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In search of greener pastures: improving the
REINZ farm price index

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SUMMARY

The agricultural sector is an important part of the New Zealand economy, and farm debt is an even larger share of bank lending. Getting a good sense of what is going on with farm prices is of considerable interest to the Reserve Bank.

Producing an accurate index of farm price movements is, however, notoriously difficult. Compared to residential housing, farms are extremely diverse and the number of farms that actually transact in the market in any one month can be very low, particularly during times when prices are falling. Both of these factors imply that a simple median of farm sales is likely to be a problematic measure of farm price movements. The resulting price index can have more to do with the type of farms sold in any period than what a typical farm owner could expect to receive from a sale.

The current Real Estate Institute of New Zealand (REINZ) farm price measures are based on the median sale prices, or prices per hectare, and are likely to be vulnerable to these compositional changes. On top of this, the only alternative measure, the Quotable Value (QV) rural index, has been discontinued. In this paper, we propose a new method to construct a timely and compositionally adjusted farm price measure from the REINZ dataset. The new approach uses information about farms sold to standardize sale prices. This involves estimating the average price effect of the available farm characteristics (such as size, region and sector), and accounting for these when computing the farm price index.

The quality of any farm price index is limited by the low volume of farm sales, particularly during periods of market stress. However, we believe our new index is a material improvement on the currently available indices on at least two counts. First, the new index has a closer alignment with the discontinued, but also compositionally adjusted, QV rural index (although there are some notable differences in the 2001 and 2009/2010 periods). Second, the new index is much less volatile than the REINZ median per hectare measure. Our approach also yields improvements on currently available indices of dairy farm prices. The new farm price measures, in conjunction with a wide variety of other information, will be an important input into our analysis of the farm market and risks around rural debt.

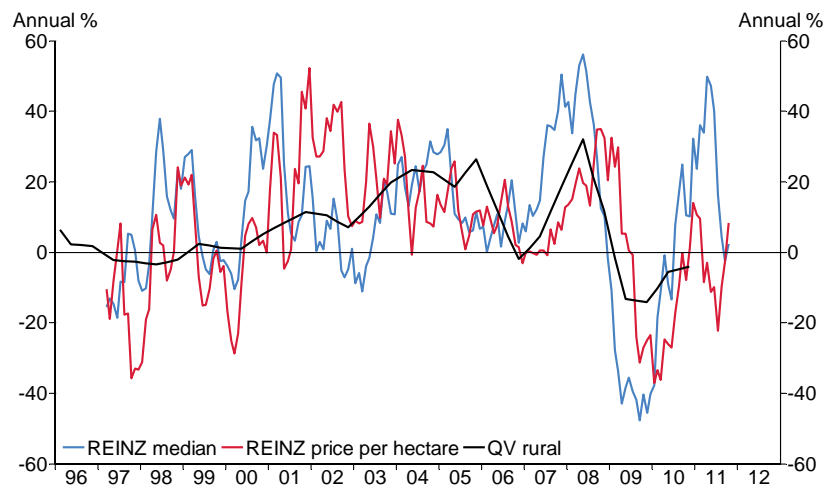
INTRODUCTION¹

A good farm price measure captures the price that a “representative” farm would sell for each period. In reality, though, there is no representative farm and, even if there was, it would not sell every period anyway. For example, farms are not like bottles of milk. They are not identical and their prices are not easily comparable. Moreover, farm price measures must rely on a small, and changing, sample of farm sales from which they must disentangle like-for-like price changes. Keeping in mind that the quality of any farm price measure will be limited by the low number of farm sales, particularly during periods of stress, this paper sets out to improve on currently available measures of farm prices by controlling for the different characteristic of farm sales.

EXISTING FARM PRICE MEASURES

There are three farm price measures that have been, or currently are, available (figure 1). The Real Estate Institute of New Zealand (REINZ) produces the median (blue line) and the median price per hectare (red line). Until recently, Quotable Value (QV), who is New Zealand’s other major provider of property information, produced the QV rural index (black line).

Figure 1: Farm price indices



Note: The REINZ indices are 3-month averages, whereas the QV index is semi-annual.

The QV rural index was constructed using the sales price appraisal ratio (SPAR) method. This means that sale prices were expressed relative to their rateable value

¹ We would like to thank David Hargreaves, Michael Reddell and Bruce McKay at Esperance Capital Ltd for helpful comments on earlier drafts. We thank REINZ for making the unit record data on farm sales available for this research.

(RV) before constructing the price index. This is a similar approach to that used to produce the QV house price index. However, in light of the low number of farm sales QV also incorporated a judgemental adjustment to the sales price to RV ratio for each council area by expert valuers.

The SPAR method helps to distinguishing compositional changes from true price movements. Because of this compositional adjustment, the QV rural index is a useful benchmark measure. However, it was recently discontinued - perhaps reflecting the recent lack of turnover in the market and the costs involved with doing the judgemental adjustment. Further, it was released only semi-annually and with a considerable delay. The currently available REINZ farm price measures, the median and the median price per hectare, are much more timely. However, they are likely to be poor approximations of like-for-like farm prices as they do not adequately adjust for the characteristics of farms sold. For instance, a spike in Waikato farm sales (one of the most expensive regions) will cause both price measures to rise, even if underlying farm prices are unchanged. The price per hectare measure does adjust for farm sizes and, therefore, is the better of these measures. REINZ acknowledge this by focusing on the price per hectare measure. However, neither approach accounts for a variety of other farm characteristics.

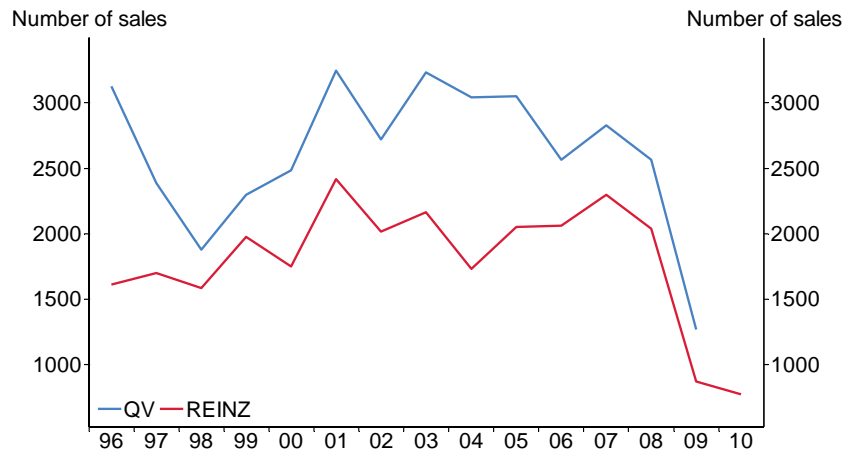
DEVELOPING A NEW FARM PRICE MEASURE

Our dataset is obtained from REINZ. It contains unit records for approximately 30,000 farm sales covering the period from 1996 to 2011. We prefer this dataset because it is available within a couple of weeks of the end of each month. The alternative dataset, underlying the QV rural index, was not available until months after the corresponding period, and only at a semi-annual frequency. This delay was mainly because QV employed sales recorded at the settlement date, whereas the REINZ data is recorded when sales become unconditional.

The main disadvantage of the REINZ dataset is that it only includes around 70 percent of the recorded farm sales (figure 3).² The 30 percent of sales not captured are likely to have been private or through non-REINZ members. While this smaller sample is a genuine weakness, particularly when the number of farm sales are low, some of the excluded sales might not reflect market rates anyway. For instance, if they were between family members the agreed price may not fully capture market fundamentals.

² We exclude lifestyle blocks from the dataset.

Figure 3: Annual freehold open market farm sales, REINZ and QV



To construct our index, we must decide among various alternative methods to apply:

- **Repeat sales**

The repeat sales method requires that many properties are sold more than once. This approach's strength is that it compares like-for-like farms. Unfortunately, repeat sales are not common in the REINZ dataset. Further, repeatedly sold properties may not be representative of all farms. For instance, if large farms sell relatively less often, they would get a smaller weight.

- **Sale price to appraisal ratio (SPAR)**

The SPAR method, which is used to produce the QV rural index, utilises valuation data to standardise sale prices. As such, this approach relies on the quality of the rateable values. On the downside, the REINZ dataset does not always include these valuations.

- **Stratification**

The stratification method groups properties from locations that typically have similar prices and assumes properties in those locations are similar. The median price within each group is calculated, and weighted together to produce an aggregate index. The impact of compositional changes between groups is accounted for by keeping the weights on each group constant. However, the impact of compositional changes within groups remains a problem. McDonald and Smith (2009) implemented this method to construct the REINZ housing price index. While this might be a reasonable method for residential indices, using it to construct a farm price index is less valuable,

because the low number of farm sales makes it difficult to disaggregate regional data.

- **Hedonic**

The hedonic approach is to standardise sale prices using information about the property. It involves constructing estimates of the impact of each characteristic on the sale price using a regression technique. The predicted sale price for each farm, based on the farms' characteristics, act similarly to the rateable value in the SPAR approach. The performance of any hedonic index, therefore, relies on the quality and usefulness of the available information. In particular, the approach relies on the ability of readily available information on farm characteristics to capture the key features that explain differences in farm prices.

We believe the most suitable method for the REINZ dataset is the hedonic approach. This is because, by a process of elimination, there are not enough repeat sales, the rateable values are too patchy for the SPAR method, and farms are not similar enough within regions with a sufficient number of sales to use stratification. This intuition was confirmed in our initial results applying the stratification approach on the REINZ price per hectare data. The constructed index, while an improvement on the current REINZ indices, did not perform nearly as well as the hedonic approach.

For each farm sale, the REINZ dataset has information (other than the price) on:

- Size;
- Sector (dairy, grazing, finishing etc.);
- Location;
- Whether the sale was leasehold or freehold;
- Whether the sale was for bare land.

These data may proxy for other factors that are not explicitly measured in our dataset. For example, a farm's location may in part explain the land's productivity. As such, we believe they capture a significant portion of compositional affects.

We apply least absolute deviation (LAD) procedure to estimate the average price effect of each characteristic. The LAD procedure reduces the impact of outliers compared to ordinary least squares. Table 1 shows the estimated coefficients (coefficient column) for each of the available characteristics.³ When the t-statistics are larger than 2 (or less than -2) the related coefficient is significantly positive (or negative). The exponential column shows the relative price for regions and sectors

³ We take the logarithm of sale prices because, otherwise, they are likely to rise exponentially (as with a constant growth rate). We exclude the constant and the monthly dummy variables from the results table.

compared to Auckland and an Arable farm respectively. For example, a Southland farm (holding constant all other factors) is 74 percent of the price of an Auckland farm, and a dairy farm is 75 percent more expensive than an Arable farm.

Table 1: Hedonic regression estimates (dependant variable is the log farm price)

	Variable	Coefficient	T-stat	Coefficient exponential
	Farm size	-0.87	-206	
	Square root farm size	3.45	183	
Regional dummy Variables (relative to Auckland)	Bay of Plenty	-0.03	-1.9	0.97
	Canterbury	-0.23	-14	0.79
	Gisborne	-0.48	-19	0.62
	Hawkes Bay	-0.33	-17	0.72
	Manawatu/Wanganui	-0.44	-27	0.64
	Nelson	-0.38	-20	0.68
	Northland	-0.51	-30	0.60
	Otago	-0.65	-37	0.52
	Southland	-0.30	-18	0.74
	Taranaki	-0.27	-14	0.76
	Waikato	-0.03	-2.1	0.97
	Wellington	-0.45	-19	0.64
	West Coast	-0.78	-28	0.46
	Auckland	0		1
Sectoral dummy Variables (relative to an Arable farm)	Special	-0.09	-4	0.91
	Grazing	-0.37	-21	0.69
	Finishing	-0.15	-7.8	0.86
	Forestry	-1.35	-50	0.26
	Dairy	0.56	29	1.75
	Horticulture	0.19	9	1.21
	SthlsHCMerino	-1.15	-16	0.32
	Arable	0		1
	Land is bare	-0.27	-15	0.76
	Leasehold status	-0.58	-12	0.56

Note: SthlsHCMerino is Southland Island high country merino and farm size is in terms of thousands of hectares.

Our regression results show that a farm's size is very important for explaining its price. We include farm size in two ways, the level and the square root of the level. The t-statistics on both terms imply they are statistically significant. Their sum implies

that bigger farms cost more in aggregate, but they are cheaper on a per hectare basis. For example, a 100 hectare dairy farm in the Waikato at the end of 2011 is predicted to sell for around \$3.7 million, or about \$37,000 per hectare. A farm twice its size (200 hectares) but otherwise the same is predicted to sell for \$5.3 million at \$27,000 per hectare. Bigger farms being cheaper on a per hectare basis could reflect many things: for example, bigger farms may include more unproductive land.

The regional dummies imply that farm locations also explain their prices. Our estimates suggest that the Auckland region is most expensive and the West Coast is the cheapest. West Coast farms are 46 percent of the price of a similar farm in the Auckland region. For a less extreme example, a Southland farm costs around 76 percent of a similar farm in the Waikato.

Our estimates suggest that, across sectors, dairy farms are the most expensive. They cost 75 percent more than comparable Arable farms and are two and a half times the price of grazing farms. We suspect this largely reflects that dairy farms require so much additional capital equipment (milking sheds etc.) than, say, grazing or arable land.

The hedonic price index is, in essence, the price changes over time that cannot explained by these farm characteristics. The index can be computed by estimating the regression with dummy variables for each time period or, equally, by using the median sale price to predicted value ratio in each month. Either way produces the same hedonic price index.

COMPARING AND EVALUATING OUR FARM PRICE MEASURE

Without a true like-for-like index to compare to, there is no fully objective way to evaluate our measure. But we get a lot of confidence from the similarity of our hedonic measure and the discontinued QV rural index. In table 2, we quantify the similarity between our hedonic index (and the two REINZ measures) and the QV rural index, using root mean squared differences of the annual percent changes.

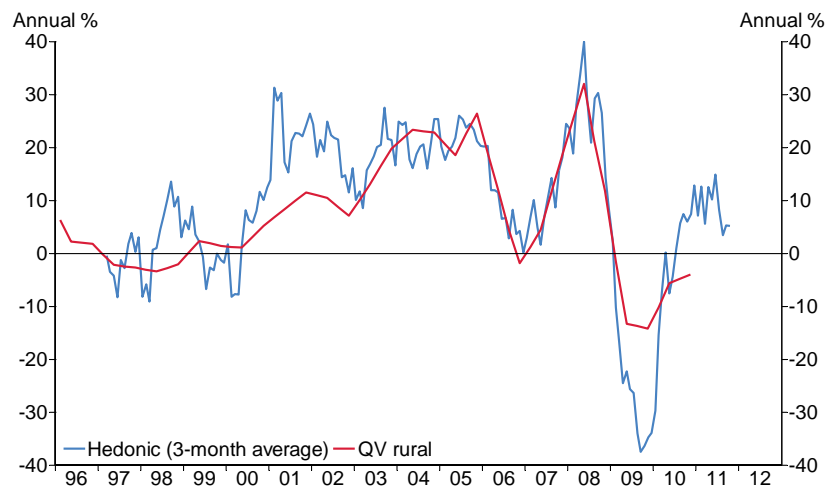
Table 2: Difference from QV rural index (annual percent change)

Method	Root Mean Squared Error
Hedonic	5.2
Price per hectare	8.8
Median price	11.1

The deviation, from the QV index, of the hedonic index is less than half of the REINZ median deviation, and less than two thirds of the REINZ price per hectare deviation. Compared to the currently available REINZ measures (figure 1), the similarity between the growth in the QV and hedonic farm price indices is striking, at least for the 2002-2008 period (figure 4). This similarity, even though they use quite different compositional adjustments, might suggest they are both converging on like-for-like farm prices.

There were two periods when the growth rates in the QV and hedonic indices deviated from each other. In 2001, the hedonic index grew by more than 20 percent, whereas the QV index grew just 10 percent. In 2009, the hedonic index fell by almost 40 percent, while the QV index declined only 15 percent. These differences are starker when the indices are shown in levels (figure 5). Interestingly, by the end of 2009 both indices were at similar levels.

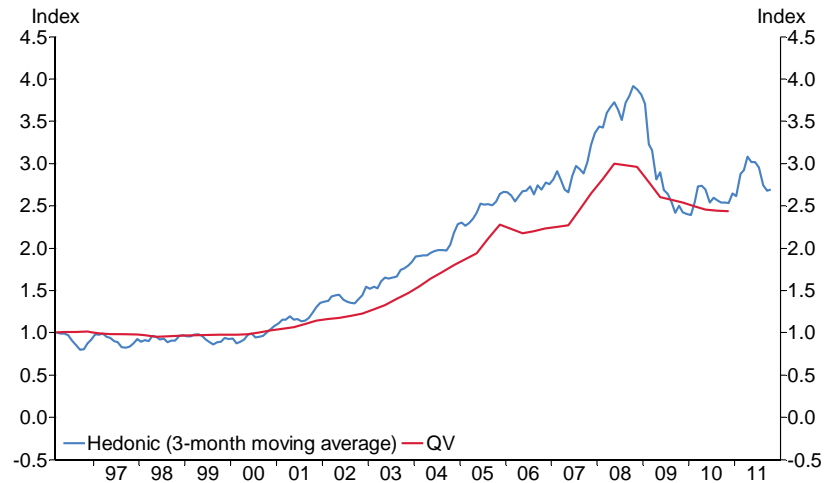
Figure 4: Comparing the growth in the hedonic and QV rural indices



Notes: The REINZ hedonic is a three month rolling average of the annual percent change. The semi-annual QV index has been interpolated to quarterly using linear interpolation.

These large divergences both occurred during turning points in farm prices. In 2001, sales picked up sharply and prices were starting to pick up; in 2008, sales slowed sharply and prices began to fall. It is difficult to tell which index is closer to the truth. It is certainly possible that there are some compositional changes occurring in these periods that the hedonic approach is, for some reason, not able to account for. However, it is equally possible that the backward looking nature of the QV methodology made the index slow to respond to turning points. This is because the rateable values used to produce the QV index, particularly after incorporating a judgemental overlay, could lag around turning points. As such, the larger cycle portrayed by the hedonic index from 2001 to 2010 is, at least, worth considering.

Figure 5: Levels of the hedonic and QV rural indices



Excessive volatility in measured farm prices is often a sign that compositional change is affecting the results. Thus, another way to evaluate our index is to measure its short-run volatility. To do this, in table 3 we compare the standard deviations of the monthly percent changes of each of the REINZ measures and our hedonic index (all three are seasonally adjusted). The hedonic index has less than half the monthly volatility of the median and only two thirds of the volatility of the price per hectare measure. This supports the notion that the unadjusted REINZ indices overstate the volatility in farm prices. Less short run volatility should make it easier to identify turning points, supporting our finding that the hedonic index is an improvement on the current REINZ measures.

Table 3: Standard deviations (seasonally adjusted)

Method	Standard deviation of monthly percent change
Hedonic	9.3
Price per hectare	15.6
Median price	21.8

The hedonic index appears to be a material improvement on the previous REINZ measures, the median and the price per hectare. But, we should not forget that it relies on the data used to construct it. We should be particularly cautious when that data is lacking (in periods of low turnover). Unfortunately, it is often during periods of low sales, when prices are likely to be falling, that there is the most interest in obtaining an accurate read on farm prices.

A HEDONIC DAIRY FARM PRICE INDEX

We complement the aggregate hedonic farm price measure with a price index for dairy farms. Dairy farms account for the majority of rural debt and are of particular interest to the Reserve Bank.

There were approximately 6,000 dairy farm sales over the period from 1996 to 2011. Compared with the aggregate farm price dataset, dairy farms are more similar and, therefore, should require fewer sales to produce a reasonable like-for-like comparison. Compared with the REINZ dairy price per hectare index, our approach also incorporates the region of the farm and the kilos of milk solids produced prior to the sale.

Again, we compare the hedonic measure to the REINZ price per hectare and the QV dairy index. We show the annual growth rates of these indices in figure 6, and compare the fit with the QV index and standard deviation in Table 3. Overall, the results show that the hedonic measure materially improves upon the price per hectare index.

Figure 6: Hedonic dairy price index versus REINZ median and QV dairy price indices

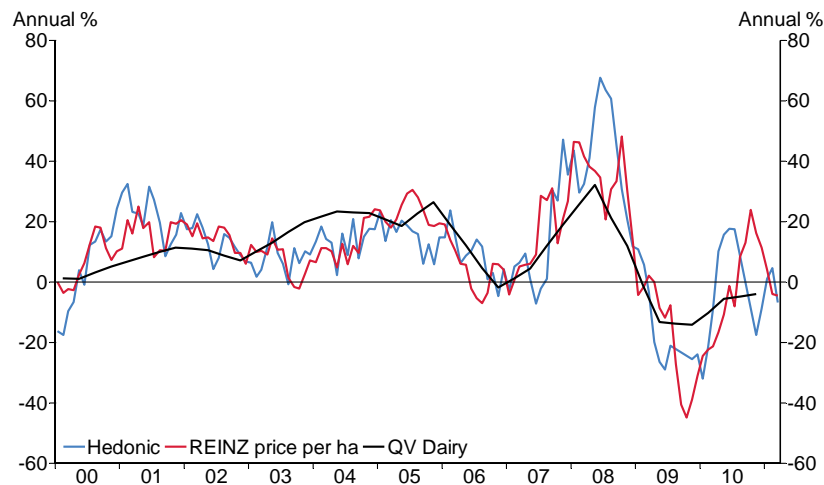


Table 3 – Summary statistics for alternative dairy price indices

Method	Root Mean Squared Error	Standard deviation of quarterly percent change
Hedonic	6.8	9.4
Price per hectare	9.1	22
Median price	13.4	42.8

CONCLUSION

We set out to improve on currently available measures of farm prices by controlling for the different characteristics of farm sales. To do this, we estimated the effects of farm characteristics on the sale prices over the full sample. Our findings show a farm's size, location, and type are all useful for explaining their price. Accounting for these factors resulted in a material improvement compared to the currently available REINZ farm price measures.

We evaluate our hedonic index by comparing it to the previous benchmark, the QV rural index. The hedonic index has a closer alignment with the QV index than the other REINZ measures. In saying this, the QV and hedonic indices diverge at two notable times, 2001 and 2009. The hedonic index suggests farm prices rose by more in the early 2000s and then fell by more in 2009. Whether this is consistent with like-for-like farm prices, or not, is difficult to tell. Our suspicion is that the QV methodology may have been slow to react to turning points. While we advise caution in interpreting the index during periods of low turnover, we believe the new measures improve on what is currently available. The new farm price measures will be an important input into our analysis of the farm market and risks around rural debt.

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C. McDonald and Smith, M. (2009) 'Developing stratified house price measures for New Zealand', Reserve Bank of New Zealand Discussion Papers, 2009:07.