

# Competitive Implications of Land Tenure Institutions: Using Oligopoly Theory to Estimate the Impacts on Māori of Owner Limits in New Zealand’s Native Lands Acts

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Version: 18 June 2021

## Abstract

Māori tribes sold large amounts of land at low prices due to 19th century land tenure institutions in Aotearoa/New Zealand. Foremost was the 1865 Native Lands Act’s “10 owner rule”, which induced subsets of Māori landowners to competitively sell collectively-owned tribal lands rather than to maximise their value through coordinated land sales. We propose a parsimonious method for estimating the loss to Māori from the 10 owner rule as it formally and informally applied, comparing coordinated (i.e. monopoly) land sales quantities, prices and profits with those of uncoordinated (i.e. oligopolistic) sales. The ratios of these measures is shown to depend only on the number of competing sellers, and the price elasticity of land demand. The latter is estimated using 19th century land sales data for Māhaki, a Poverty Bay tribe, for which coordinated land sales would have resulted in prices up to 5.5 times higher than actual, up to 87% less land being sold, and land sales profits up to 7.1 times higher. This illustrates the competitive impacts of land tenure institutions, and is relevant for assessing the historical losses of landowners prejudiced by them.

JEL Classifications: D02, K13, L13, P48, Q15.

Keywords: Institutions, Land tenure, Owner limits, Māori, Oligopoly, Reparations.

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# 1 Introduction

Prior to the influx of European settlers in the 19th century, the indigenous Māori inhabitants of Aotearoa/New Zealand exercised their customary authority (rangatiratanga) over all of the country's 0.27m km<sup>2</sup> (66.9m acre) territory. Within just 20 years of Māori and the British Crown having signed the Treaty of Waitangi (te Tiriti, or the Treaty), in 1840, possession of 65% of the country had passed out of Māori hands, including 99.5% of the country's South Island (accounting for 56% of the country's land area), and 20% of its North Island.<sup>1</sup> As illustrated in Figure 1, by 1939, on the eve of the centenary of the Treaty's signing, 96% of Aotearoa's territory was no longer in Māori possession. Only 10% of the North Island's area, and less than 1% of the South Island's, was still in Māori possession.<sup>2</sup>

In the decades immediately following 1840, the principle means by which Māori land was acquired was through a right of pre-emption contained in the Treaty. This ensured that Māori could sell land only to the Crown, at prices which – as a matter of policy – were substantially below market value.<sup>3</sup> While this was intended to avoid exploitative land purchases by settlers, in practice it became a device used by the Crown to secure large tracts of land at below-market prices.

From 1865, large-scale land alienation by North Island Māori continued apace as a consequence of changes to Māori land tenure institutions.<sup>4</sup> In particular, a succession of Native Lands Acts were passed which, among other things, provided for ownership of collectively-owned Māori lands to be attributed to only subsets of the relevant owners – so-called “individualisation” – with the named individuals unilaterally able to sell their resulting interests. These Acts “were a response to the failure of Crown pre-emption to produce lands for settlement in sufficient volumes to meet demand.”<sup>5</sup>

A particular example of individualisation was the “10 owner rule” introduced in section 23 of the Native Lands Act 1865.<sup>6</sup> Under that rule, in

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<sup>1</sup>Figures based on data in Ward (1997, p. xxiv).

<sup>2</sup>Māori land holdings in the South Island increased marginally between 1860 and 1939 as a consequence of the South Island Landless Natives Act 1906. However, as well as being negligible, the lands allocated to Māori under this legislation also tended to be remote and of poor quality (Ward (1997, p. xx)).

<sup>3</sup>Ward (1997, pp 43-45).

<sup>4</sup>A detailed history of the relevant land tenure provisions, and associated operation of the Native Land Court created to administer them, can be found in Boast (2008), and Waitangi Tribunal (2004, Chapter 8).

<sup>5</sup>Waitangi Tribunal (2004, p. 527).

<sup>6</sup>For a history of the rule, see Waitangi Tribunal (2004, Chapter 8), or Boast and Black (2010).

Figure 1: Land Area of Aotearoa/New Zealand Retained by Māori in 1939 (Shaded Black), with Tūranganui a Kiwa District Highlighted



Source: Adapted from Figures 3 and 5 of Ward (1997).

most cases no more than 10 individual owners' names could be recorded on the title of formerly collectively-owned land. However, because owners were able to sell their interests without the approval of other tribe members, this rapidly resulted in widespread, uncontrolled and uncoordinated land alienations, with a consequential depressing effect on land sale prices. One prominent Māori academic described the Native Lands Act 1865 as being an “engine of destruction for any tribe’s tenure of land.”<sup>7</sup>

The 10 owner rule was formally abolished under the Native Lands Act 1873, which allowed for all owners' names to be recorded on land titles.<sup>8</sup> However, the intent of that later legislation was to reduce the number of owners to no more than 10 by successive subdivision of titles. Hence, in practice, the 10 owner rule continued to present a natural limit on how many individual owners could be recorded against any one land title.<sup>9</sup>

<sup>7</sup>Kāwharu (1977, p. 15).

<sup>8</sup>Waitangi Tribunal (2004, pp 398, 400).

<sup>9</sup>Waitangi Tribunal (2004, p. 440).

The aim of the Native Lands Acts was “the extinction of the native communal ownership, and the substitution of titles known to the law in lieu thereof”.<sup>10</sup> This end was achieved by various means, primarily by pitting individual landowners against each other in the process of selling lands to either the Crown, or private European buyers.<sup>11</sup> While tribes may have wished not to sell their collectively-owned lands, or to have only sold them in much smaller amounts and at much higher prices, the process of individualisation created a prisoner’s dilemma for Māori landowners. As noted in Waitangi Tribunal (2004):<sup>12</sup>

“[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 Māori landlessness).

This paper examines the impacts of such Māori land tenure institutions on a specific Māori tribe (iwi), Te Aitanga a Māhaki (Māhaki). Being one of a number of tribes based in the Tūranganui a Kiwa (Poverty Bay) district of Aotearoa/New Zealand, Māhaki is a prominent example of a tribe that in the late 19th century unwillingly sold the majority of its lands, at very low prices, due to prejudicial land tenure reforms and their implementation.<sup>13</sup>

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<sup>10</sup>Waitangi Tribunal (2004, p. 432).

<sup>11</sup>As explained in Waitangi Tribunal (2004, Chapter 8), this was often aided by ruses such as Crown purchasing agents or private buyers targeting individual sellers, or private Europeans selling goods (or alcohol) on credit to Māori buyers, and then forcing them to sell their individualised land interests in order to settle the debts.

<sup>12</sup>Waitangi Tribunal (2004) notes additional institutional defects associated with Māori land titles that also served to depress realised prices. For example (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.”

<sup>13</sup>For a detailed history, see Waitangi Tribunal (2004, Chapter 8). 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.”

Indeed, in its inquiry into Tūranganui a Kiwa district claims by local tribes against the Crown for historical breaches of the Treaty, the Waitangi Tribunal concluded:<sup>14</sup>

“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.”

More specifically, Waitangi Tribunal (2004) criticised the Crown for individualising titles, and for prejudicially frustrating Māhaki’s efforts to effectively collectivise the management of its lands (i.e. to sell lands on a more co-ordinated basis, to increase sales prices, and to reduce the amount of land sold).<sup>15</sup>

In this paper, how Māhaki might have gained from collectivised (i.e. co-ordinated) land sales – instead of competitive land sales – is modelled using oligopoly theory. More particularly, collectivised land sales are treated as producing 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).<sup>16</sup> Conversely, competitive land sales are modelled as oligopolistic selling – i.e. each seller has regard to how its own choice of sales quantity affects price, but collectively landowners 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 Māhaki to estimate the PED, it is shown that coordinated land sales could have resulted in the tribe enjoying prices up to 5.5 times higher than those realised, and up to 87% less land being sold (with retained land being more valuable by virtue of higher prices). Based on these results, Māhaki’s land sale profits are shown to potentially have been up to 7.1 times higher than realised.

From an institutional economics perspective, the form of tenure created by the Native Lands Acts represents a departure from classical institutional characterisations. A significant literature points to the importance of good institutions and secure property rights in supporting investment, and economic

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<sup>14</sup>Waitangi Tribunal (2004, p. 536).

<sup>15</sup>For example, see Waitangi Tribunal (2004, pp 509, 525-526, 535).

<sup>16</sup>This is analogous to assuming that landowners cartellise their land sales – i.e. agree to make land sales that maximise their collective profits (i.e. the monopoly outcome) rather than their individual profits.

development and performance.<sup>17</sup> Indeed, security of tenure and low trading costs are commonly held to be key features of efficient land institutions,<sup>18</sup> while extractive institutions are associated with colonisation in countries that were inhospitable to European settlers (e.g. due to high mortality rates).<sup>19</sup> The Native Lands Acts, however, represent deliberate steps to *reduce* the security of communal property rights, simultaneously lowering the transaction costs of settlers when acquiring Māori land and converting it to private ownership, while *raising* the transaction costs of Māori in defending their retention of communally-owned lands.<sup>20</sup> Such extractive behaviour arose in an environment that was relatively benign for settlers (in terms of mortality rates), and was not for the benefit of a coercive state per se. Rather, the Acts changed land tenure to facilitate colonisation through a reallocation of land from Māori to settlers, in the process lowering transaction costs and creating efficiency gains for the latter, but creating transaction and other costs for the former.

This study does not compare the relative efficiency of collective and private land ownership.<sup>21</sup> Nor does it assess the relative efficiency of land ownership by Māori and settlers. Rather, it assesses how land tenure institutions affected land sale incentives and outcomes for Māori, relative to a counterfactual in which land sales could have continued to occur, but with Māori being able to exercise greater control over such sales.<sup>22</sup>

To the best of the author’s knowledge, this is the first study of its kind, using oligopoly theory and empirical estimation to quantitatively assess the extent to which land tenure institutions may have over-induced land sales, and depressed land sale prices and profits. As well as helping to better understand the economic consequences of institutional design, this study also

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<sup>17</sup>Knack and Keefer (1995), Besley (1995), Acemoglu et al. (2001), Besley and Ghatak (2010), Acemoglu and Robinson (2013).

<sup>18</sup>For example, see Rodrik (2009).

<sup>19</sup>Acemoglu et al. (2001).

<sup>20</sup>These costs arose from survey requirements and costly/onerous Native Land Court processes for confirming titles flowing from the Native Lands Acts (e.g. see Waitangi Tribunal (2004, Chapter 8), Boast (2008)).

<sup>21</sup>Contrast, for example, Platteau (2000), Besley (1995), Besley and Ghatak (2010, section 2.3.3).

<sup>22</sup>In that sense, the relevant consideration is not the relative efficiency of different property right assignments between Māori and settlers, but rather the sustainability of collective land sales if tribe members could deviate from collusion and engage in individual sales. Since te ao Māori, the Māori world view, emphasises the importance of the wellbeing of future generations (e.g. see <https://ourlandandwater.nz/about-us/te-ao-maori/>), it is likely that Māori tribes may well have been sufficiently patient as to have been able to sustain collusive behaviour. Agents’ patience is emphasised in studies of how collusive behaviour among firms can be sustained (e.g. Belleflamme and Peitz (2010, pp 345-346)).

aids in estimating the historical losses experienced by Māori where failures or deliberate choices in such institutional design breached the Crown’s duties to Māori under the Treaty (or otherwise). Formally assessing such losses using established economic techniques can assist in assessing suitable reparations, where forums for reparation exist.

The next section derives relationships between monopoly and competitive (more specifically, oligopolistic) land sales quantities, prices and profits respectively, showing how they depend only on the number of sellers and the PED. Section 3 provides estimates of the PED for Māhaki lands in the 19th century, while Section 4 applies those estimates to show the extent to which coordinated sales could have produced higher prices and profits, and lower sales volumes, than those arising under the 10 owner rule as it formally or informally applied. 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:<sup>23</sup>

$$L \equiv \frac{p - c}{p} = -\frac{1}{\eta} \quad (1)$$

where  $p$  is price,  $c$  is the marginal cost of production, and  $\eta$  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  $L$ . This index indicates that the more price-elastic is demand (i.e. the more negative is  $\eta$ ), 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  $\eta$  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 ( $\eta$ ) and the price elasticity of total demand. As we will show, this depends on the number of firms, denoted  $n$ , competing oligopolistically.

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<sup>23</sup>For example, see any standard introductory text on industrial organisation, such as Carlton and Perloff (2015).

Begin by defining residual demand:

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

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  $\eta_o$  as the elasticity of supply of those firms:

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

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.  $\eta_o \approx 0$ ), in which case this relationship simplifies to:

$$\eta \approx n\epsilon \quad (3)$$

Substituting (3) into (1) we have:

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

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

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

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:

$$\frac{p_M^*(\epsilon, 1, c)}{p_{O(n)}^*(\epsilon, n, c)} = \frac{n\epsilon + 1}{(\epsilon + 1)n} \quad (5)$$

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.  $\epsilon$  (as discussed in the next section).

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

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

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):

$$\frac{\Pi_M^*}{\Pi_{O(n)}^*} = n^{-\epsilon} \left(\frac{n\epsilon + 1}{\epsilon + 1}\right)^{\epsilon+1} \quad (7)$$

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

Of particular relevance to the Māhaki situation is the 10 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. As discussed in Section 1, the rule was formally abandoned in 1873, but in practice the number of sellers recorded on land titles remained effectively capped at 10.

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  $\epsilon$  when assessing the relative impacts of collectivised versus individualised sales.

### 3 Estimated Price Elasticity of Market Demand

Data on land sales prices and volumes in Tūranganui a Kiwa 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, isoelastic demand is estimated as:

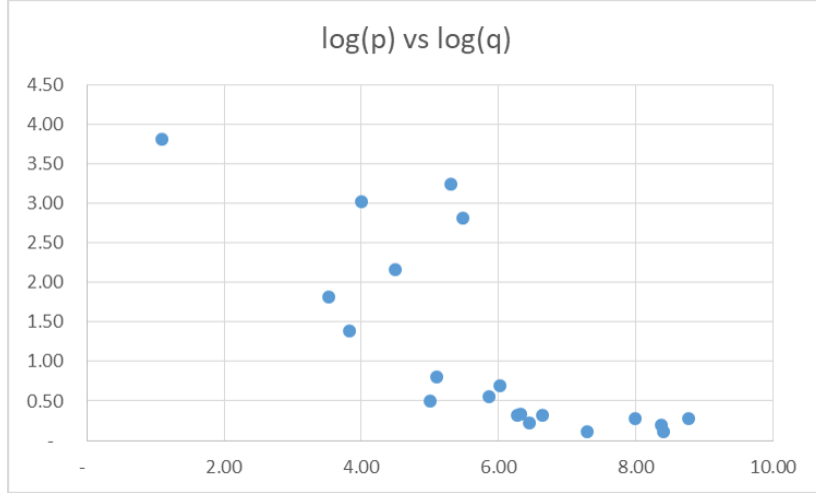
$$\log(q) = \alpha + \beta \log(p) + u \quad (8)$$

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

Figure 2 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: Log Prices and Quantities from 1891 Māhaki Land Sale Auction



## 4 Results

### 4.1 Price Premia Achievable under Controlled Sales

Figure 3 plots the price premium from monopoly instead of oligopolistically competitive land sales, as a function of  $n$ , for the two estimated values of  $\epsilon$ . 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 our estimated elasticities, and fixing  $n = 10$ , we find:

$$\frac{p_M^*}{p_{O(10)}^*} = \begin{cases} 5.5 & \text{with } \hat{\epsilon} = -1.2 \\ 2 & \text{with } \hat{\epsilon} = -1.9 \end{cases} \quad (9)$$

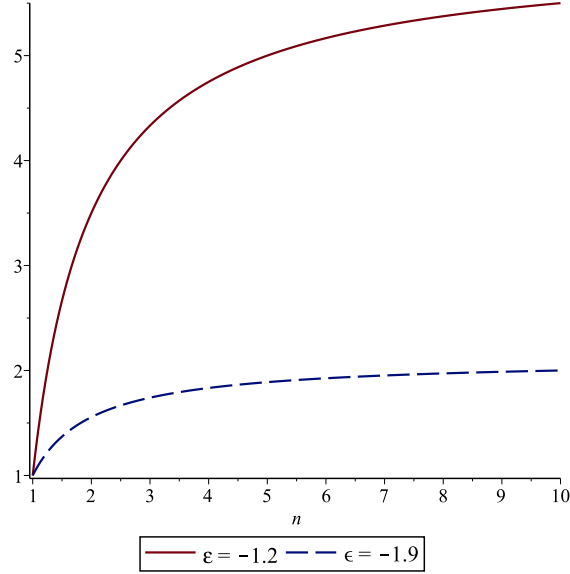
In other words, depending on which estimate of  $\epsilon$  is relied upon, Māhaki might have been expected to enjoy land sale prices that were either double those actually achieved with individualised titles, or up to 5.5 times that amount, had the tribe been able to collectivise its land sales.

### 4.2 Relative Land Quantities Sold and Retained

With  $n = 10$  and our estimated elasticities, we find:

$$\frac{q_M^*}{q_{O(10)}^*} = \begin{cases} 13\% & \text{with } \hat{\epsilon} = -1.2 \\ 27\% & \text{with } \hat{\epsilon} = -1.9 \end{cases} \quad (10)$$

Figure 3: Profit-Maximising Monopoly and Oligopoly Land Sale Prices,  $\frac{P_M^*}{P_{O(n)}^*}$



This implies that the extra land retained under collectivised sales is 73-87% of the land area actually sold under the 10 owner rule. Hence, with coordinated sales Māhaki would have sold just a fraction of the land areas that it sold under the 10 owner rule, and at much higher prices as per (9).

### 4.3 Relative Profits under Controlled Sales

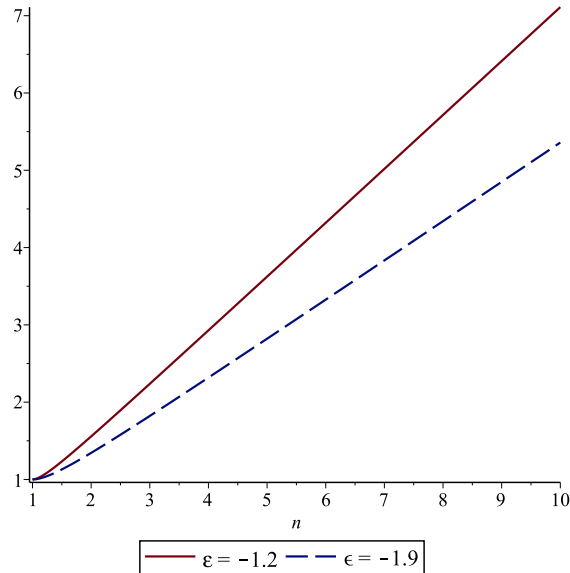
Similarly, the profits Māhaki could have enjoyed from monopolistic instead of oligopolistically competitive land sales as a function of  $n$  is shown in Figure 4.

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

$$\frac{\Pi_M^*}{\Pi_{O(10)}^*} = \begin{cases} 7.1 & \text{with } \hat{\epsilon} = -1.2 \\ 5.4 & \text{with } \hat{\epsilon} = -1.9 \end{cases} \quad (11)$$

In other words, the total profits realisable by Māhaki under coordinated land sales are estimated to have been 5.4-7.1 times higher than what the tribe actually realised under uncoordinated sales.

Figure 4: Maximised Monopoly and Oligopoly Land Sale Profits,  $\frac{\Pi_M^*}{\Pi_{O(n)}^*}$



## 5 Conclusion

This paper provides a parsimonious and tractable way to estimate the price and profit premia that Māori tribes like Māhaki might have enjoyed had they been able to effectively collectivise land sales. This is relative to tribes engaging in uncontrolled (i.e. oligopolistically competitive) sales as a consequence of Māori land tenure institutions in Aotearoa/New Zealand – i.e. a succession of Native Lands Acts, and the associated 10 owner rule that formally or informally operated in the 19th century. In particular, making standard assumptions as to profit-maximising behaviour for different levels of competition, all that is required to estimate these premia is information regarding the likely competitive intensity of land sales (represented by  $n$ ) and the price elasticity of demand for land (i.e.  $\epsilon$ ).

Using a sample of 19th century land sales data for the Poverty Bay district, it is estimated that local tribe Māhaki could have enjoyed land sale prices double or up to more than five times those actually realised, and retained up to 87% of the lands sold (at higher prices), had the tribe 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 outcomes Māhaki could have enjoyed had it enjoyed greater effective control over its land sales. This illustrates the competitive impacts of land

tenure institutions, and can be used to estimate landowners losses caused by prejudicial features of such institutions. Such loss estimates are relevant to questions of reparations, should forums for reparations exist.

The approach in this study is likely to be conservative – i.e. understates the gains to collectivisation – since it assumes oligopolistic land sellers would have chosen their sales quantities simultaneously (i.e. a la Cournot). A more realistic approach, based on the historical record in Waitangi Tribunal (2004, Chapter 8), would have been to assume a form of Stackelberg oligopoly, in which one landowner sells first, obtaining a first-mover advantage over later selling landowners. It is 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.<sup>24</sup> Modelling of this extension is left to future work, as is an analysis of the wider impacts of Aotearoa/New Zealand’s Native Lands Acts.

## Acknowledgement

This model and its results were developed in the course of preparing a brief of evidence commissioned by Te Aitanga a Māhaki for legal proceedings before the Waitangi Tribunal. The author gratefully acknowledges financial support from Te Aitanga a Māhaki for this work. The views expressed herein represent those of the author, and are not necessarily those of Te Aitanga a Māhaki.

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<sup>24</sup>E.g. see Anderson and Engers (1992).

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