A Forest-Profit Expectations Dataset for New Zealand, 1990–2008

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Abstract

In this paper, we construct a dataset of annual expected forest profits in New Zealand from 1990–2008 at a fine spatial resolution. We do not include land values in any of our profit calculations. We estimate four measures of expected forest profits based around net present value (NPV), land expectation value (LEV), equal annual equivalent (EAE), and internal rate of return (IRR). Our estimates of expected profits are based on the assumption that land owners form their expectations adaptively; that is, they use recent data on prices and costs to form expectations. We illustrate our data by showing regional variation in each of our measures, changes over time in NPV on land in forest in 2008, and variation in NPV over space in 2008. The final dataset, working datasets, and the code used in this work are publicly available to the research community and can be accessed from the authors' website:
http://www.motu.org.nz/building-capacity/dataset/u10073_forest_profit_expectations_dataset.

JEL codes

Q5, Q15, Q23, Q24

Keywords

Forestry, expected profits, expected investment returns, New Zealand, dataset

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1. Introduction

In this paper we develop a spatially and temporally rich dataset of forest profit expectations for New Zealand. This dataset is available from the authors' website.[1] The measures that we calculate may be better interpreted as expected investment returns, excluding land cost. We exclude land values because they are endogenous to both forestry returns and other competing returns; inclusion would invalidate the use of our data as explanatory variables in a regression framework – or any causal analysis. However, profits inclusive of land values can easily be generated from this dataset by combining it with land value data.

Having measures of expected forest profits are important for several reasons. Standard economic models of land values have expected profits as their primary determinant (Capozza and Helsley (1990); Lubowski, Plantinga, and Stavins (2008)). Expected profits are also important for land use decisions (e.g. Parks (1995)). Researchers could relate changes in expected profits to outcomes of interest, such as land use, environmental outcomes, land values, local labour market outcomes, or regional income flows. However, there is a lack of publicly available up-to-date data on expected forest profits. The closest available data is from a series of regional zone studies on realised forest profits published by the Ministry of Agriculture and Forestry (MAF) in the 1990s.[2]

We estimate expected forest profits on each 25 hectare pixel in New Zealand annually from 1990 to 2008 under the assumption that the land is initially bare; for parcels of land that were not forest in a certain year, the value of a new forest is an important determinant of forest conversion. We assume that land managers have adaptive expectations; they use past information on revenues and costs to estimate profits in the future. Surveys of forest valuators suggest this is not unreasonable (e.g., Manley (2010)).[3] Forest valuations typically predict future revenue by using some average of recent log prices. Moreover, Horgan (2007) documents substantial co-movement between forestry profit measures and new planting, which is also consistent with adaptive expectations. This method of expectations formation would be rational if prices and costs were random walks. We report four profit measures: net present value (NPV), land expectation value (LEV), equal annual equivalent (EAE), and internal rate of return (IRR); Evison (2008) proposed using NPV as well as IRR as measures of investment returns for cross land use comparability.

[1] http://www.motu.org.nz/building-capacity/dataset/u10073_forest_profit_expectations_dataset; the working data and code are available from the authors upon request.

[2] See for example MAF (1994).

[3] Manley has conducted biennial industry surveys since 1996; the most recent results are found in Manley (2010).

The rest of this paper is organised as follows. In section 2 we describe our data in detail. Section 3 shows how we estimate profit expectations given our data. Section 4 presents summaries of the data that we develop and compares it to profit measures from Manley and Maclaren (2010). Section 5 discusses some potential uses.

2. Data

This section describes the data that we use to estimate expected forest profits spatially and temporally. It is divided into further subsections. To estimate expected revenues we need data on output prices and yields; these are detailed in subsections 2.1 and 2.2. We also need an estimate of a new forest's expected pruning and thinning regime; data used for this purpose is describe in subsection 2.3. Data on establishment and operating costs, logging costs, and cartage costs are described in subsection 2.4; temporal variation in these costs is introduced by extrapolation and this is described in subsection 2.5. Subsection 0 deals with discount rates data. Subsection 2.7 summarises the temporal and spatial variability of the data that we use to create the panel dataset of expected forest profits across all of NZ from 1990–2008.

2.1. Price data

We want estimates of expected forest profits from 1990–2008. We focus on export prices for our expected revenue estimates. There are two advantages to focusing on export prices. First, export prices are credibly exogenous; this is important if researchers want to relate the profit measures developed in this paper to outcomes of interest in a regression framework. Second, the share of New Zealand's wood production that is exported has traditionally been large and growing; see Figure 1. Thus export prices are likely to be the relevant prices for new forestry investment decisions.

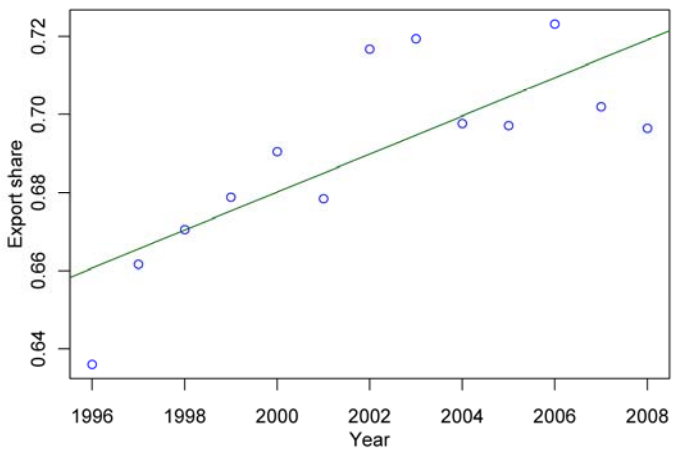

Figure 1: Roundwood equivalent removals for domestic use and export, 1996–2008
Notes. The circles give the annual export share of roundwood removals, and the line gives the OLS fit.

MAF's indicative price data is collected through surveys of large forest owners. These prices may not be representative of the price that can be obtained by small forest owners. However, typically a few forest owners have held most of country's forest land; in 2010 more than 70 percent of all plantation land was owned by large forest owners (MAF, 2010).

In order to estimate the revenue from unpruned logs we must aggregate the price information on different grades of unpruned logs provided by MAF; this is because National Exotic Forestry Description (NEFD) yield data[4] is not broken down by grade. Inspection of the prices for unpruned logs across grades reveals remarkable homogeneity. Figure 2 shows the nominal quarterly price of unpruned logs across grades. We use their unweighted mean as our aggregate unpruned log price series.

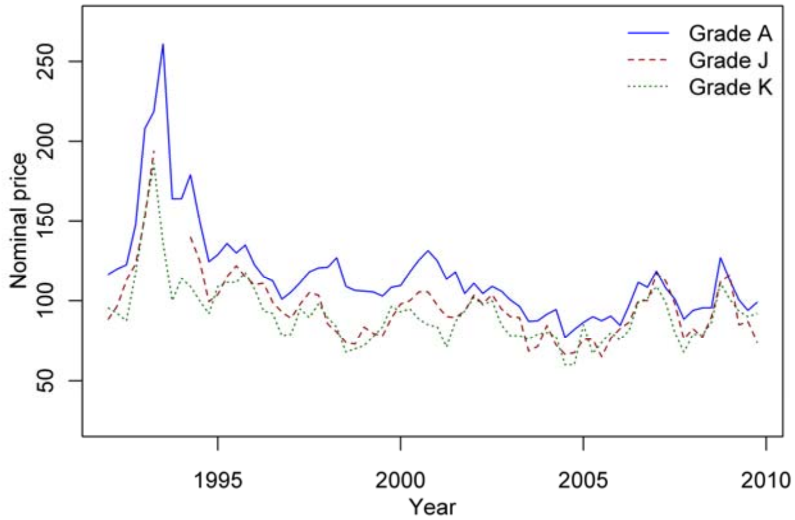

Figure 2: Nominal quarterly price of unpruned logs, 1992q1–2009q4

In order to estimate forestry profitability expectations back to 1990 we need relevant price data.[5] The only consistent estimates of log prices over this period are export unit values, shown in Figure 3, which are calculated from volume and value export data obtained from Statistics New Zealand (SNZ).[6] We use this export unit value series to extrapolate MAF's

[4] For example MAF (2008).

[5] We extended the dataset back to 1973 but do not include the full period for several reasons. Firstly, our estimates back to 1973 required us to extrapolate a lot of the data that we discuss below over long periods. Secondly, high inflation rates in the early 1980s imply low real interest rates, and this affects expected returns a lot.

[6] Value and volume data (from 1989) can be obtained from the overseas trade section of the SNZ website, www.infoshare.govt.nz. In particular we use HS4403. This data includes the value and volume from wood products of many species. However, it turns out the radiata pine typically accounts for more than 95 percent of each category. Note also that the same data is available for 5 year periods from MAF.

indicative prices back to 1990. We do this by normalising the unit value series to be 1 in 1992 and then multiplying the unit value series by the real price of each of the log products in 1992.[7]

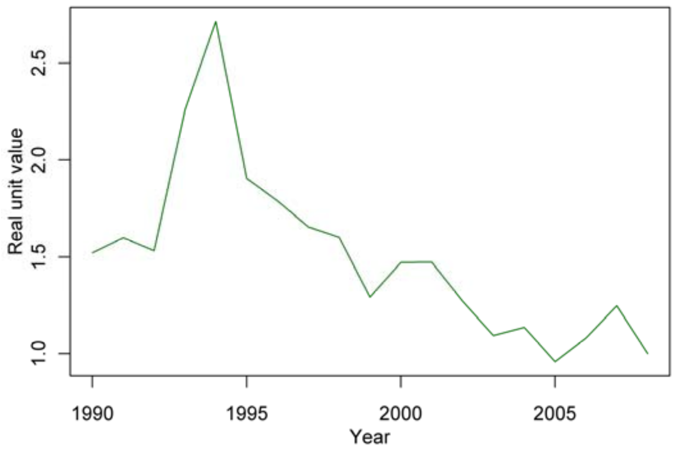

Figure 3: Real export log unit values, 1992–2008

The large amount of co-movement in the individual prices series shown in Figure 4 suggests that extrapolation from one index of export unit values is reasonable.

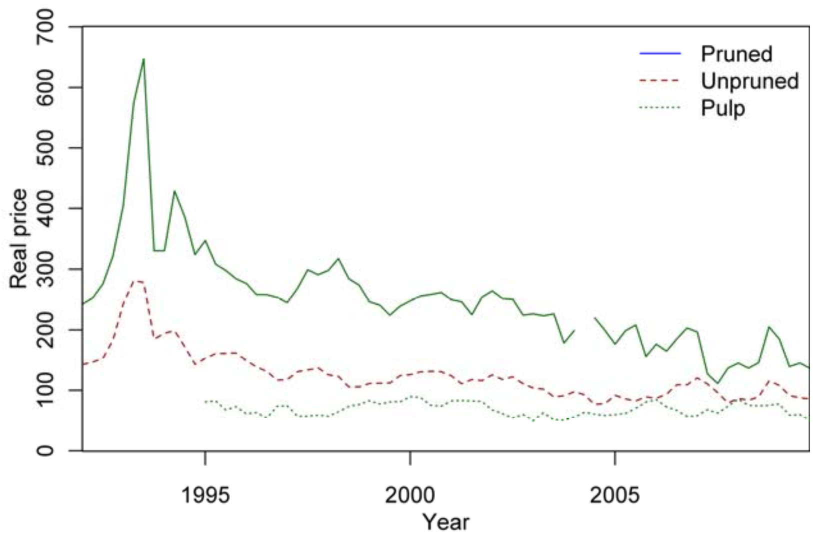

Figure 4: Real quarterly price of pruned, unpruned, and pulp logs, 1992q1–2009q4

Notes. The graph shows MAF's indicative prices for pruned, unpruned (average across grades), and pulp logs; all prices are converted into real terms with a base year of 2008.

2.2. Regional yield data

To estimate forest revenue, we need data on yields. We use MAF wood yield tables for radiata pine (MAF, 2010). These tables provide estimates of the wood yield, in cubic metres per

[7] The unit value series gives us a measure of fluctuations in the real price of aggregate log products. The real price of each separate log product in 1992 gives us a measure of the level of the series. While we extrapolate from 1992 for pruned and unpruned logs, for pulp logs we extrapolate from 1995 because there is no data for 1992–1994.

hectare, as a function of age for each of 13 wood supply regions (WSRs). The tables' yield estimates are based on recent yield data. Earlier yield tables do exist (MAF 1996). However because of changes in methodology, these are not directly comparable to the current tables. Thus we use the current tables for all years. This means that our estimates do not capture changes in forest productivity and probably underestimate yields from forests planted now.[8]

For each of the 13 WSRs, the tables provide estimates for the wood yield, in cubic metres per hectare, of pruned logs, unpruned logs, and pulp logs. Yields differ by tending regime: pruned with thinning, pruned without thinning, unpruned with thinning, and unpruned without thinning. They also differ by forest type: pre-1990 and post-1989. In Figure 5 we present wood yield data for the Central North Island (CNI) in 2008. For each tending regime and forest type, yields are assumed to be 0 for forests that are less than 10 years old. After that yields typically increase with age. Yields are estimated only for forests younger than 40 years old. This is because typical radiata pine rotations are much shorter than 40 years.

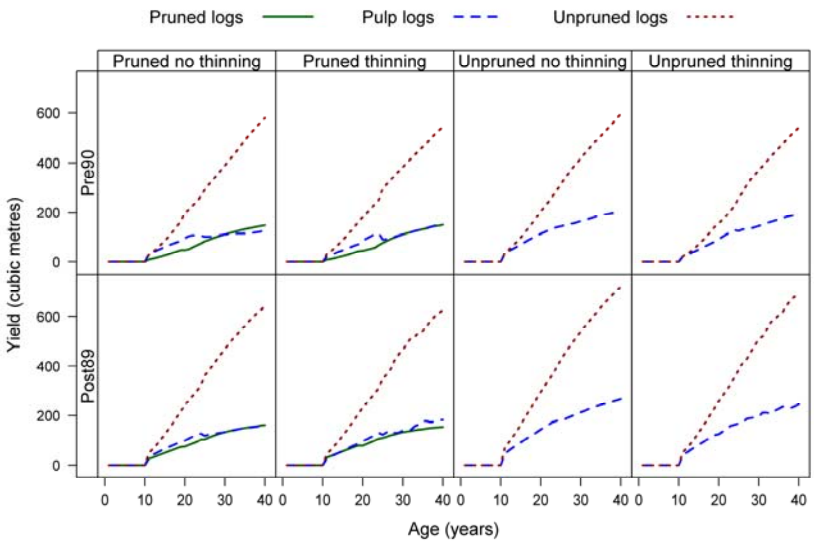

Figure 5: CNI wood yields by pruning regime and forest type in 2008

2.3. Expected pruning and thinning regime

Yields, and hence expected profits, depend on pruning and thinning decisions (henceforth referred to as regimes). Data on the area of forest in each regime by WSR and age[9]

[8] The current tables do not have data for the West Coast region. Furthermore, it is widely believed that the earlier tables overstated West Coast yields. Therefore, as recommended by Steve Wakelin from Scion Ltd, we halve the West Coast yield from the earlier tables, and use that yield throughout this paper.

[9] Forests are categorised into age groups of 5 years. For example, age class one includes forests that are in their first to fifth years of growth, and age class two includes forests in their sixth to tenth years of growth.

can be found in NEFD reports for the years 1990–2008. Areas by regime for the youngest age class should be interpreted as intentions, because pruning and thinning does not occur until the forests are older.[10] We assume that the regime of a new forest will be the same as the intended regime for other young forests (up to 5 years old) nearby (in its WSR). In practice, not all nearby, young forests will have the same intentions regarding their regime. Thus we treat a new forest as if it will have a mixture of regimes in the same proportion as nearby young forests.

Table 1 presents the data we used to estimate revenue for land in the CNI that had pre-1990 forest on it in 2008, according to the Land Use and Carbon Analysis System (LUCAS).[11]

Table 1: Price, yield, and revenue data, CNI, 2008, pre-1990 forests

	Log type			
	Pruned	Unpruned	Pulp	
Price 12Q average ($/m^3)	162.35	96.64	71.15	
	Tending regime			
	Pruned no thinning	Pruned thinning	Unpruned no thinning	Unpruned thinning
Area age class 1 (ha)[a]	14,028	1,190	55,185	628
Proportion of total area	0.20	0.02	0.78	0.01
Yield pruned logs (m^3)	101	99		
Yield unpruned logs (m^3)	351	349	381	333
Yield pulp logs (m^3)	106	102	155	134
Total yield (m^3)	558	551	536	468
Sum weighted yield (m^3)	540			
Rev. pruned logs ($)	13,454	13,135		
Rev. unpruned logs ($)	30,323	30,210	32,945	28,789
Rev. pulp logs ($)	7,829	7,574	11,465	9,955
Total revenue ($)	51,606	50,919	44,410	38,744
Sum weighted rev. ($)	50,151			

[a] Area age class 1 (ha) is the number of hectares in each pruning and thinning regime for forests on pre-1990 land in the Central North Island that are up to 5 years old; these numbers come from NEFD reports.

2.4. Forestry costs

We use several sources of cost data. Establishment and operating costs (referred to as growing costs below) are from MAF (2002). They vary with age and depend on pruning and thinning decisions. We include annual overhead costs of $69 per hectare regardless of tending

[10] For our estimates that go back to 1973 we inferred the area of young forest in each tending regime using age class data. For example, the area of forest in 1989 between 10 and 15 years old was inferred from the area of forest between 16 to 20 years old in 1994.

[11] http://www.mfe.govt.nz/issues/climate/lucas/

regime. These overhead costs cover insurance, rates, maintenance, weed and fire control, and management costs. Th

Table 2 reports the NPV of operating costs for pruned and unpruned regimes. Initial establishment costs are roughly $1,300. Pruning and thinning extra costs occur in the first 10 years, and yearly operating costs are roughly $70. The detailed costs are given in Table 3.

Table 2: NPV of operating costs, CNI, 2008, pre-1990 forests

Regime	Present value of operating costs ($/m3)
Pruned ($/ha)	3,516
Unpruned ($/ha)	2,355
Weighted cost ($/ha)	2,603

Notes. The weighted cost is weighted by the area of land that is pruned/unpruned.

Harvest costs include both logging costs and cartage costs. We use data from the Regional Log Price and Cost Report, May-2010 (AgriFax, 2010). The report provides data on the sum of logging and cartage costs, which depend on the slope of a parcel and its distance to the relevant mill or seaport.[12] Parcel slope is classified into four groups: flat, easy, steep, and very steep.[13] Distance to mill or seaport is classified into 7 groups: less than 40km, 40–60km, 60–80km, 80–100km, 100–120km, 120–160km, 160–200km.

We use the Land Environments New Zealand (LENZ) slope map (Landcare Research, 2004); the original map is at a high resolution so we resample it. We estimate cartage distance by the distance from a parcel to the nearest large mill or seaport;[14] for confidentiality reasons MAF only identified the location of the 20 largest mills in New Zealand. Our cartage distance has two sources of measurement error that offset each other. Firstly, not all logs are sent to the nearest mill or port; in fact, sometimes the nearest mill will not process all log products. Thus, using the distance to the nearest mill or port will cause us to underestimate the cartage distance for some parcels. On the other hand, because we only include the distance to large mills we will overestimate the distance for parcels that would use closer, smaller mills; we will underestimate if more distant mills are used. Finally, as we are interested in expected profits, it is really the expected cartage distance that matters. This depends on the distribution of mills at harvest time,

[12] The costs are given in dollars per tonne. We convert them to dollars per cubic metre using a conversion factor of .955; the AgriFax report uses conversion factors between .94 and .97.
[13] AgriFax does not provide a concordance between verbal classifications of slope and measurements in degrees; however, AgriFax's verbal classification is the same as LENZ so we use their concordance.
[14] Our distance measure is the sum of the Euclidean distance from a parcel to the nearest road and the distance along the road to the nearest mill or seaport.

		Capital costs	Forestry operations									
Regime	**Age**	**Land Preparation/Fencing/ Tracking**	**Planting / fertilising/ releasing**	**Prune 1**	**Prune 2**	**Prune 3**	**Waste Thin 1**	**Waste Thin 2**	**Dothistroma spray**	**Mapping**	**Mid-rotation inventory**	**Pre-harvest inventory**
pruned with or without production thinning	1	356	945									
	4								29	10		
	6			678								
	7				550		218					
	8					520						
	9							295				
	14										27	
	27											84
unpruned with or without production thinning	1	356	945									
	4								29	10		
	6								29			
	10						454					
	14										27	
	27											84

Table 3: Establishment and operating costs

Notes. We include annual overhead costs of $69. These are omitted from the table to save space. The data are from a MAF report published in 2002.

including mills that do not currently exist. If a forest owner expects a new mill to be established near her forest, then we will overestimate her expected cartage costs.

Estimates of roading costs were provided by Dr Rien Visser from the College of Engineering (Forest Engineering) at the University of Canterbury. The raw estimates are $35,000 per kilometre for land less than 17 degrees steep, and $100,000 per kilometre for land steeper than 17 degrees. The average road length per hectare is estimated to be 23 metres. This gives a roading cost of $805 per hectare for land with slope less than 17 degrees, and $2300 per hectare for land steeper than 17 degrees.

Table 4 presents cost data that depend on parcel varying characteristics. These are logging costs, cartage costs, and roading costs. They vary based on a parcel's slope and its distance to the nearest port or mill. Logging and cartage cost data also vary by island; slope and distance to mill or port mean that generally costs are higher in the South Island.

Table 4: Logging costs, cartage costs and roading costs, CNI, 2008

Logging cost ($/m3)		Cartage cost ($/m3)		Roading cost ($/ha)	
Flat	19.21	0–40 km	9.10	Slope < 17	777.17
Easy	22.24	40–60 km	12.13	Slope ≥ 17	2220.47
Steep	26.83	60–80 km	15.16		
Very steep	32.35	80–100 km	18.20		
		100–120 km	21.23		
		120–160 km	28.31		
		200+ km	32.35		

2.5. Incorporating temporal variation in costs

The cost data that we use have no temporal variation; the growing costs are measured in 2002 and harvest, logging, and roading costs are measured in 2008. However it is not unreasonable to think that technological and economic changes (including changes in wages and infrastructure) have altered the costs of forestry over time. The only data that we are aware of on temporal variation in forestry costs is the producer price index (PPI) for forestry and logging input costs, obtained from SNZ. This series is shown in Figure 6. It represents the variation in the real cost of forestry and logging inputs relative to June 2008. We use this series to extrapolate our establishment and operating costs, logging costs, cartage costs, and roading costs back to 1990.

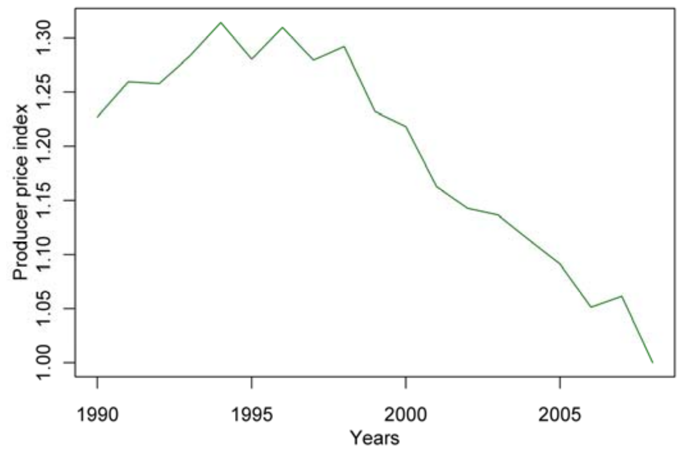

Figure 6: Producer price index – forestry and logging input costs, 1972–2008

Notes. The graph shows the producer price index for forestry and logging inputs. The index of real input prices was developed from the forestry and logging inputs price indices and was deflated by the all industries input price index.

2.6. Discount rates

Revenues and costs from forest planted today will be realised at different times in the future. Thus, any estimate of expected forest profits must take into account the time value of money.

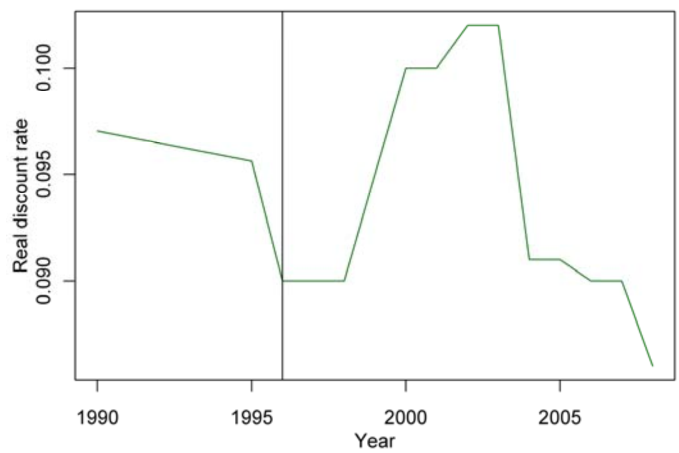

Figure 7: Real discount rate for forest valuation from 1972 to 2009

Notes. The vertical line at 1996 splits the figure into two sections. To the right, the real discount rate is the mean rate reported in Manley's survey for the corresponding year. To the left, the real discount rate is estimated as discussed.

Figure 7 shows the real discount rates that we use. Manley has conducted surveys on the real discount rates used for forest valuation in New Zealand biennially from 1996 to 2009. Average real discount rates for pre-tax and post-tax cash flows are reported for each survey.[15] Thus, we use these average real discount rates for the period covered by the surveys. We

[15] All money values in this paper are pre-tax, thus we use the Manley pre-tax real discount rates.

extrapolate prior to 1996 using a simple regression of the rates used in Manley's surveys on time and a constant.

2.7. The temporal and spatial variability of our data

Table 5 summarises the level of temporal and spatial variation in the variables that we use to estimate expected forest profits. The final column provides information about the years where data has been extrapolated. Our final set has annual, parcel-level variation. Revenue varies annually at the WSR level. Costs vary annually at the parcel level. For a given year, variations in expected forest profits within a WSR are driven by variation in slope and distance to mill or seaport.

Table 5: Level of variability in final derived data

	Units	Spatial	Temporal	Other	Extrapolation
Real prices	$/m^3$	None	Yearly	none	1990–1991[b]
Yields	m^3/ha	WSR	None	regime, pre-1990, post-1989	None
Growing costs	$/ha	None	Yearly	regime, age	1990–2008[c]
Logging costs	$/m^3$	Parcel	Yearly	slope	1990–2008[d]
Cartage costs	$/m^3$	Parcel	Yearly	distance	1990–2008[d]
Roading costs	$/km	Parcel	Yearly	slope	1990–2008[d]
Discount rates	None	None	Biennial	none	1990–1995

[a] All dollars are in real terms with base period June 2008.
[b] Real prices for pulp logs area extrapolated to 1994.
[c] Measured in 2002.
[d] Measured in 2008.
[e] The mean discount rates used for forest valuations in Manley's surveys are reported biennially. However, prior to 1995 discount rates are extrapolated annually.

3. Calculating various profitability measures

In this section we describe the formulae used to calculate each of our profit measures. Standard cash flow discounting techniques are used. The expected harvest age is assumed to be 28 years; however, harvest ages have not changed much during the period for which we develop our expected profit data. Firstly, we illustrate the calculation of each of our profitability measures for a parcel of pre-1990 forest in the CNI in 2008, using the same data that was presented in section 2. This is illustrative of our general methodology; we simply extend these calculations to all parcels in New Zealand between 1990 and 2009, treating pre-1990 and post-1989 forests separately. In the remainder of the section, we formalise our methodology.

3.1. A numerical example

The data in Tables 5, 6, and 7 is sufficient for us to calculate our estimates of NPV, LEV, and EAE for any parcel of pre-1990 forest in the Central North Island in 2008. In this section we present a numerical example. Consider a hectare of land with slope 19 degrees that is less than 40 km to the nearest mill or port. We estimate its expected NPV in dollars per hectare as

$$\begin{aligned} \boldsymbol{NPV} &= \boldsymbol{PV_{Revenue}} - \boldsymbol{PV_{GrowingCosts}} - \boldsymbol{PV_{LoggingCosts}} - \boldsymbol{PV_{CartageCosts}} - \boldsymbol{PV_{RoadingCosts}} \\ &= \frac{50{,}150.80}{(1+0.080)^{28}} - 2{,}603.43 - \frac{22.24 \cdot 539.96}{(1.080)^{28}} - \frac{9.10 \cdot 539.96}{(1.080)^{28}} - \frac{777.17}{(1.080)^{28}} \\ &= 1158.36 \end{aligned}$$

where PV denotes the present value of a quantity, and 539.96 is the yield for the given parcel; recall from Table 5 that growing costs are in dollars per cubic metre. We estimate its LEV as

$$\boldsymbol{LEV_{pt}} = 1158.36\frac{(1+0.08)^{28}}{(1+0.08)^{28}-1} = 1310.23$$

3.2. Formalising our methodology

In this section we briefly describe how we estimate our expected profit measures for any parcel of land in WSR w in year t. The expected present value of revenue is estimated as

$$\boldsymbol{PVrevenue_{w,t}} = \frac{\sum_i \boldsymbol{P_{i,t}} \sum_j \boldsymbol{A_{j,w,t} Yield_{i,j}}}{(\boldsymbol{1}+\boldsymbol{r})^{\boldsymbol{28}}}$$

$P_{i,t}$ denotes the price of log type i. $A_{j,w,t}$ is the proportion of young forest in regime j. $Yield_{i,j}$ is the wood yield for log type i given tending regime j at harvest time. This is really just saying revenue is price times quantity. However, we take a weighted average of quantities over tending regimes.

We estimate the expected present value of lifetime growing costs of a hectare of forest as

$$\boldsymbol{PV_{GrowingCosts_{w,t}}} = \sum_j \boldsymbol{A_{j,w,t}} \sum_{k=1}^{28} \frac{\boldsymbol{GrowingCosts_{j,k,t}}}{(\boldsymbol{1}+\boldsymbol{r})^{\boldsymbol{k}}}$$

$GrowingCosts_{j,k,t}$ are estimates of the real growing costs for a forest in regime j that is k years old.

The present values for logging costs, cartage costs, and roading costs are given by

$$\boldsymbol{PV_{LoggingCosts_{s,w,t}}} = \frac{\sum_i \sum_j \boldsymbol{A_{j,w,t} Yield_{i,j} LoggingCosts_{s,t}}}{(\boldsymbol{1}+\boldsymbol{r})^{\boldsymbol{28}}}$$

$$PV_{CartageCosts_{d,w,t}} = \frac{\sum_i \sum_j A_{j,w,t}\, Yield_{i,j} CartageCosts_{d,t}}{(1+r)^{28}}$$

$$PV_{Road_{s,t}} = \frac{Road_{s,t}}{(1+r)^{28}}$$

$LoggingCosts_{s,t}$ denotes logging costs per cubic metre for land with slope s. $CartageCosts_{d,t}$ denotes cartage costs per cubic metre, which depend on a parcel's distance $\boldsymbol{d}$ to the nearest mill or seaport. $Road_{s,t}$ denotes average roading costs per parcel and these depend on a parcel's slope.

For a given year, the net present value of a parcel depends on its WSR, its slope, and its distance to the nearest mill or seaport. It is given in the following equation, which has the benefit of highlighting all the levels of spatial variation in our expected profit estimates.

$$NPV_{s,d,w,t} = PVrevenue_{w,t} - PV_{GrowingCosts_{w,t}} - PV_{LoggingCosts_{s,w,t}} - PV_{CartageCosts_{d,w,t}} - PV_{Road_{s,t}}$$

$EAE_{s,d,w,t}$ and $LEV_{s,d,w,t}$ for the same parcel at time t can be calculated in terms of $NPV_{s,d,w,t}$. In particular

$$EAE_{s,d,w,t} = NPV_{s,d,w,t} \frac{r(1+r)^H}{(1+r)^H - 1}$$

$$LEV_{s,d,w,t} = NPV_{s,d,w,t} \frac{(1+r)^H}{(1+r)^H - 1}$$

The IRR is calculated as the interest rate that sets NPV equal to zero.

$$NPV_{s,d,w,t}(IRR_{s,d,w,t}) = 0$$

4. Estimates of Expected Forest Profits

In this section we present some of our estimates of expected forest profits. We focus on parcels of New Zealand that were already radiata pine in 2008 according to LUCAS. Thus, the numbers represent expected profits if this LUCAS land were planted from bare land in 2008. Parcels with negative expected profits should not be converted in 2008; however, much of this land could have seemed like a profitable conversion in the mid-1990s when log prices were high.

Table **6** presents mean estimated expected forest profit by WSR. Estimates of expected NPV, EAE, and LEV are all calculated using an 8 percent real discount rate. The mean real discount rate for this period reported in Manley's survey was 8.6 percent. However using an 8 percent discount rate enables easier comparison with estimates reported in Manley and Maclaren (2010).

Table 6: Mean expected forest profit by WSR for land in radiata pine in 2008

	NPV	EAE	LEV	IRR
Auckland	1337	121	1512	9.90
Northland	1180	107	1335	9.64
Central North Island	1135	103	1283	9.62
East Coast	1064	96	1204	9.30
Hawkes Bay	1109	100	1255	9.41
Southern North Island East Coast	957	87	1083	9.17
Southern North Island West Coast	382	35	432	8.53
Marlborough	-370	-33	-418	7.23
Nelson	426	39	482	8.66
West Coast	-1885	-171	-2132	1.20
Canterbury	-887	-80	-1003	6.11
Otago	-513	-46	-580	7.15
Southland	-256	-23	-290	7.57
New Zealand Weighted Average	647	59	732	8.75

Notes. Our expected profit estimates for the West Coast are very low. This is driven by low wood yields for this region. As mentioned earlier, we halved MAF's wood yields on the advice of forestry experts.

Our estimated mean expected LEV in CNI is $1135. Manley and Maclaren (2010) estimate an LEV of just under $1000 for a forest harvested at 28 years of age. These estimates are close. Moreover their estimate used yields for a very specific clearwood forest as opposed to look-up tables for CNI. Our means hide large variation in estimated expected forest profits within WSRs. In particular, parcel steepness and distance from nearest mill or port have large effects on costs. For example, for pre-1990 forest in 2008 our estimates of expected NPV for CNI are $1279.55 for flat land within 40 km of a mill or port, $899.92 for flat land between 60 km and 80 km from the nearest mill or port, and $669.35 for steep land within 40 km of a mill. Moreover, distant, steep parcels have negative estimates for expected NPV; however, relatively few of these parcels are plantation forests according to LUCAS.

The weighted average expected NPV for the entire country is $647. Moreover expected profits are larger for WSRs that are further north; the WSRs with the largest forest areas have positive expected NPV. This geographic trend is driven by two main factors. Firstly, the look-up tables estimate that wood yields typically increase as we move north through WSRs. Secondly, logging and cartage costs are typically higher in the South Island.

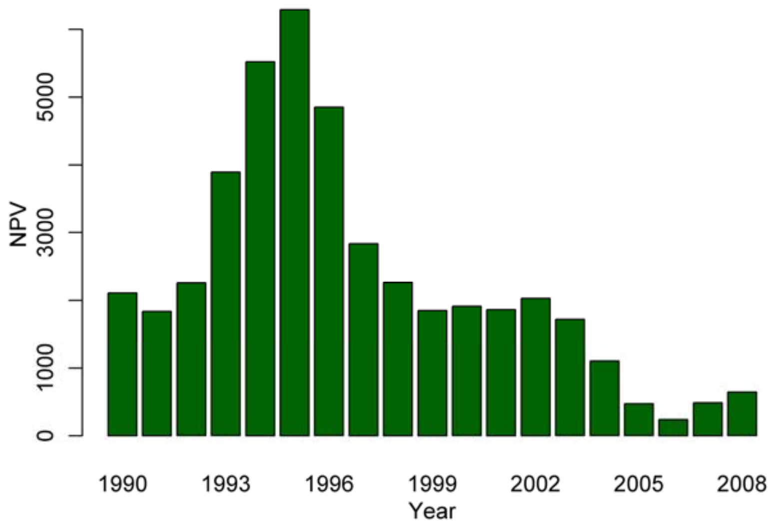

Figure 8: Estimates of mean NPV of land that is forest in LUCAS, 1990–2008

Figure 8 shows the mean of our estimates of expected NPV over time. In every year we take the mean over land that was forest according to LUCAS in 2008. The discount rate that is used for the calculations is allowed to vary year by year; in 2008 it is 8.6 percent. The discount rates that we use are larger in the early 1990s than in later periods; 11.5–12.5 percent compared to 8.5–10 percent. Figure 4 shows that real prices for both pruned and unpruned logs have been falling since the mid-1990s. This is a large cause of the lower estimates of returns in the later years in Figure 8.

Figures 9 and 10 show the spatial variation in our estimated expected forest NPV. The WSR borders are shown by black lines. It is clear that there is a lot of variation in profits within WSRs as well as between WSRs.

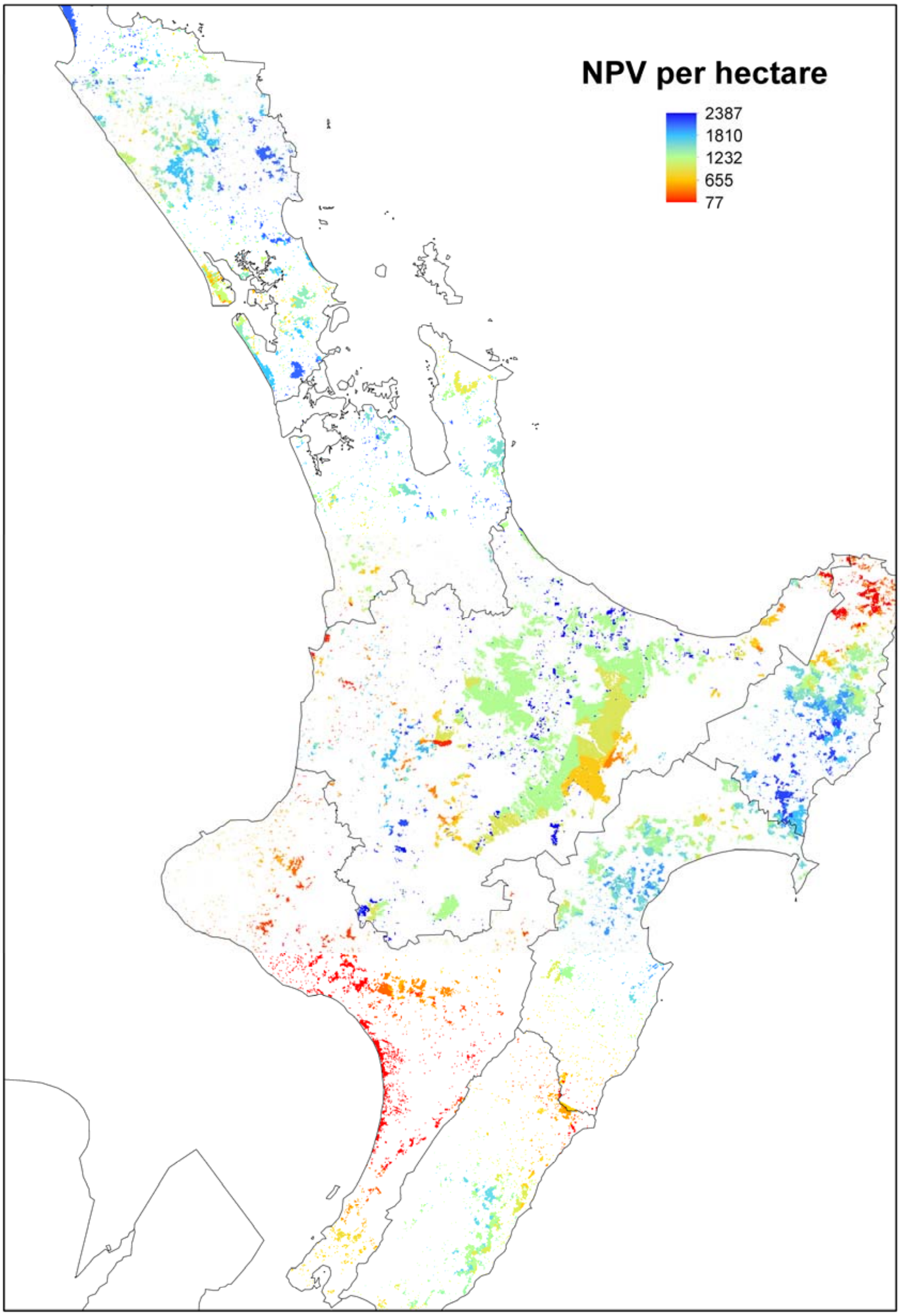

Figure 9: Expected NPV per hectare on North Island LUCAS forest in 2008

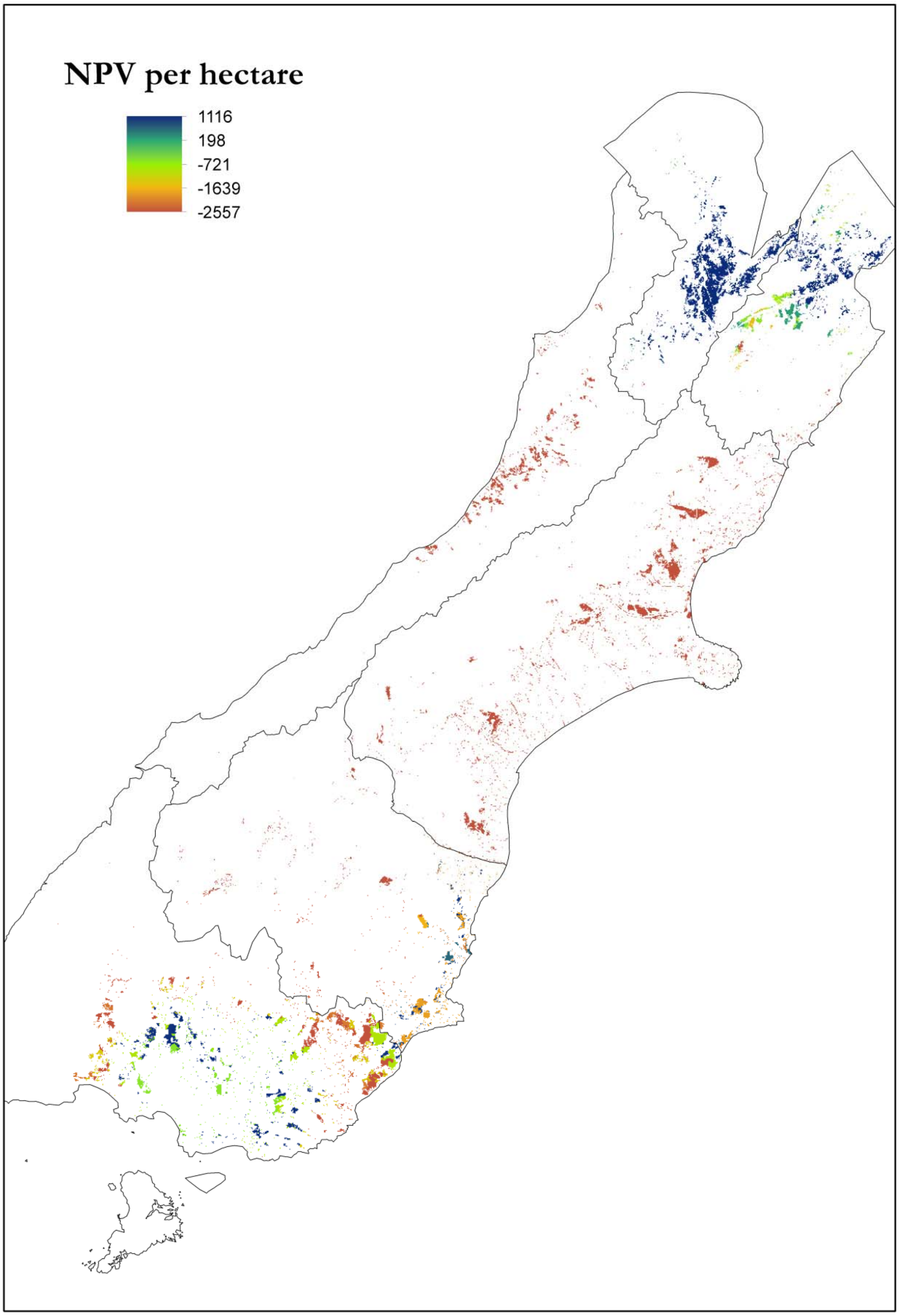

Figure 10: Expected NPV per hectare on South Island LUCAS forest in 2008

5. Conclusion

In this paper we constructed a panel data set on forest profit expectations for New Zealand. The cross-sectional unit is a 25 hectare parcel, and all parcels in New Zealand are covered. The panel has annual time variation for the period 1990–2008. We create four profitability measures: NPV, LEV, EAE, and IRR. The final profitability maps have variation by wood supply region, slope, and distance to sea ports, as well as over time.

Our estimates of expected forest profits are based on the assumption that land owners have adaptive expectations. That is, they use past levels of prices and costs to form expectations about potential profits from forestry in the future. This is consistent with surveys by Manley (such as Manley, 2010) and research by Horgan (2008). We also assumed constant forestry productivity and constant expected harvest age.

The dataset that we have constructed uses industry standard measures of profits and the most recently available data. The dataset can be used to look at land use change in New Zealand. The code for constructing the data is available, and so the dataset can be updated as data as desired. This work can be extended in several directions. The current dataset could incorporate spatially explicit estimates of wood yields such as those in Kirschbaum (2011). It would also be useful to incorporate data on changing wood yields and changing costs over time.

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