Does tenure review in New Zealand's South Island give rise to rents?*

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Abstract.

Under "tenure review," a New Zealand pastoral lessee surrenders part of his leasehold to conservation and acquires a freehold interest in the remainder. 28 new freeholders paid the Crown $6.9 million for freehold rights to 101,752ha, then sold 46% of that land for $135.7 million. We model tenure review as a sequential real option – first to acquire freehold, then to subdivide and sell all or part of their new freeholds. We find little evidence that the Crown accounted for these option values when negotiating tenure review, and conclude that the capital gains enjoyed by former lessees are rents.

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I. Background.

In 1990, about 20% of the South Island of New Zealand consisted of Crown land leased to pastoral farmers. Crown pastoral leases are an old and controversial feature of the South Island landscape (Stewart 1909). Current leases have 33 year terms and are perpetually renewable, as per the Land Act 1948. Leases are alienable, with the Crown's permission. However, a pastoral lessee may alienate but not subdivide. Moreover, the lessee must obtain Crown consent for any use of his leasehold other than extensive pastoralism.

Since 1992, a pastoral lessee can apply to acquire a freehold interest in part of his leasehold, if he agrees to cede the balance of his leasehold to public conservation land. The resulting land reform transaction is called "tenure review." Under tenure review, the Crown sells its residual ownership interest in the part of the leasehold "capable of economic use,"[1] and buys the lessee's interest in the part deemed to have conservation or recreation value. As such, a tenure review deal consists of two distinct but coincident sales.

The formal structure of bargaining is the same for each tenure review deal. Only the lessee may bid and negotiate with the Crown to purchase freehold ownership. A New Zealand government agency called Land Information New Zealand (LINZ) administers the process, and takes advice from the Department of Conservation (DOC), the Fish and Game Councils of New Zealand, and Maori *iwi* on how the land is to be divided. LINZ officials do not negotiate directly with lessees. Instead, LINZ retains contractors to bargain on its behalf. Contractors' compensation does not vary with the terms of the deal agreed to. Instead the contractor is compensated for completing tasks on a check-list, with the final payment made when the deal is closed. LINZ employs a professional valuer to estimate the values of the Crown's and lessee's residual interest in a leasehold that has entered tenure review. Nevertheless, the Crown sets no reserve price on its residual interest in a leasehold. Moreover, LINZ instructs its contractors to maintain a neutral stance in negotiations, advising them that "money should not stand in the way of a deal."[2] Before August 2006, the financial terms of all tenure review deals were known only to the lessees, the contractors involved, and a few LINZ officials.[3]

II. Tenure review as a real option.

The owner of an *option* has the right, but not the obligation, to undertake some specified economic action (Dixit and Pindyck 1994: chpt. 1), either at any future time or on or before some future date. If the action is performed, the option is *exercised* and the option expires. Exercising an option may require time, money, and other resources in addition to the cost of acquiring the option; the *exercise price* is the monetary value of these resources. A time-limited option can expire unexercised.

A *real option* is an option to undertake a real investment, defined as an outlay of resources that might yield an economic benefit in at least one future period. Unlike financial options, a real option is not traded in a financial market and usually has an unspecified duration. Real options may be

bought and sold, and may be created, destroyed, and transferred by public policy. For example, a new restriction on land use can extinguish options for landowners (Dixit and Pindyck 1994: §12.3), and constitute a compensable taking (e.g. *Lucas v South Carolina Coastal Council*). Conversely, removing a land use restriction from a parcel of land transfers the option to develop it from the public sector to those who freehold it.

Pastoral lessees in effect hold two valuable real options (hereinafter simply "option"). The first is the option to acquire freehold, created by the tenure review policy and retroactively legalised by the Crown Pastoral Land Act 1998. The second option, which is conditional on the prior exercise of the first, is the option any freeholder has to vary the economic use of his land, including subdividing it.

If the values of these options are underestimated, tenure review will give rise to a type of windfall gains or economic profits known as *rents*. Rents should not to be confused with *rental*, the periodic monetary payment a lessee makes to his landlord under the terms of his lease. Rents encourage inefficient rent-seeking, and the way they are distributed across households can exacerbate income inequality. On rents and rent seeking, see Katz and Rosen (1994: 657-663).

We now restate this logic more formally. Let the value of the lessee's and the Crown's interest in a pastoral leasehold be I_L and I_C, respectively. I_L includes the value of all land improvements, including roads, fences, lessee's residence, sheds, and fertiliser.[4] Prior to the advent of tenure review in 1992, the market value of a leasehold, $V_{<92}$, was:

$$V_{<92} = I_L + I_C.$$

With the advent of tenure review in 1992, the lessee acquired the option to obtain freehold title to some part of his leasehold. Let F_{FH} be the value of a lessee's option to acquire a freehold interest in part of his leasehold by going through tenure review. Starting in 1992, the market value of a leasehold in course became:

$$V_{\geq 92} = I_L + I_C + F_{FH}.$$

With the completion of tenure review, the former lessee becomes a freeholder, and like any other freeholder, he has the option to sell all or part of his land. Let the value of this option be F_{OS}. Henceforth, let I_L and I_C pertain only to the portion of the leasehold going into freehold. The value of a freehold, V_{FH}, is then defined as:

$$V_{FH} = I_L + I_C + F_{OS}.$$

Hence in a world with tenure review, pastoral lessees face a *compound* or *sequential* option (Dixit and Pindyck 1994: §10.1.A).[5] The two options are intimately related, in that a large part of the value of the option to freehold, F_{FH}, derives from the value of the freeholder's option to onsell and subdivide, F_{OS}.

We obtained, under the terms of the Official Information Act 1982, copies of the valuation reports commissioned by LINZ and containing estimates of $V_{\geq 92}$ and V_{FH}. In only four out of 77 tenure review deals did these valuation reports find material value above and beyond that arising from

pastoral farming; Table 4 gives particulars for the four exceptions. Hence the Crown usually bargained with farmers as if F_{OS} were zero.

The lower the exercise price, the more valuable the option (Dixit and Pindyck 1994). The exercise price of the option to freehold, E_{FH}, is the lessee's costs of going through tenure review, which includes I_C, the notional price the Crown charges the lessee for acquiring the freehold. The exercise price of the option to subdivide and/or to vary the land use can be substantial, depending on the extent of subdivision and the applicable district plan rules. E_{OS} includes the legal costs of obtaining council consent, and any required improvements to roading, electricity, water, and sewerage. While both E_{FH} and E_{OS} are nonnegative, E_{OS} is modest if the freehold is sold without subdividing.

We now illustrate these concepts with an example. In 2006, the Crown completed a tenure review deal for the Richmond Station on the northeast shore of Lake Tekapo. The valuation report divided Richmond Station into zones, one of which comprised 540 hectares and 9km of Lake Tekapo shoreline. The report asserted that the "highest and best use" of those 540 hectares was "very definitely" deer farming, and estimated the value of the freehold owner's option to vary land use (F_{OS} in the notation of this paper) to be \$42,200, or \$78 per hectare.[6] In 2006, the senior planner for the Mackenzie District that includes the Richmond Station, reported that the district has no minimum lot size; hence consent to subdivide is perfunctory, and thus E_{OS} is low.[7] Indeed, in 2008 the council approved a residential subdivision for the Richmond shoreline without public consultation.[8]

III. Empirical Set-up.

III.1. The main hypothesis linking prices, rents, and parcel size.

We hypothesize that under-valuing, or failing to value, F_{OS} will give rise to rents enjoyed by the former lessee. Let P_{OS} be the price per hectare obtained when a new freeholder sells some part of his freehold. Let P_F be the price per hectare the new freeholder paid under tenure review to purchase the Crown's interest in the land to be privatised.[9] The ratio P_{OS}/P_F measures the realised capital gain enjoyed by a lessee who has completed tenure review. This capital gain also includes any rent enjoyed by the new freeholder as a result of having gone through tenure review.

We further hypothesise that P_{OS}/P_F will be negatively correlated with the size of the onsold parcel.[10] P_{OS}/P_F therefore is also an increasing function of the cost of subdivision E_{OS}, with E_{OS} being negatively correlated with parcel size, and attaining a minimum when there is no subdivision. Hence the Crown's omission of F_{OS} when calculating what to charge for the freehold, results in larger values of P_{OS}/P_F, the greater the extent of subdivision. Hence P_{OS}/P_F is most likely to be entirely rent-driven when the freeholder sells his entire farm.

III.2. The variables.

Unless otherwise indicated, the source for all data on parcels onsold is Quotable Value New Zealand (QVNZ). The dependent variable is $\ln(P_{OS}/P_F)$. This variable and *Size* are logged because Figure 1 strongly suggests that the relation between these two variables is linear in logs.

We propose the following four explanatory variables:

ln*Size*   = log of the size of an onsold parcel, in hectares;

Location   = 1 if the leasehold out of which the parcel was carved lies within 10km of Queenstown or Wanaka, and/or within sight of Lakes Hawea, Pukaki, Tekapo, Wakatipu, or Wanaka; = 0 otherwise;

%Sold   = Fraction of the new freehold onsold as of mid-2008, when the dataset for this paper was put together.

Time elapsed = Years elapsed between completion of tenure review (as per LINZ data discussed in Brower et al. 2010) and the date of subsequent onsale. Only the year a tenure review deal was completed is known. Hence when constructing this variable, we arbitrarily assumed that tenure review was completed as of 1 January of the given year.

The size of a land parcel carved out of a privatised leasehold is indicative of the use to which the buyer proposes to put the land. Specifically, the smaller the parcel, the more intensive the contemplated land use, and the higher the market price the parcel can command. Stillman (2005) found that extensive pastoralism is the least valuable use of New Zealand rural land, which is 2.5 to 14 times less valuable than other rural land uses such as horticulture, viticulture, and dairy. Hence a small to medium size parcel suggests a major departure from extensive pastoral land use; thus parcel size is our operational measure of land use change. Higher value uses (e.g., lifestyle blocks, viticulture, lakefront sections) are correlated with smaller parcels. Hence a small parcel will command a higher price per hectare than a large one, and we predict that the estimated coefficient on ln*Size* will be negative.

Characteristics associated with *Location* give rise to amenity values and hence higher market prices. We predict that the estimated coefficient on *Location* will be positive. In the scatterplot in Figure 1, parcels with *Location* = 0 are plotted with triangles, while parcels with *Location* = 1 are plotted with circles. A positive coefficient on *Location* suggests LINZ undervalued location amenities, which would give rise to rents. The value of *Location* pertains to the entire freehold and not to any specific parcel carved out of it. *%Sold* is a proxy for the extent of *cherry picking*, as discussed in section V.1. We expect the estimated coefficient on this variable to be negative.

The estimated coefficient on *Time elapsed* measures the capital gain a new freeholder enjoys due to the rise in price of all rural land over the period 1992-2009, and because he is entitled to a fair return on the money he spent on acquiring freehold. We predict that the estimated coefficient on *Time elapsed* will be positive, and have a value similar to New Zealand dollar long-term interest rates. Any part of $\ln(P_{OS}/P_F)$ explained by *Time elapsed* is not rent.

III.3. Data limitations.

We obtained market prices for 186 parcels carved out of former pastoral leaseholds. We removed eight parcels from the sample because they were carved out of four pastoral leaseholds which completed tenure review but for which LINZ has no records. In three of these four cases, P_F cannot be calculated. The result is a final sample of 178. In one case, Hillend station on the outskirts of Wanaka, one buyer bought a parcel of 2443ha out of the 2659ha privatised. The Queenstown Lakes

District Council has granted consent for this large parcel to be subdivided into 25 to 45 parcels.[11] Ideally, this should have increased our sample by 25 to 45 data points, but only a single aggregate sale was recorded.

It should be noted also that the Crown reports of number of hectares privatised in each lease are not reliably accurate to the single digit. In many if not most cases, the reported estimate of number of hectares privatised did not rely on a precise survey. Frequently, DOC, LINZ, and QVNZ disagreed on how much land was privatised, but the discrepancy rarely exceeded 50ha. For example, a single section was sold from Mataura Valley, measuring 4357ha, while LINZ reported only 4322ha had been privatised. While it is likely that 4357ha is more accurate than 4322ha, we have remained faithful to the area data reported by LINZ.

The hectares onsold values are more accurate, as they do rely on a precise survey. In order to account for these discrepancies and make the data reported in this paper as accurate as possible, we employed Geographic Information Systems (GIS) to overlay the spatial data reported by QVNZ on top of LINZ data on the area privatised. At Mataura Valley, this overlaying procedure did not uncover any obvious errors. But in other leases, where overlaying QVNZ data on top of LINZ data revealed discrepancies, and we discarded data for onsold parcels whose QVNZ boundaries were outside the LINZ-reported boundaries of the original lease.

Another flaw in the LINZ data is, of course, the four tenure review deals for which we found: 1) evidence of a pastoral lease on maps and in GIS data; 2) onsale prices for sections carved out of the privatised portion of the former leasehold; 3) documentation in DOC files; but 4) no or incomplete records from LINZ of a tenure review settlement. We have included these four missing deals in Table 2, but not in the samples for the estimated regressions reported in section IV. For Raglan Run, we lack only the date when the deal was finalised and the price the Crown paid for the lessee's interest. But because LINZ has no record of Raglan Run, we did not include it in the regression sample. However, we did include it Table 2a, which collects together all cases in which the former lessee sold his entire freehold in a single transaction.

%*Sold* is calculated as of mid-2008, when the data for this paper were put together. Based on conversations with property sales offices, and a perusal of web advertisements, we conclude that few parcels, if any, have onsold since then, probably because of the ongoing depression in the New Zealand property market.

IV. Empirical findings.

Table 1 gives the size distribution of all 825 parcels carved out to date of former leaseholds privatised through tenure review. Eight parcels were discarded for reasons reported in section III.3, and 639 parcels have yet to be sold.[12] The remaining 178 onsold parcels, with an aggregate area of 47,110ha, comprise the core data of this paper. They were carved out of 28 of the 77 leaseholds that completed tenure review during 1992-2008. These 28 new freeholders paid the Crown $6.9 million for the right to freehold 101,752ha, then realised $135.7 million by selling 46% of their land. Table 2 breaks down these data by former leasehold.

The estimated regressions are reported in Table 3. The only regression to include all 178 data points is (5), which revealed two residual outliers, with standardised values of –3.54 and –4.51.[13] Deleting these two outliers yields the sample used to estimate regressions (1)–(4). The coefficients on ln*Size* are estimated precisely, and range from –0.71 to –0.73. The vast part of the explanatory power of these regressions is due to ln*Size* alone; regression (1) with the single variable ln*Size* has an $\bar{R}^2$ of 0.804. The estimated coefficients on *Location* and *Time elapsed* in (2) and (3) were also significant, and their values were as hypothesised. However, the incremental effect of these variables on $\bar{R}^2$ did not exceed 0.023. The estimated coefficients on %*Sold* in (4) and (5) failed to attain significance.

V. Discussion.

P_{OS}/P_F ranges from 1.8 to 27,096, with a median value of 992. We submit that this large implied capital gain is consistent with a former lessee enjoying a substantial rent as a result of having gone through tenure review.

V.1. Subdivision, cherry picking, and rents.

The results reveal a strong negative correlation between the size of an onsold parcel and the capital gain realised when it is sold, suggesting that subdivision could be the main driver of rents. It also suggests that the price of land onsold to date may be unrepresentative of the average price of land privatised in tenure review, because runholders will onsell the most valuable land first, a situation we call *cherry picking*. Cherry picking would result in P_{OS} exceeding P_F for small but more valuable parcels. Hence a negative coefficient on ln*Size* by itself does not necessarily indicate the presence of rent, but could result if freeholders sell the most valuable parcels first.

There are nine freeholds where cherry picking cannot apply, because as of mid-2008, the new freeholder has sold most or all of his new freehold. These nine freeholds include four from Table 2a (Raglan Run excepted), where the entire farm was sold in one transaction, plus five former freeholds in Table 2 (Cairnmuir, Earnscleugh, Glencreagh, Hillend, and Wentworth) where the new freeholder sold 90% or more of his freehold in two or more transactions. These nine new freeholders sold more than just the cherries. Hence the average value of P_{OS}/P_F for parcels carved out of those nine leaseholds should be lower than the overall mean. Likewise, we would expect that low values of %*Sold* are indicative of cherry picking. Hence the estimated coefficient on %*Sold* should be negative. But in fact, that coefficient in Table 3 was positive as well as insignificant.

In these nine cases, any capital gain in excess of the costs of going through tenure review is a rent, because E_{OS} is likely to be small. In the five cases in Table 2a (which includes Raglan Run, excluded from the regressions), P_{OS}/P_F ranged from 7 to 54, and the former lessees netted $16.5 million in aggregate capital gains. Hence tenure review can give rise to substantial rents even in the absence of subdivision.

There are other, simpler, facts inconsistent with cherry picking. Cherry picking cannot explain why the total proceeds from selling part of a freehold can exceed what the Crown charged to privatise the entire freehold, as is the case for all former leaseholds but Woodbine. At Woodbine, the lessee

paid $110K to acquire the freehold, then sold one 0.1ha parcel for $100K. In all other cases, the proceeds from onselling part (Col. 4, Table 2) of a freehold exceeded the cost of purchasing the whole freehold (Col. 2, Table 2).

V.2. Rival explanations.

Two sets of explanations have been advanced for why the values of P_{OS}/P_F are as large as they are. The High Country Accord, an advocacy group for pastoral lessees, proposes to explain the discrepancy between P_{OS} and P_F by:

1a) Tenure review does not grant the right to subdivide, but only the option to apply to subdivide;

1b) The time, cost, and uncertain outcome of applying for consent to subdivide;

1c) The boom in rural land prices, 2000-08;

1d) Pastoral leasing being nearly equivalent to ownership, so lessees owned over 90% of the value of the land at the outset.[14]

Table 2a shows that profits from onselling can be substantial even without subdividing, hence countering proposed explanations (1a) and (1b). Regression (3) reveals that *Time elapsed* has an estimated coefficient is 0.08. This estimate is consistent with an average yield of 6.65% on 10 year New Zealand government bonds.[15] A value of 0.08 is too small to be consistent with any of (1a)-(1c). More specifically, if (1c) were the case, the estimated coefficient on *Time elapsed* would clearly exceed the time value of money.

If (1d) were true, then the lessees' ownership interest, expressed as a percent of the capital value of the land, should be consistent across leases, because the same statutes govern all leases. One would thus expect the P_{OS}/P_F in Figure 1 to cluster around a value indicative of the lessees' property interest the land. In fact, the P_{OS}/P_F range over five orders of magnitude, ruling out any possible clustering of this nature.

LINZ proposed the following explanations for the capital gains:

2a) F_{OS} was minimal when most tenure reviews were completed;

2b) LINZ relied on expert valuation advice to obtain $V_{\geq 92}$ and V_{FH};

2c) LINZ concedes that tenure review appraisals conducted before the CPLA 1998 took effect, failed to take into account the option to vary land use and subdivide. However, LINZ denies that this was the case for appraisals conducted after 1998;[16]

2d) An independent report (Armstrong et al. 2005) concluded that tenure review prices were "fair" because both Crown and lessee agreed to all aspects of the deals.

(2a), (2b) and (2c) assume that after 1998, valuers retained by the Crown took into account the option value of subdivision. However, in all tenure review deals but the four shown in Table 4, the valuation reports made no mention of subdivision potential. Of these four deals, only Alphaburn

(on the outskirts of Wanaka on the shoreline) has onsold any part to date. The valuer estimated F_{OS} for Alphaburn to be worth \$3 million for the entire 3365ha privatised. Nevertheless, the Crown sold its interest (worth I_C) to the lessee for \$365,500. Less than one year after privatization, the new freeholder sold 193ha, 6% of the new freehold, for \$10.1 million. Hence even in the rare cases when assumptions (2a)-(2c) are correct, the Crown sold its interest for between two and ten times less than what the valuer estimated.

(2d) implicitly assumes that the only parties with an interest in tenure review outcomes are those at the bargaining table, namely the Crown negotiating agent and the lessee. In effect, this assumes away any public interest in Crown land, and ignores any interests of taxpayers such as recreational uses, ecosystem services, and other values. Furthermore, Brower (2008: 48-59) found that Crown negotiating agents were instructed by their LINZ principals to remain neutral when bargaining, and to not advocate for conservation, recreation, or the Crown financial interest. Thus the assumption that a lessee and a Crown agent alone can reach an efficient, Pareto optimal, or fair agreement is questionable (Brower 2008: 140-141; Ellickson 1991).

There is one further possible explanation for the large values of P_{OS}/P_F: a high P_{OS} merely serves to reimburse the developer for the high exercise price of both real options. If V_{OS} is the sum of the sale prices of sections carved out of a privatised pastoral lease (Table 2, column 4),[17] then a counter to our rent hypothesis would be that the exercise price equals or exceeds the total capital gains, or $E_{OS}+E_{FH} \geq V_{OS}-V_{\geq 92} = \$129$ million. This is unlikely because even for the five cases in Table 2a, where E_{OS} can be assumed negligible and E_{FH} is a sunk cost, the capital gain $V_{OS}-V_{\geq 92}$ was \$16.5 million. In any event, it is not incumbent on the Crown to assure that lessees recoup E_{FH}, because tenure review occurs only at the request of the lessee.

The explanations proposed by the High Country Accord, LINZ, and us, all fail to explain the size of the capital gains arising from onselling all or part of a former pastoral leasehold. Hence we are unable to reject our hypothesis that tenure review gives rise to rents.

V.3. Equity, efficiency, and rent-seeking.

As large discrepancies between P_{OS} and P_F are consistent with erstwhile lessees' enjoying large rents after tenure review, we now examine possible problems stemming from large rents. Rents give rise to questions of equity and efficiency. These rents might not be inefficient because abolishing pastoral leases abolishes severe restrictions on the possible economic uses for the land, which could result in greatly increased output. The question then becomes how the benefits from this increased output should be divided between the Crown and the new freeholder. But these rents could raise the cost to the Crown of implementing tenure review. Rents cause F_{FH} to be positive, and risk inflating $V_{\geq 92}$ substantially. The latter raises the cost to the Crown of acquiring land under pastoral lease to add to the conservation estate.

Furthermore, conferring rents to former lessees encourages lessees to engage in rent seeking, inefficient by definition (Krueger 1974). Rent seeking can also be detrimental to conservation values. Lueck and Jeffrey (2003) describe how landowners can engage in rent seeking by deliberately destroying conservation value on their land, and thus evading land use restrictions arising from the USA Endangered Species Act (1973). Pastoral lessees face similar incentives to clear native bush,

or otherwise "improve" leasehold land, in order to strip it of conservation value and thus make it suitable for privatization.[18]

VI. Conclusion.

Following tenure review, 28 new freeholders paid the Crown $6.9 million for freehold rights to 101,752ha. They then sold 46% of that land for $135.7 million. The resulting aggregate capital gain of $128.8 million raises the question of whether the Crown sold the freehold rights too cheaply, thus conferring rents on the new freeholders. To answer this question, we modeled tenure review as a sequential option – first to acquire freehold, and then to onsell one's land, possibly after subdividing it.

We use the ratio of the prices (per hectare) former lessees received when they onsold part of their new freeholds, P_{OS}, to the price at which the Crown sold the freehold to the lessee, P_F, as a proxy for rents. Consistent with parcel size resulting directly from subdivision and indirectly from expected variation in land use, we found a strong, negative correlation between the *Size* of an onsold parcel and rents per hectare. Regressing $\ln(P_{OS}/P_F)$ on $\ln Size$ alone yields an $\bar{R}^2$ of 0.804.

We found little evidence that the Crown adequately valued this subdivision potential. In fact, in only four of 77 deals did the Crown valuer place any value whatsoever on subdivision. And in those four deals, the Crown sold its interest for between 9% and 48% of what the valuer estimated for subdivision alone, notwithstanding farming and other values.

We similarly found little evidence that the exercise price of the option to subdivide explains the capital gains observed. In the five cases when no subdivision occurred and the entire freehold was sold, the aggregate proceeds from sale were nearly 20 times what the former lessees had paid to acquire freehold, resulting in an aggregate capital gain of $16.5 million. Finally we considered, and rejected, several other non-rent explanations for the capital gains, then looked at problems of equity and efficiency posed by these rents and the rent-seeking to which they give rise.
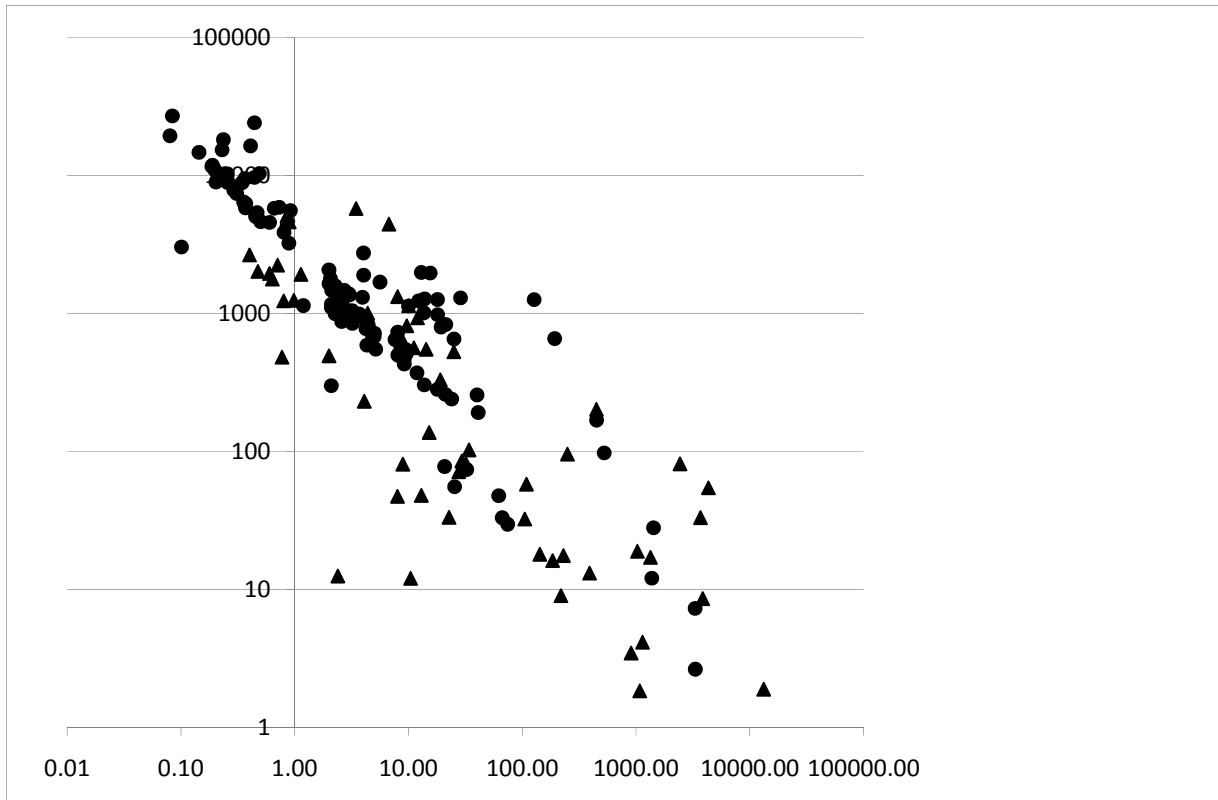
Endnotes.

1. Crown Pastoral Land Act 1998, section 24(a)(2).

2. LINZ contractor quoted in Brower *et al*. (2010: 470).

3. For more on the institutions and other aspects of tenure review, see Brower *et al*. (2010).

4. Land improvements rarely, if ever, change hands in a tenure review deal, because the CPLA stipulates that land capable of economic development be privatised, and land with conservation values goes to conservation (CPLA 1998: § 24(a)). Land with improvements is assumed to be land capable of economic development, and improvements usually destroy any conservation value. The result has been that improved land almost always ends up as freehold.

5. Assuming that the price of freehold land follows a geometric Brownian motion, F_{OS} and F_{FH} correspond, respectively, to equations (10) and (17) on pp. 324-325 of Dixit and Pindyck (1994).

6. Letter "Regarding Valuation for Tenure Review – Pt. 087 Richmond Station pastoral lease," from Quotable Value Tenure Review Team Leader to LINZ, April 26, 2005. At pages 12, 13, and 16. Document released under Official Information Act 1982.

7. Hayley Shearer, Mackenzie District senior planner, quoted in Mike White "High Country Hijack," *North & South,* August 2006. At page 45.

8. Emma Bailey. "Council allows new subdivision for Tekapo," *Timaru Herald,* 19 July 2008.

9. The data for P_F are from LINZ and are described in Brower et al. (2010).

10. Thorsnes and McMillen (1998) document this correlation in an urban context.

11. NZPA. "Sam Morgan buys Wanaka station for $25m-plus," *Otago Daily Times*, 23 October 2008.

12. For web advertisements of some of these parcels see for example: http://queenstown.nzsothebysrealty.com/queenstown-real-estate-listings/?Category=QueenstownStations .

13. Each of these outliers corresponds to a single parcel carved out of the former Glenroy and Halwyn pastoral leases. For these transactions, $P_{OS}/P_F = 12$, which is unaccountably small given that the parcels in question were only 12ha apiece.

14. Geoffrey Thomson, "High Country Report Flawed," *The Press*, March 8, 2006. This was an opinion piece by the then chair of the High Country Accord, taking exception to Brower (2006). This is also the view of the current Chair of the High Country Accord, Jonathan Wallis, as quoted in Ben Heather, "Farmers deny rip-off over tenure review land deals," *The Press*, 22 Feb 2010.

15. This number is the yield, calculated from prices on the secondary market, on a benchmark New Zealand government bond, averaged from the start of 1992 to the end of 2009. The benchmark government bond has at least 10 years to maturity at the time of issue, and at least 8 years to maturity at the time the yield is calculated. (Reserve Bank of New Zealand, http://www.rbnz.govt.nz/statistics/exandint/b2/download.html).

16. LINZ pastoral manager, Mathew Clark, quoted in Ben Heather. "Farmers deny rip-off over tenure review land deals," *The Press*, 22 Feb 2010.

17. Values of V_{OS} are shown in column (4) in Tables 2 and 2a.

18. Donald Aubrey, then High Country Chair of Federated Farmers, said that charging higher rents for environmental amenities and conservation values is "a clear disincentive for responsible environmental care" in: Staff, "Rents Could Rise, High Country," *Otago Daily Times,* October 14, 2006.

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Figure 1.

Effect of Size of Onsold Parcel on Price Appreciation.

Horizontal axis: Size of onsold parcel, in hectares.

Vertical axis: P_{OS}/P_F.

Plot markers:

▲:   *Location* = 0.

●:   *Location* = 1.

Note. Sample size is 178. Logs are base 10 for easier reading. *Location* = 1 if the parcel is situated ≤10km from a lake, Queenstown, or Wanaka; otherwise, *Location* = 0.

Table 1. Size distribution of parcels carved out of land privatised under tenure review.						
Size range of parcels (ha)	*Total parcels*	*# parcels sold*	*Total ha sold*	*Aggregate sales proceeds*	*Average price/ha*	*Notes*
≤1	118	50	25.4	$21,474,000	$846,880	
1.01−10	211	62	282.7	$20,285,979	$71,760	Average includes two outliers.
10.01−50	192	42	879.5	$15,988,900	$18,180	
50−100	44	3	203.3	$485,000	$2,386	
100−500	130	13	3235	$24,067,000	$7,440	
500−1000	37	2	1432.5	$2,701,000	$1,886	
>1000	93	14	43493	$54,221,000	$1,328	Includes 30-40 Hillend parcels sold as a unit.
>1000	92	13	40828	$29,221,000	$672	Excludes Hillend parcels.
Note. Includes sections carved out of Leatham, Mt. Dewar, Raglan Run, and Whitcomb, tenure review deals recorded by the DOC but not by LINZ; see Table 2a.						

Name of Former Leasehold	Hectares Privatised (1)	Total Paid for Freehold (2)	Hectares Onsold (3)	Total Price Paid for Onsold Land (4)	# Parcels Onsold	(4)÷(3) (2)÷(1)
Table 2: Data broken down by former leasehold.						
Privatisations for which LINZ has records.						
Leasehold includes a lake view, or lies within 10km of Queenstown or Wanaka.						
Alphaburn	3365	$267,500	193.00	$10,100,000	1	658.24
Bendigo	8727	$172,500	625.23	$4,685,000	13	379.07
Closeburn	930	$199,889	13.53	$17,696,000	25	6090.22
Cone Peak	2181	$350,000	40.00	$1,650,000	1	257.03
Eastburn Waitiri	5910	$535,000	1809.91	$9,700,000	2	59.20
Glenroy	1973	$400,000	13.24	$425,400	3	158.52
Hillend	2659	$336,000	2443.00	$26,200,000	2	84.87
Midrun-Lake McKay	5372	$179,375	1.25	$492,000	7	11787.7
Mt Pisa I & II	4633	$413,000	53.31	$2,066,000	5	434.67
Mt Rosa	1388	$155,556	53.04	$7,521,000	21	1265.38
Pukaki Downs	3722	$191,000	581.66	$4,665,000	4	156.30
Queensberry Hills	2905	$120,000	1791.46	$7,347,500	20	99.28
Rhoboro Downs	4648	$55,000	127.00	$1,900,000	1	1264.23
Spotts Creek	3344	$282,600	3306.00	$2,030,000	1	7.27
Waiorau	2691	$191,000	4.00	$785,000	1	2764.58
Wentworth	3840	$351,111	3441.27	$5,547,000	14	17.63
Woodbine	338	$110,000	0.10	$100,000	1	3069.36
Leasehold neither includes a lake view, nor lies within 10km of Queenstown or Wanaka.						
Ardgour	3719	$640,000	229.21	$1,466,000	6	37.17
Avalon	1352	$134,000	1341.19	$2,264,000	1	17.03
Ben Ohau	4375	$169,500	3694.81	$6,047,000	9	42.24
Blackstone Hill	2684	$175,000	1055.05	$129,000	1	1.88
Brookdale	1027	$106,000	1029.98	$2,000,000	1	18.81
Cairnmuir	4437	$141,000	4082.29	$5,334,000	13	41.12
Earnscleugh	16410	$608,889	15273.36	$1,624,000	7	2.87
Glencreagh-Camberleigh	922	$310,000	922.09	$1,751,000	2	5.65
Halwyn	3713	$124,444	622.70	$1,397,500	7	66.96
Mataura Valley	4322	$164,858	4357.00	$9,000,000	1	54.15
Omahau Downs	165	$31,000	5.70	$1,819,000	8	1696.93
Subtotals	101,752	$6,914,222	47,110	$135,741,400	178	19.67

Table 2 (cont.)						
Name of Former Leasehold	*Hectares Privatised* (1)	*Total Paid for Freehold* (2)	*Hectares Onsold* (3)	*Total Price Paid for Onsold Land* (4)	*# Parcels Onsold*	$(4) \div (3)$ / $(2) \div (1)$
Privatisations for which LINZ records are incomplete.						
Leatham	no data	no data	118.53	$780,000	5	na
Mt Dewar	no data	no data	4.00	$401,479	1	na
Raglan Run	1583	$84,500	1574	$2,000,000	1	23.80
Whitcomb	no data	$191,000	406.00	$300,000	1	na
Subtotals		$275,500	2102.53	$3,481,479	8	na
Grand Totals		$7,189,722	49212.89	$139,222,879	186	na

Table 2a. Cases in Which Runholder Onsold His Entire Freehold						
Name of Former Leasehold	*Hectares Privatised* (1)	*Total Paid for Freehold* (2)	*Hectares Onsold* (3)	*Total Price Paid for Onsold Land* (4)	*# Parcels Onsold*	$(4) \div (3)$ / $(2) \div (1)$
Avalon	1352	$134,000	1341.19	$2,264,000	1	17.03
Brookdale	1027	$106,000	1029.98	$2,000,000	1	18.81
Mataura Valley	4322	$164,858	4357.00	$9,000,000	1	54.15
Raglan Run	1583	$84,500	1574.00	$2,000,000	1	23.80
Spotts Creek	3344	$282,600	3306.00	$2,030,000	1	7.27
Total	11628	$771,958	11608.17	$17,294,000	5	19.81

Note: LINZ has no record of Raglan Run. Spotts Creek is within 10km of Queenstown.

Table 3. Estimated Regressions.									
Estimate Number	Sample Size	Constant	ln Size	Location	Time elapsed	%Sold	$\bar{R}^2$	SER	BIC
(1)	176	7.93 (0.07)	-0.73 (0.03)	---	---	---	0.804	0.923	240
(2)	176	7.51 (0.17)	-0.71 (0.03)	0.53 (0.17)	---	---	0.818	0.894	236
(3)	176	7.09 (0.18)	-0.71 (0.04)	0.49 (0.17)	0.08 (0.03)	---	0.828	0.865	233
(4)	176	7.04 (0.20)	-0.72 (0.04)	0.53 (0.17)	0.08 (0.03)	0.15 (0.21)	0.827	0.867	235
(5)	178‡	6.87 (0.23)	-0.73 (0.04)	0.61 (0.20)	0.09 (0.03)	0.27 (0.22)	0.794	0.960	256

‡ Sample includes two observations giving rise to residual outliers and omitted from the other estimates in this table.

Note. Dependent variable is $\ln(P_{OS}/P_F)$. *SER* = standard error of the regression. *BIC* = Schwarz criterion. Regressions estimated via OLS using TSP 4.5. Estimated standard errors in parentheses are robust to heteroskedasticity.

Table 4. The Value of the Option to Vary Land Use.			
Lease name	Valuer's estimation of the value of option to vary land use (F_{OS})	Price at which the Crown sold the freehold	Price at which all or some of the freehold land was sold or has been advertised
Alphaburn	$3M	$267,500	193ha sold for $10.1 million
Glendhu	$4.5M	$579,000	$10 million golf course + 42 residential sections proposed. Case pending before the Environment Court[1]
Glen Nevis	$1.2M	$570,000	2437ha (out of 2484ha privatised) for sale "by negotiation"[2]
Wyuna	$5.25M	$1.3M	33 sections of 5-8ha apiece advertised "from $975,000" each[3]

1. http://www.odt.co.nz/your-town/wanaka/142647/proposed-golf-resort-hurdles-remain .
2. http://queenstown.nzsothebysrealty.com/queenstown-properties/?Location=Glen-Nevis-Station-Kingston-Queenstown&PropertyID=706&Lr=1 .
3. http://queenstown.nzsothebysrealty.com/queenstown-properties/?Location=Wyuna-Preserve-Glenorchy-Queenstown&PropertyID=218&Lr=1 .