Competitive Implications of Land Ownership Institutions – Using Oligopoly Theory to Estimate the Impact of the Native Land Act's Ten Owner Rule

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Abstract

A major component of many claims by Maori against the Crown, under the Treaty of Waitangi, is the role of 19th century land tenure institutions in causing Maori to sell excessive amounts of land at unduly low prices. Foremost was the 1865 Native Land Act's "ten owner rule", which induced named subsets of Maori landowners to competitively sell collectively-owned tribal lands rather than to maximise their value through coordinated land sales and retention. This paper proposes a parsimonious method for estimating the loss to Maori from the ten owner rule, comparing coordinated (i.e. monopoly) land sales quantities, prices and profits with those of oligopolistically competitive sales. Using oligopoly theory, the ratios of these measures is shown to depend only on the number of competing sellers (here, ten), and the price elasticity of land demand. The latter is estimated using 19th century land sales data for a Poverty Bay iwi (i.e. tribe). For that iwi, it is estimated that coordinated land sales would have resulted in prices up to 5.5 times higher than actually realised, up to 87% less land being sold, and land sales profits up to 7.1 times higher. This approach is relevant for assessing the historical losses of iwi affected by the ten owner rule, and illustrates the competitive impacts of land ownership institutions.

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1 Introduction

The Turanga (i.e. Poverty Bay) iwi (i.e. tribe), Te Aitanga a Mahaki (Mahaki), is a leading example of a Maori tribe that in the late 19th century unwillingly sold the vast majority of its lands – and at very low prices – due to faulty land tenure reforms and their implementation.[1] Indeed, in its inquiry into Turanga Treaty claims, the Waitangi Tribunal (the Tribunal) concluded (Waitangi Tribunal (2004, p. 536)):

> "The effect on the ground in Turanga of [the land tenure system and its administration by the Native Land Court] was that within 30 years, 70 per cent of the Maori land base had been sold at knock-down prices."

Key to this outcome was the provision, in various Native Lands Acts, for the individualisation of hitherto collectively-owned tribal lands. The stated aim of the underlying policy was "the extinction of the native communal ownership, and the substitution of titles known to the law in lieu thereof" (Waitangi Tribunal (2004, p. 432). This end was achieved by various means, primarily by pitting individual landowners each other in the process of selling native lands to either the Crown, or private European buyers.[2] While collectively tribes may have wished not to sell their collective lands, the process of individualisation created a prisoner's dilemma for Maori landowners. As noted by the Tribunal in Waitangi Tribunal (2004):

"[I]n the context of the competition for land between Maori, it was better to get on the front foot and apply for title than to be an objector to someone else's claim." (p. 417)

"Maori queued up at the door of the court to have their lands investigated. Some were willing participants, but some were not. The unwilling ones had no real alternative because ... [t]o refuse to join the queue was to risk losing everything." (p. 420)

"[T]he procedure of the [Native Land Court] has snapped the faggot-band, and has left the separate sticks to be broken one by one." (p. 530, quoting Justice Richmond's 1873 inquiry into Maori landlessness).

[1] A detailed history of the relevant land tenure provisions, associated operation of the Native Land Court, and impacts on Mahaki, is given in Chapter 8 of Waitangi Tribunal (2004). As Boast (2008, p. 687) put it, "The tenurial problems which developed in Poverty Bay were unusually intricate, leading to the area developing an unenviable national reputation as a place where practically everything had gone wrong."

[2] Aided by ruses such as Crown purchasing agents or private buyers targeting individual sellers, or private Europeans selling goods (or alcohol) on credit to Maori buyers, and then forcing them to sell their individualised land interests in order to settle the debts.

A particular example of the individualisation of Maori land titles is the "ten owner rule" introduced in section 23 of the Native Lands Act 1865.[3] Under that rule, in most cases no more than ten individual owners' names could be recorded on the title of formerly collectively-owned land. However, those owners were able to sell their interests without the approval of other tribe members. As suggested by the above quotes, this rapidly resulted in widespread uncontrolled and uncoordinated land alienations, with a natural depressing effect on land sale prices.[4]

Kawharu (1977, p. 15) described the Native Lands Act 1865 as an "engine of destruction for any tribe's tenure of land." Likewise, in Waitangi Tribunal (2004), the Tribunal criticised the Crown for individualising titles, and for not enabling Mahaki to effectively collectivise the management of its lands (i.e. to sell lands on a more coordinated basis, to increase sales prices, and reduce the areas sold).

In this paper I model how Mahaki might have gained from collectivised (i.e. coordinated) land sales – instead of competitive land sales – using oligopoly theory. More particularly, collectivised land sales can be regarded as producing something approximating the land sales quantities, prices and profits achievable under monopoly (i.e. a single seller, internalising the impact on price of its choice of how much land to sell). Conversely, competitive land sales can be modelled as oligopolistic selling – i.e. each seller might have regard to how its own choice of sales quantity affects price, but collectively they sell more land, and at a lower price, than they would have had they acted collectively.

I show that the ratio of monopoly to oligopoly prices, quantities and profits can be expressed in terms of just the number of oligopoly sellers and the price elasticity of demand (PED) for land. Using 19th century land sales data for Mahaki to estimate the PED, I estimate that coordinated land sales could have resulted in the iwi enjoying prices up to 5.5 times higher than actually realised, and up to 87% less land being sold (with retained land being more valuable by virtue of higher prices). Based on these results, I also estimate that Mahaki's land sale profits would have been up to 7.1 times higher than realised.

[3]For a history of this rule, see Chapter 8 of Waitangi Tribunal (2004), or Boast and Black (2010).

[4]Waitangi Tribunal (2004) notes there were additional institutional defects associated with Maori land titles that also served to depress realised prices. Indeed (pp 518-519): "the price purchasers would have been willing to pay for unenforceable contracts to purchase multiple undivided interests in Maori customary land was a fraction of the amount they would have paid for a Crown-granted title able to be acquired in a single transaction without bureaucratic or judicial interference."

The next section derives relationships between monopoly and competitive (more specifically, oligopolistic) land sales quantities, prices and profits respectively, and shows how they depend only on the price elasticity of demand for land faced by each seller. Section 3 provides estimates of that parameter, while Section 4 applies those estimates to show the extent to which coordinated sales would have produced higher prices, and lower sales volumes and profits, than those arising under the ten owner rule. The final section provides a discussion and concludes.

2 Model

Based on standard analysis of the price (or quantity) choice of a profit-maximising firm, the "price-cost margin" of that firm at its profit maximum is:[5]

$$L \equiv \frac{p-c}{p} = -\frac{1}{\eta} \tag{1}$$

where p is price, c is the marginal cost of production, and η is the price elasticity of demand facing the firm. The latter measures the percentage change in quantity demanded when price changes by 1%. For "normal" goods, it is negative, since an increase in price results in less quantity being demanded, all other things being equal.

The left-hand side of (1) is commonly referred to as the Lerner Index, and is denoted L. What this index tells us is that the more price-elastic is demand (i.e. the more negative is η), the greater is the profit margin enjoyed by the profit-maximising firm (i.e. p proportionately exceeds c by a greater amount). This relationship holds for any profit-maximising firm, with η interpreted as the price elasticity of the *residual* demand faced by that firm, meaning that portion of total demand that is not served by rival firms.

To compare the above relationship between a monopolistic and oligopolistic seller, it is necessary to derive the relationship between the residual price elasticity of demand (η) and the price elasticity of total demand. As we will show, this depends on the number of firms, denoted n, competing oligopolistically.

Begin by defining residual demand:

$$D_r(p) = D(p) - S_o(p)$$

[5]For example, see any standard introductory text on industrial organisation, such as Carlton and Perloff (2015).

where $D(p)$ is total market demand, and $S_o(p)$ is the supply of other firms. Differentiating $D_r(p)$ with respect to p we have:

$$\frac{dD_r(p)}{dp} = \frac{dD(p)}{dp} - \frac{dS_o(p)}{dp}$$

Multiplying both sides by p/q, and defining Q_o as the total supply of other firms, and η_o as the elasticity of supply of those firms:

$$\begin{aligned}\frac{dD_r(p)}{dp}\frac{p}{q} &= \frac{dD(p)}{dp}\frac{p}{q} - \frac{dS_o(p)}{dp}\frac{p}{q} \\ &= \left[\frac{dD(p)}{dp}\frac{p}{Q}\right]\frac{Q}{q} - \left(\frac{dS_o(p)}{dp}\frac{p}{Q_o}\right)\frac{Q_o}{q} \\ &= \epsilon\frac{Q}{q} - \eta_o\frac{Q_o}{q} \end{aligned} \tag{2}$$

where $\epsilon \equiv \frac{dD(p)}{dp}\frac{p}{Q}$ is the price elasticity of total demand, and $\eta_o \equiv \frac{dS_o(p)}{dp}\frac{p}{Q_o}$. Observing that a given firm's residual price elasticity of demand is $\eta \equiv \frac{dD_r(p)}{dp}\frac{p}{q}$, and assuming n identical firms (so that $Q = nq$ and $Q_o = (n-1)q$), equation (2) rewrites as:

$$\eta = n\epsilon - (n-1)\eta_o$$

In the short-run the elasticity of supply can be assumed to be zero (i.e. $\eta_0 \approx 0$), in which case this relationship simplifies to:

$$\eta \approx n\epsilon \tag{3}$$

Substituting (3) into (1) we have:

$$\frac{p-c}{p} = -\frac{1}{n\epsilon}$$

Solving this for profit-maximising price p^* yields:

$$p^* = \begin{cases} \frac{\epsilon c}{\epsilon+1} & \text{In the monopoly case } (n=1) \\ \frac{n\epsilon c}{n\epsilon+1} & \text{In the oligopoly case with } n\text{sellers.} \end{cases} \tag{4}$$

Assuming all sellers face the same marginal cost of production c, denoting the profit-maximising monopoly price (in which case $n = 1$) as p^*_M, and the profit-maximising oligopolistically competitive price with n sellers as $p^*_{O(n)}$, we can write the ratio of these two prices using (4) as follows:

$$\frac{p^*_M}{p^*_{O(n)}} = \frac{n\epsilon+1}{(\epsilon+1)n} \tag{5}$$

Hence, once we know the number of oligopolistic sellers, n, all we need to determine how much extra price a collective seller would enjoy over an oligopolistically competitive seller is an estimate of the price elasticity of demand, i.e. ϵ (as discussed in the next section).

Furthermore, assuming isoelastic demand $q(p) = ap^{\epsilon}$ with constant elasticity ϵ (recalling that $\epsilon < 0$ for normal goods), the level of industry/total demand at the profit-maximising price is:

$$q^*(p^*) = \begin{cases} a\left(\frac{\epsilon c}{\epsilon+1}\right)^{\epsilon} & \text{In the monopoly case } (n=1) \\ a\left(\frac{n\epsilon c}{n\epsilon+1}\right)^{\epsilon} & \text{In the oligopoly case with } n\text{sellers.} \end{cases} \tag{6}$$

The ratio of profit-maximising monopoly land sales quantity to industry oligopoly sales is therefore:

$$\frac{q^*_M(p^*)}{q^*_{O(n)}(p^*)} = n^{-\epsilon}\left(\frac{n\epsilon+1}{\epsilon+1}\right)^{\epsilon}$$

The proportionately extra land retained under coordinated land sales is thus:

$$1 - \frac{q^*_M(p^*)}{q^*_{O(n)}(p^*)}$$

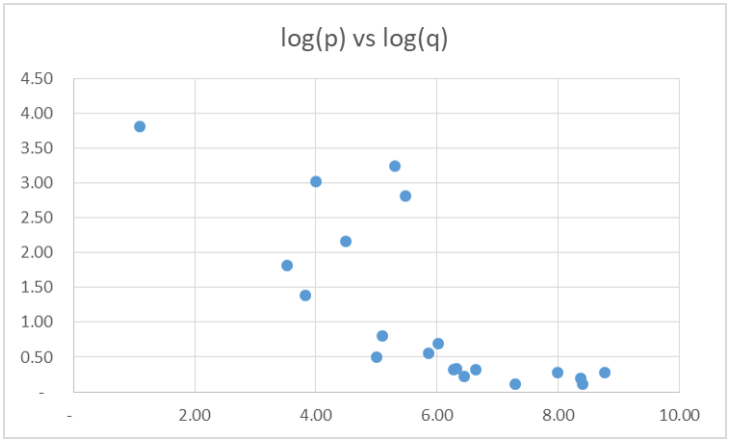
With maximised profit of seller i being $\Pi^*(p^*) = q_i(p^*)(p^* - c)$, we can derive the ratio of maximised monopoly profit (with $q_i(p^*) \equiv q^*_M(p^*)$) to maximised oligopoly profit (with $q_i(p^*) \equiv q^*_{O(n)}(p^*)/n$ assuming n symmetric sellers) using (4) and (6):

$$\frac{\Pi^*_M}{\Pi^*_{O(n)}} = n^{-\epsilon}\left(\frac{n\epsilon+1}{\epsilon+1}\right)^{\epsilon+1} \tag{7}$$

where $\Pi^*_{O(n)} = n\Pi^*_{O(n),i}$ with n symmetric oligopoly sellers. This ratio, which depends on just n and ϵ, tells us how much more profit collective land sellers would have enjoyed over sellers who were instead competing oligopolistically.

Of particular relevance to the Mahaki situation is the ten owner rule imposed under the Native Lands Act 1865 – i.e. the rule that required only 10 owners' names to be listed on titles, and allowing them to sell lands without reference to others. This implies that we can fix $n = 10$ to represent the oligopolistically competitive land sales situation, to be contrasted with the monopolistic outcome ($n = 1$) that might have been realised under effective collective land sales. Hence all that remains is to estimate ϵ when assessing the relative impacts of collectivised versus individualised sales.

Figure 1: Log Prices and Quantities from 1891 Mahaki Land Sale Auction



3 Estimated Price Elasticity of Market Demand

Data on land sales prices and volumes in Turanga in the late nineteenth century are scarce. However, Murton (2001, pp 231-232) provides data from 1891 sales, which reports the results of a (distressed) monopoly sale. Using this data, I estimate isoelastic demand as:

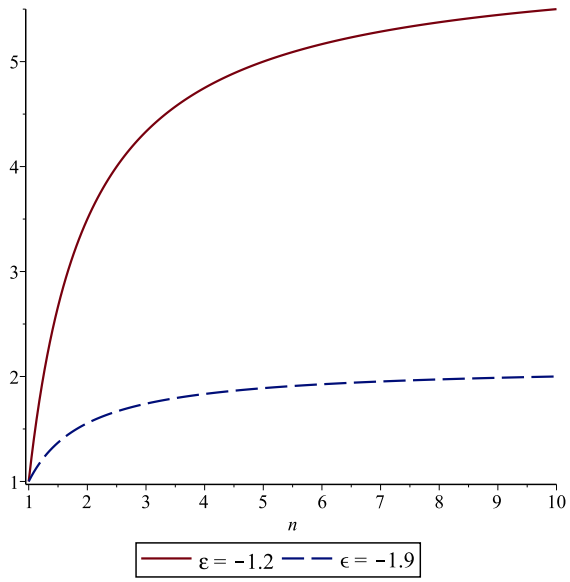
$$log(q) = \alpha + \beta log(p) + u \tag{8}$$

where q is the quantity of land demanded in acres, and p is the price per acre in pounds. Parameters to be estimated are (α, β), while u is assumed to be distributed as iid $N(0, \sigma^2)$ with variance σ^2. Since this model is expressed in logs, I can interpret β as our required percentage change in quantity for a 1% change in price – i.e. β represents our desired price elasticity of demand, ϵ.

The following figure plots the relationship between $log(q)$ and $log(p)$, showing that it is broadly linear (save for four possible "outliers"), and with a negative slope as expected:

Estimating (8) using ordinary least squares produces estimated price elasticities of $\hat{\epsilon} = -1.2$ (full sample) and $\hat{\epsilon} = -1.9$ (treating four observations as "outliers"). These estimated elasticities can be used in (5) to estimate the price premium from monopoly instead of oligopolistically competitive land sales, or in (7) to estimate the profit premium that monopoly sales would have realised.

Figure 2: Profit-Maximising Monopoly and Oligopoly Land Sale Prices, $\frac{p^*_M}{p^*_{O(n)}}$



4 Results

4.1 Price Premia Achievable under Controlled Sales

Figure 2 plots the price premium from monopoly instead of oligopolistically competitive land sales, as a function of n, for my two estimated values of ϵ. As can be seen, the ratio rises sharply as the number of sellers increases from 1 to around $4-5$, and is then relatively flat. Based on my estimated elasticities, and fixing $n = 10$, I find:

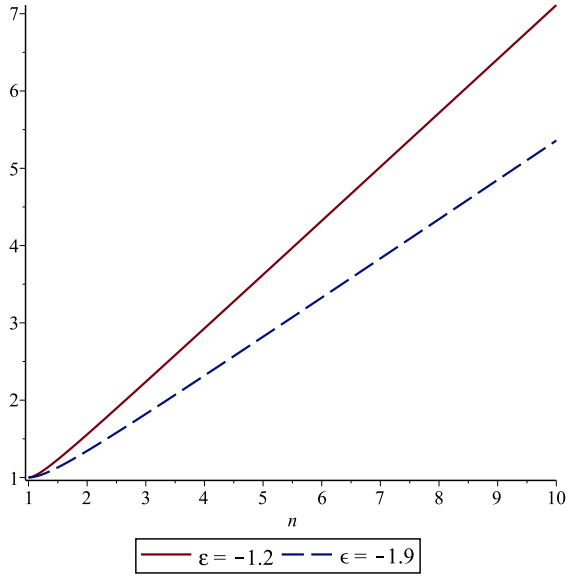
$$\frac{p^*_M}{p^*_{O(10)}} = \begin{cases} 5.5 & \text{with } \hat{\epsilon} = -1.2 \\ 2 & \text{with } \hat{\epsilon} = -1.9 \end{cases} \tag{9}$$

In other words, depending on which estimate of ϵ is relied upon, Mahaki might have been expected to enjoy land sale prices that were either double what they actually achieved with individualised titles, or up to 5.5 times that amount, had they been able to collectivise their land sales.

4.2 Relative Land Quantities Sold and Retained

With $n = 10$ and my estimated elasticities I find:

Figure 3: Maximised Monopoly and Oligopoly Land Sale Profits, $\frac{\Pi^*_M}{\Pi^*_{O(n)}}$



$$\frac{q^*_M}{q^*_{O(10)}} = \begin{cases} 13\% & \text{with } \hat{\epsilon} = -1.2 \\ 27\% & \text{with } \hat{\epsilon} = -1.9 \end{cases} \tag{10}$$

This implies that the extra land retained under collectivised sales is 73-87% of the land area actually sold under the ten owner rule. Hence, under coordinated sales Mahaki would have sold a mere fraction of the land areas that it sold under the ten owner rule, and at much higher prices as per (9).

4.3 Relative Profits under Controlled Sales

Similarly, the profits Mahaki could have enjoyed from monopolistic instead of oligopolistically competitive land sales as a function of n is shown in Figure 3.

I find that the ratio of monopolistic to oligopolistically competitive land sales profits is greater than one for all n. Specifically, under ten owner rule ($n = 10$):

$$\frac{\Pi^*_M}{\Pi^*_{O(10)}} = \begin{cases} 7.1 & \text{with } \hat{\epsilon} = -1.2 \\ 5.4 & \text{with } \hat{\epsilon} = -1.9 \end{cases} \tag{11}$$

In other words, I estimate that the total profits realisable by Mahaki under coordinated land sales would have been 5.4-7.1 times higher than what the iwi actually realised under uncoordinated sales.

5 Conclusion

This paper provides a parsimonious and tractable way to estimate the price and profit premia that Maori tribes might have enjoyed had they been able to effectively collectivise land sales instead of engaging in uncontrolled (i.e. oligopolistically competitive) sales. In particular, making standard assumptions as to profit-maximising behaviour for different levels of competition, all that is required to estimate these premia are information regarding the likely competitive intensity of land sales (represented by n) and the price elasticity of demand for land (i.e. ϵ).

Using a sample of land sales data for Mahaki, it is estimated that the iwi could have enjoyed land sale prices double or up to more than five times those they did realise, and retained up to 87% of the lands they sold (at higher prices), had they been able to collectivise those sales. Likewise, land sale profits would have been up to 7.1 times higher than realised. In each case, these ratios can be applied to estimates of actual sales prices or profits to provide an indication of the extra value Mahaki could have enjoyed if it had enjoyed greater effective control over its land sales. This approach illustrates the competitive impacts of land sales institutions, and can be used to estimate tribal losses caused by such institutions.

Arguably this approach is conservative, since it assumes oligopolistic land sellers would have chosen their land sales quantities simultaneously (i.e. a la Cournot). A more realistic approach would have been to assume a form of "Stackelberg" oligopoly, in which one landowner sells first, obtaining a first-mover advantage over later landowners. It is a well-established that this form of oligopolistic competition advantages first sellers and consumers (here, land buyers), but harms later sellers, and results in lower overall profits.[6] I leave modelling of this extension to future work.

Disclosure

This model and its results were developed in the course of preparing a brief of evidence on behalf of Te Aitanga a Mahaki for legal proceedings before the

[6] E.g. see Anderson and Engers (1992).

Waitangi Tribunal. The author received financial support from Te Aitanga a Mahaki for this work.

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