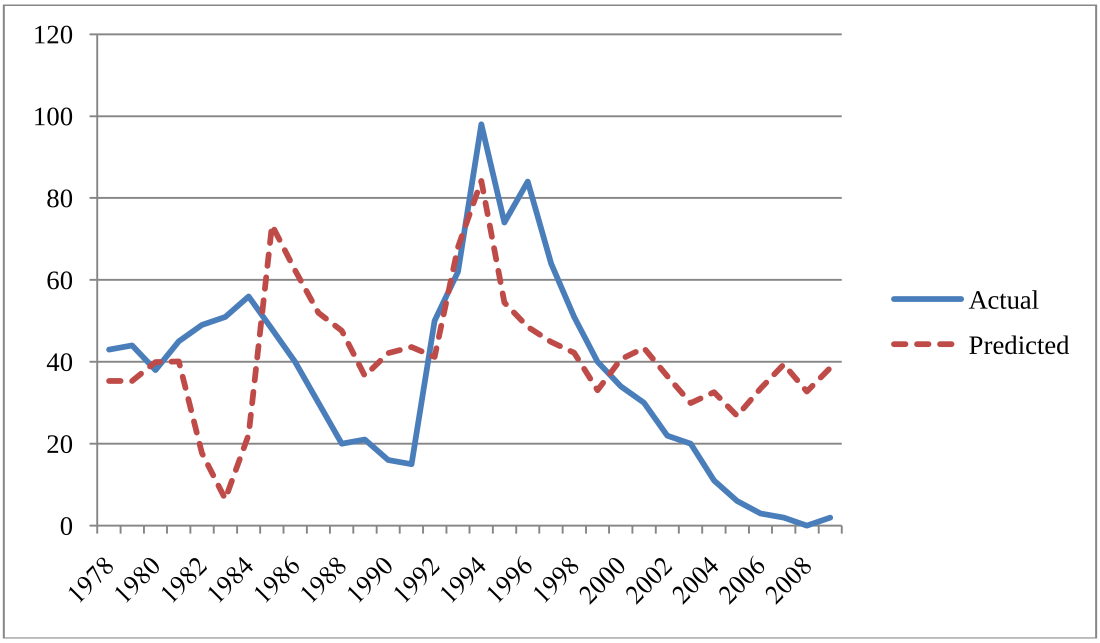
The adjusted R^2 value for this equation is 0.4967. Data were from 1978 to 2009

Conclusion

The available data indicate that returns from commercial forestry are intermediate between land uses offering high returns, such as dairy and arable cropping, and those offering low returns, including sheep and beef farming.

The predictive power of the regression model is not particularly strong. This is probably because it is not taking account of all important factors – the relative profitability of competing land uses, for example. Further work is required to develop a satisfactory model. However the inclusion of land price and forestry profitability measured by land expectation value, are justified, both theoretically and statistically.

Figure 5: Regression model performance



Discussion

Returns for farming land uses include only returns from the primary land use – other farm income, or off-farm income are not included – and therefore the data cited here may not be representative of total household income.

Profitability of forestry is determined from a discounted cash flow analysis of new land planting, and is compared with farming returns from a "going concern", as represented by the MAF Farm Monitoring Reports. While this may be adequate when discussing the likelihood of land use change towards forestry, it underestimates the returns from forestry as a going concern.

Land converted into commercial forestry comes from three main land types – scrub, unimproved pasture and improved pasture. MAF data show that the contribution of these different land types has varied over the recent past – it may be that different drivers are required to predict land use change from these different sources.

Land-use change occurs at the margin – this analysis only considers average values. The amount of land use change that occurs should depend largely on the amount of this marginal land that is available. A spatial model, such as Motu's LURNZ model, should provide a more realistic response than comparing average returns. Such an approach would also be more effective at recognising and accounting for land-use change at the sub-property level.

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