Farmland Prices in New Zealand and Finland

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EXTENDED ABSTRACT

Farmland prices are a critical determinant of farm profitability. Yet around the world analyses of farm land prices rarely produces models which are both contextually and empirically robust. This paper examines the movement of land prices in both Denmark and New Zealand during the period 1981 to 2005.

Typically, farm prices are modelled in terms of their fundamental economic values as reflected by discounted future earnings (net-present value type of models (NPV)). Hedonic modelling approaches are helpful in relating earnings potential to land characteristics but still leave significant variation unexplained. This paper takes an alternative approach which is, in part, motivated by the observation that significant areas of land in Finland are owned by non-farmers and this is also true in New Zealand, though to a lesser extent. Hence the paper explores the impact of the wider economic performance on stochastic trend in land values by examining the convergence between Gross Domestic Product (GDP), aggregated agricultural income (AAI) and farmland prices (FP). A number of regional policy issues are also related to heavily subsidised agriculture in Finland.

Our approach is to convert data series into a stationary form and in this way ensure the necessary conditions for analysis. Results from unit root testing provide evidence that logs of average farmland price (FP), GDP and aggregated agricultural income (AAI) series are first difference stationary I(1) series. In the case of the New Zealand data, the ADF was capable of confirming the result. For the Finnish data, the Hadri test was done in level as well as in first differences. On first differences, the null of joint stationarity is accepted. This suggests that the Finnish data series of GDP, aggregated agricultural income and farmland prices are also first difference stationary. However the Hadri test gives mixed results of stationarity of New Zealand data at levels, suggesting that these series are joint stationary I(0). This result is not supported by other panel data joint stationary tests. Unit root tests clearly suggest that modelling must be done on first differences.

Results do not support prediction of fast structural change in factors affecting Finnish farmland prices. However, they support the view that agricultural factors do not have a large effect on agricultural land prices in Finland. This might partially explain why hedonic land price models fail to give reasonable explanation power over variations in farmland prices. Models where value of the land is given by the capitalized value of current and expected future streams of net income from agriculture fail because, at least in the Finnish case, they capture only a limited part of stochastic variation in land prices.

However, the situation is completely different within the New Zealand data. Here the results give a reasonable base for models relying on the present value approach, because a reasonable part of the stochastic variation in land prices is explained by agricultural factors affecting agricultural income.

Results also support the idea that agriculture's influence on agricultural land prices is weakening. However, changes are not as dramatic as could be expected by agricultural product price statistics.

These results show the importance of analysts extending their analyses to make better use of indicators of changes in the wider economy when seeking to explain fluctuation in agricultural land prices and in looking to anticipate future changes.

1. INTRODUCTION

Farmland price is one of the most important determinants of agricultural production. Most of the existing models of agricultural land values adopt an income approach in which the value of an asset is modelled as the present value of expected future cash flows. Indeed, predictions related to future profitability have had a great impact on farm land prices. When Finland opened negotiations to join the European Union (EU), farmers started to feel uncertainty over their future. Because future profits are capitalized on the basis of current expectations, agricultural land values dropped sharply. This happened well before actual entry into the EU. Nevertheless, other factors cannot be ignored. Between 1991 and 1994, Finland faced a serious depression. This was because of the relaxation of monetary control that induced a drop in the value of the Finnish currency (FIM). Gross Domestic Production (GDP) did not recover to the level of 1990 until 1997. New Zealand farmers faced similar radical changes in the economical environment in 1984, when New Zealand's agricultural subsidy system was wound down. However, changes in GDP were not as radical as they are in Finland.

This paper examines the factors affecting farmland prices in New Zealand and Finland. An unconventional methodology based on studying convergence of time series is introduced for this purpose. This approach is widely used in other areas of economic analysis. However, this methodology has not yet been introduced in agricultural land price analysis either in Finland or in New Zealand. To fill this gap in research, two foundational methods for studying time series convergence are used.

Earlier studies have concentrated on the hedonic price models, where influential factors are related to the characteristics of farm land (Kantola, 1979; Laurila, 1988; Ylätalo, 1992; Peltola, 1997; Pyykkönen, 2006 and Peltola, et al. 2006). These factors commonly include soil structure, fertility, plot structure, among others. However, much of the variation in land prices could not be explained by the hedonic price models. More importantly some fundamental trend might be totally ignored.

Changes in land values are also explained by changes in land usage (Stillman, 2005). Stillman found in New Zealand that, between 1989 and 2003, the value of rural land under every kind of use increased substantially. He also found considerable changes in land usage, but these changes were essentially uncorrelated to changes in land value. Analysis highlights that only 2 % of the approximately 235% increase in overall land value is explained by changes in land use. However, initial land usage plays an important role when price changes are explained.

Pyykkönen (2006) reviewed studies, where possible reasons for rejection of the traditional net present value formula are studied. In Pyykkönen's work (2006) increasing attention is paid to the time series properties of farmland price series. Some studies have also introduced indicators from the general economy; however, none of these studies has paid attention to the relationship between GDP and farmland prises.

By deduction, it seems that changes in farmland prices are not completely explained by agricultural factors. This might be due to the fact that almost half of the farmland in industrialised countries is no longer owned by farmers (Ryan et al., 2001). Most of these landowners have become landowners by heritage. Commonly they have committed to their work in urban surroundings and will not take up the opportunity to go farming (Väre 2005). Instead, they are willing to lease land to an active farmer. Thus they can retain their advantage of using the farm compound and fields for recreational purposes.

To our knowledge, no time series studies exist of the relationship between changes in the general economy and farmland prices. Our hypothesis is: Changes in the general economy have an impact on farmland prices and this impact might change over time. To evaluate this argument, the convergence between Gross Domestic Production (GDP), aggregated agricultural income (AAI) and farmland prices (FP) was studied.

Because economic time series are often non-stationary, it is essential to study time series properties, i.e. unit roots and possible co-integration, prior to model building (Engle & Granger, 1987). However, co-integration does not provide sufficient information about economic behaviour (Haldane & Hall, 1991). This study aims to fill this gap in information and to understand the reasons for the changes in farmland prices. This is needed especially because the disparity between the cash return from farming and capital gain being earned is as far out of balance as it has been in past 50 years (The National Bank of New Zealand, Rural Report March, 2007).

Part of the information might be lost because of aggregation of farm land. It is not possible to deviate price series to the market subgroups based on land usage or land characteristics. This means that no information is available about possible behavioural differences between different market segments. It is also notable that time series analysis gives only a general explanation for price changes. Hedonic price analysis is needed to explain why two field parcels next to each other might realise different market prices. The order of the transactions related to these field parcels is then one of the sources of error in time series analysis.

2. METHODOLOGY

Economic time series often have properties which must be considered in order to avoid technical problems. In this case, series presenting natural logarithms of real[1] GDP, real farmland prices (FP) and real Aggregated Agricultural Income (AAI) might be non-stationary, and differences between the series do have infinite variance, i.e. they drift infinitely apart. This is an interesting phenomenon in itself, but it also raises the need for more information about time series properties of the series in question. Furthermore, series must be converted into stationary transformations, otherwise testing for co-integration of these series is necessary. However, this is not enough to tell anything about structural changes in the contribution of explanatory variables to agricultural land prices (Haldane & Hall, 1991). We try to avoid complicated testing of co-integration. Our aim is to convert data series into a stationary form and in this way ensure the necessary conditions for analysis.

2.1 Convergence of time series

To test for economic convergence, Hall et al. (1992) developed a model consisting of the differentials between any two time series and the differential between one of the series and a third series based on the model provided by Haldane and Hall (1991). The model of Hall et al. (1992) is given as follows:

$$\left[X_1 - X_2\right]_{(t)} = a_{(t)} + b_{(t)}\left[X_1 - X_3\right]_{(t)} + e_{(t)} \quad (1)$$

where X_1, X_2, and X_3 are the logs of the economic factors. Hall et al. (1992) showed that if the X_1 and X_2 series have converged, then b(t) is expected to approach zero, meaning here that X_1 is mostly or in extreme cases [b(t)=0] totally affected by changes in X_2. In this extreme case, interpretation of a(t) is

$$\left[X_1 - X_2\right]_{(t)} = a_{(t)} + e_{(t)} \quad (2)$$

and $a_{(t)}$ describes the mean difference of the series while $e_{(t)}$ is the stochastic variation of this difference.

Time-varying parameters $a_{(t)}$ and $b_{(t)}$ can be estimated by applying the Kalman filter procedure.

2.2 Modelling the magnitude of factors affecting agricultural land prices

Results from unit root testing provide evidence that logs of average farmland price (FP), GDP and aggregated agricultural income (AAI) series are first difference stationary I(1) series. In the case of the New Zealand data, the ADF was capable of confirming the result. For the Finnish data, the Hadri test was done in levels as well as in first differences. On first differences, the null of joint stationarity is accepted. This suggests that the Finnish data series of GDP, aggregated agricultural income and farmland prices are also first difference stationary. However the Hadri test gives mixed results of stationarity of New Zealand data at levels, suggesting that these series are joint stationary I(0). This result is not supported by other panel data joint stationary tests.

Unit root tests clearly suggest that modelling must be done on first differences. This complicates modelling and interpretation of the results, because we have to deal with price changes but not with absolute prices. However, we start our analysis with the model extended to the form

$$\left[FP_{t-1} - GDP_{t-1}\right]_{(t)} = a_{(t)} + b_{(t)}\left[FP_{t-1} - AAI_{t-1}\right]_{(t)} + e_{(t)} \quad (3)$$

Interpretation of $b_{(t)}$ is then that yearly changes in FP/GDP ratio could be explained by $b_{(t)}$ time's yearly changes in FP/AAI ratio. If $b_{(t)}$ approaches 0, changes in FP/AAI ratio do not have any connection to with changes in FP/GDP ratio and FP moves in tandem with GDP. If $b_{(t)}$=0, changes in FP/GDP ratio could be seen from $a_{(t)}$. However, if $b_{(t)}$=1 means that FP drops out and implications for FP in this equation are difficult to see. Nonetheless, there is an implication in terms of GDP and AAI moving more closely together. This kind of result would also be interesting, but is not the focus of this study. To extend the picture or FP/GDP and FP/AAI relations we estimate second version of model

$$\left[FP_{t-1} - GDP_{t-1}\right]_{(t)} = a_{(t)} + b_{(t)}\left[AAI_{t-1} - GDP_{t-1}\right]_{(t)} + e_{(t)} \quad (4)$$

Now if $b_{(t)}$=0 it implies that FP still moves in tandem with GDP. However, this time $b_{(t)}$=1 implies that FP moves in tandem with AAI. If AAI and GDP are moving in tandem (could be seen from equation 3), then we might look at the overtime behaviour of $a_{(t)}$ to determine what is happening to FP/GDP ratio.

Because the New Zealand data are in semi-annual format it is not reasonable to expect that current AAI has any connection to current FP. We use one lag on right hand side variables in the New Zealand data. This is supported by data on changes in the number of sales as well as changes in prices.

[1] Series are measured in real prices in 2005 Euros and NZ Dollars. "Real prices" is not continuously repeated in text.

3. DATA

A very limited amount of data exists for this study.

Pyykkönen (2006) has presented properties for representative farmland transfers in Finland. Price information is collected by the National Land Survey of Finland (NLS) and it is published in Real Estate Market Price Statistics. These data are annually compared to New Zealand farmland sales data which are semi-annual. The data based on farmland districts are collected and published by Valuation New Zealand in rural and urban property sales summaries. Farmland prices are presented in statistics as current prices (Figure 1).

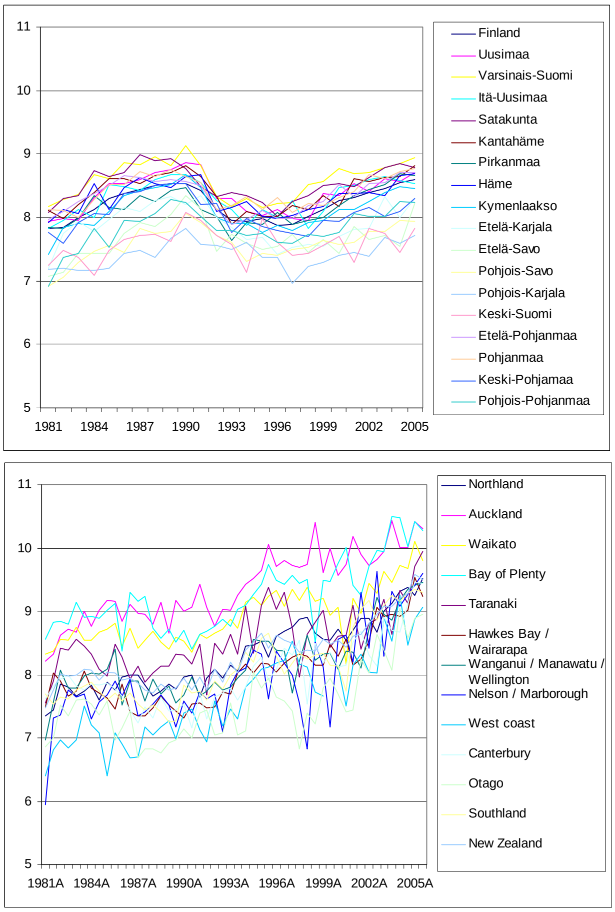

Figure 1. Regional farmland price data (nominal prices, local currency, and in log levels).

Farmland price data are augmented by the series of GDP provided by Statistics of Finland[2] and Data Stream Network of New Zealand[3]. Data about aggregated agricultural income are provided by MTT Economic research in the form of annually published Finnish Agriculture and Rural Industries publications (Niemi & Ahlstedt, 2006). Information about aggregated agricultural income in New Zealand is obtained from Statistics New Zealand in the form of quarterly series S1RB for Agriculture. All series have been converted from nominal prices to real prices by using the consumer price index provided by Tilastokeskus and the Datastream network of New Zealand. Real prices are presented in 2005 euros and dollars.

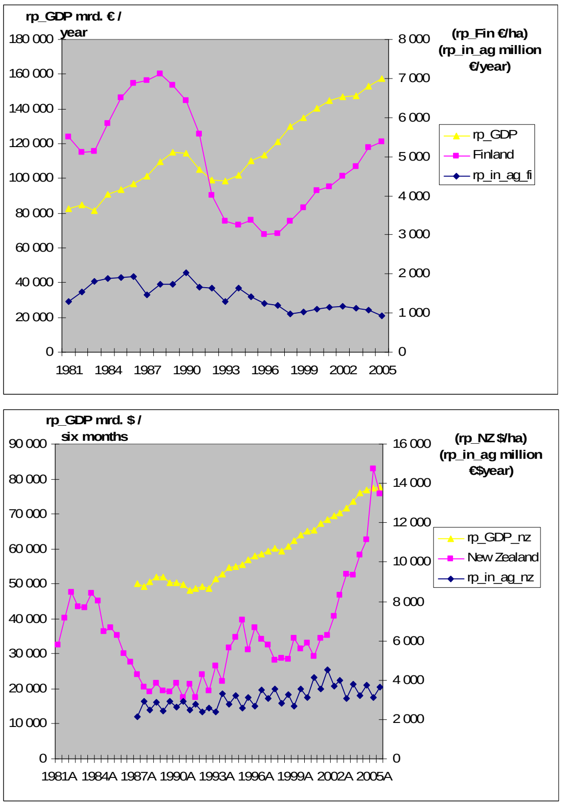

Figure 2. Real Price Gross Domestic Product (RP_GDP) on the top in million € and NZ$, average farmland real prices in Finland (Finland) and in New Zealand (New Zealand) in thousand €/ha and NZ$/ha, and aggregated agricultural income in million €/year (RP_IN_AG) on the right. All prices are in 2005 euros and NZ dollars. New Zealand data are in a six monthly format. Analyses are done in natural logarithm format.

To clarify the nature of changes in farmland price, GDP and aggregated agricultural income, first differences of these series are presented in Figure 3. This figure shows clearly that, in New Zealand agricultural land prices follow the changes in agricultural income; however this is not the case in Finland. In spite of the difference it is not possible to identify whether there has been any change in this situation over time.

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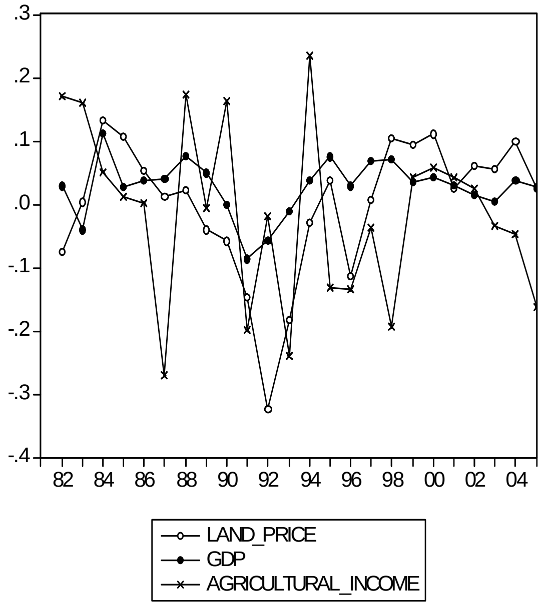
2 http://www.stat.fi/tup/suoluk/suoluk_kansantalous.html

3 http://www.thomson.com/content/financial/brand_overviews/Datastream_Advance



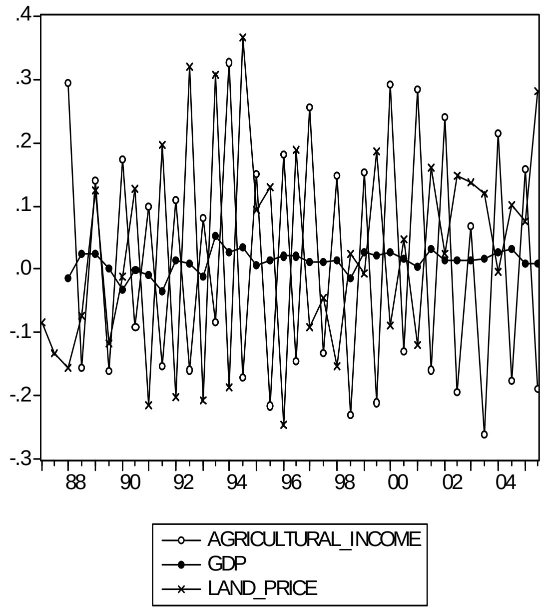


Figure 3. First differences of farmland land price, GDP and aggregated agricultural income in Finland (top) and in New Zealand (bottom). Series are in natural logarithm format.

4. RESULTS

4.1 Constant parameters

From equations 3 and 4 we obtain evidence that farmland prices (FP) in Finland are not strongly related to aggregate agricultural income (AAI). Result from equation 3 indicates that 100% increase in the FP / AAI ratio will lead to a 26% increase in the FP / GDP ratio. On the other hand, equation 4 shows that a 100% increase in AAI / GDP ratio will have no effect on the FP / GDP ratio. However, there is a lot of variation in farmland prices which could not be explained by these variables only and their over time constant parameters (Table 1a and 1b). In particular, equation 4 gives very unreliable results. By using the Chow test we get some evidence of structural break in equation 3 at 1999* and in equation 4 at 1998**4.

Table 1a. Constant parameters for a and b in equation 3 for Finnish data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
a	-0.031	0.015	-2.015	0.056
b	0.260	0.097	2.668	0.014
R-squared	0.244	F-statistic		7.121
Adjusted R-squared	0.210	Prob(F-statistic)		0.014
Durbin-Watson stat	1.165			

Table 1b. Constant parameters for a and b in equation 4 for Finnish data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
a	-0.027	0.018	-1.453	0.160
b	0.021	0.128	0.169	0.867
R-squared	0.001	F-statistic		0.028
Adjusted R-squared	-0.044	Prob(F-statistic)		0.866
Durbin-Watson stat	0.826			

From equations 3 and 4 we gained evidence that farmland prices are more related to aggregated agricultural income in New Zealand than they are in Finland (Tables 2a and 2b). Result from equation 3 indicates that 100% increase in the FP / AAI ratio will lead to a 45% increase in the FP / GDP ratio. In contrast, equation 4 shows that a 100% increase in AAI / GDP ratio leads to a 42% increase in FP / GDP ratio.
However there is some variation in farmland prices which could not be explained by constant parameters (Table 2a and 2b). By using Chow test we get some evidence of structural break in equation 3 at 1997* and in equation 4 at 1990S2**5 on New Zealand data.

4 Significant level *=10% and **=5%.
5 Significant level *=10% and **=5%.

Table 2a. Constant parameters for a and b in equation 3 for New Zealand data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
a	0.011353	0.012782	0.888152	0.3807
b	0.446558	0.040413	11.04984	0.0000
R-squared	0.782	F-statistic		122.098
Adjusted R-squared	0.775	Prob(F-statistic)		0.000
Durbin-Watson stat	2.986			

Table 2a. Constant parameters for a and b in equation 4 for New Zealand data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
a	0.025	0.024	1.063	0.296
b	0.423	0.126	3.349	0.002
R-squared	0.254	F-statistic		11.219
Adjusted R-squared	0.231	Prob(F-statistic)		0.002
Durbin-Watson stat	2.544			

Data also gives a support to predict that $a_{(t)}=0$ for convenience then we can rewrite equation 4 to a form

$$FP_{t-1} = b_{(t)} AAI_{t-1} + \left(1 - b_{(t)}\right) GDP_{t-1} + e_{(t)} \qquad (6)$$

which yields,

Table 2c. Constant parameters for b in equation 6 for New Zealand data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
b	0.451904	0.127226	3.551988	0.0011
R-squared	0.245583	Durbin-Watson stat		2.699119
Adjusted R-squared	2.493475			

The movements in FP are a weighted average of movements in AAI and GDP where the split is $b_{(t)}$,$(1-b_{(t)})$. The result indicates that AAI and GDP have almost equal effect on FP in New Zealand. In this case, movements in $b_{(t)}$ would tell about how this split changes over time. Again Chow test indicates structural break at 1991**.

4.2 Time varying parameters (TVP)

Estimates of the $b_{(t)}$) coefficient from equation 3 are presented in figure 4. Results highlight the difference in factors affecting agricultural land prices in New Zealand and Finland. In Finnish data the parameter $b_{(t)}$ gets values close to zero, having an ending value of 0.30 (Figure 3). Due to the limited number of data points at the beginning of the recursive estimation process, the confidence interval for $b_{(t)}$ is substantially large. However, the coefficient is significant at 10% risk level and the confidence interval reverts quickly when data is fed year by year into the model.

Data do not support prediction of fast structural change in factors affecting Finnish farmland prices. However, they support the view that agricultural factors do not have a large effect on agricultural land prices in Finland. This might partially explain why hedonic land price models fail to give reasonable explanation power over variations in farmland prices (Goodwin et al., 2003). Models where value of the land is given by the capitalized value of current and expected future streams of net income from agriculture fail because, at least in the Finnish case, they capture only a limited part of stochastic variation in land prices.

However, the situation is completely different within the New Zealand data. The State Variable $b_{(t)}$ gets values close to 1 having an ending value of 0.70. This gives a reasonable base for models relying on the present value approach, because a reasonable part of the stochastic variation in land prices could be explained by agricultural factors affecting to agricultural income.

Data also support the idea that agriculture's influence on agricultural land prices is weakening. However, changes are not as dramatic as could be expected by price statistics. At least the tremendous overseas demand faced around 2000 for sensitive New Zealand agricultural land seems to have only had a moderate effect on state variable $b_{(t)}$ (NZ 2004). This might be because of the nature of the recursive estimation process, where sharp changes might be considered as errors. Considering this fact, it might be alarming to notice the downward sloping trend of $b_{(t)}$ in New Zealand data.

On the basis of OLS estimates, there seems to be no use in estimating equation 4 from the Finnish data. OLS estimates also reveal that we could not ignore the connection between AAI and FP when farmland prices in Finland are explained. This means that we could not drop $b_{(t)}$ from equation 3 and estimate TVP estimate just for $a_{(t)}$. However, the discovery from the New Zealand data, that there is no constant on a model explaining the price relation between FP, AAI and GDP is important. It is interesting to notice that AAI and GDP seem to effect FP in New Zealand. However, time varying parameters indicate that this ratio has changed remarkably over time. TVP estimates for equation 6 are presented in figure 5.

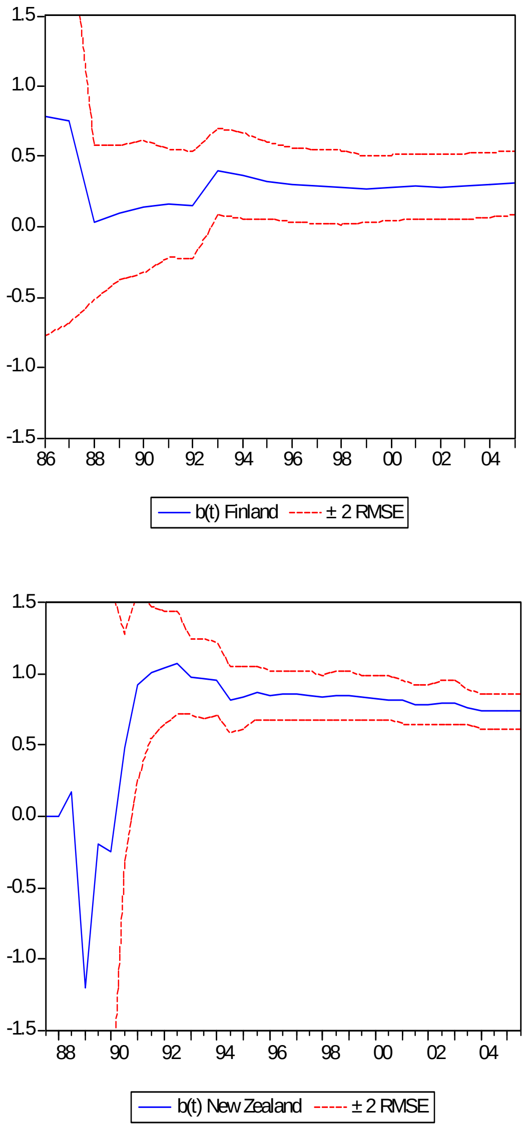


Figure 4. Estimates of State Variable coefficient $b_{(t)}$ from equation 3.

While, agricultural products play an important role in New Zealand exports its share of GDP is only 5 %. For this reason, we do not need to clear GDP figures from agriculture, when comparing effects from agriculture and the general economy on farmland prices. Time varying parameters estimated from equation 6 suggest a weakening impact from agriculture to farmland prices. From these results however, it could be argued that the magnitude of the impact of agriculture on farmland prices has fallen from ¾ to ½ of total variation in farmland prices within the last 10-12 years in New Zealand. The ending value for $b_{(t)}$ was 0.46.

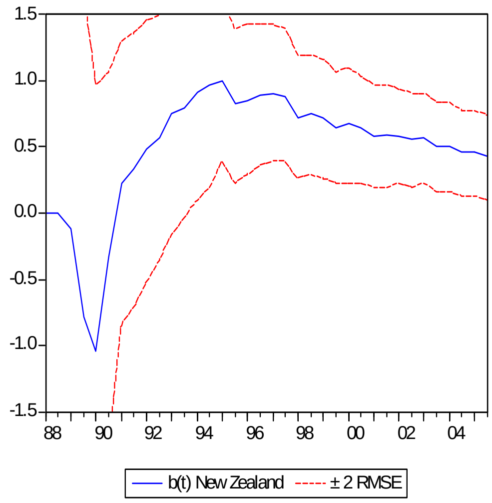


Figure 5. Estimates of State Variable coefficient $b_{(t)}$ from equation 6.

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