To fence or not to fence: A partial probit analysis

Upananda Herath Paragahawewa
AgResearch, Ruakura Research Centre, Hamilton, New Zealand
Email: Upananda.paragahawewa@agresearch.co.nz
Tele: +6478385324
Fax: +6478385117

Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009

Abstract

Based on the results of a probit model estimated from a survey of 1625 farmers from seven major dairying regions in New Zealand, farmers' attitudes (perception about the overall benefits) appear to be are a major governing factor of waterway fencing in all regions. While fencing in Northland and West Coast regions was lower than elsewhere, owner/operators in those regions tended to fence more than farmers with other types of ownership structures. Environmental issues also appeared to be important; however the level of environmental awareness did not reflect the actual degree of fencing.

1. Introduction

Dairy farming in New Zealand extends over 2 million hectares. The majority of this land is privately owned (Agritech, 2006). The major waterways are owned by the crown (Harris, 2004), however landholders can privately own the margin of the land that borders these waterways (the riparian margin). Research suggests that stock access to stream and rivers increases pugging, erosion and direct pollution of water streams (MAF, 2001). The Dairying and Clean Streams Accord was established in 2003 to address dairy-related steam pollution in New Zealand. The exclusion of dairy cattle from streams, rivers and lakes and their banks by fencing is one of the six priorities outlined in the Accord. Fencing is the simplest and the easiest way of excluding stocks from streams. However, fencing is not widely adopted by dairy farmers in New Zealand at present (MAF, 2008). A qualitative assessment (Bewsell et al., 2007) conducted in four catchments in New Zealand indicates that management of stock is a key factor influencing farmer's decision on stream and waterway fencing. However to date, there has been no proper quantitative analysis of determinate factors of fencing and economic studies have yet to fully examine them.

In this study, a model based on random utility theory (McFadden,1974) is developed to evaluate the impact of a range of factors (demographic, economic, social capital, and attitude) on the adoption of waterway fencing in the New Zealand dairy sector. In contrast to existing qualitative studies, this study attempt to account for adoption levels. The adoption level is quantified as the proportion of total length of the streams and drains within and adjacent to a given farm that has been fenced at the time of the survey.

2. Literature and background

Studies by Prokopy et al., 2008; Knowler and Bradshaw, 2007; Kabi and Horwitz, 2006; and Rubas, 2004 have attempted to summarise the extensive literature on adoption of environmental best management practices (EBP). A statistical meta-analysis on agricultural innovations, including EBPs by Rubas (2004), indicated that education and farm size had a weakly positive relationship, age had a weakly negative relationship, and outreach had an insignificant relationship with adoption. A review on adoption of conservation easements by Kabi and Horwitz (2006) found that landholder demographics such as age and tenure, landholder’s knowledge, and attitudes about the programs were main determinants of adoption. Knowler and Bradshaw (2007) reviewed studies from all over the world on adoption of conservation tillage. They indicated that, apart from social capital, there were no universal variables to explain adoption. Prokopy et al. (2008) conducted a comprehensive review of 55 studies on adoption of EBPs over the past 25 years (1982-2007) in the USA. They categorized the independent variables employed in different studies into four broad groups namely, capacity (variables that increases farmers ability to adopt, such as education), attitudes, awareness, and farm characteristics. Their review indicated that most studies were inconclusive about the factors that consistently determine adoption of EBPs. Variables categorized under capacity, such as education levels, income, farm area, capital, farm diversity, labour, and access to information, were found to be insignificant in many studies. When they were significant in EBP adoption, the relationship was positive more often than negative (Prokopy et al., 2008). In the case of the farmers' attitude variables, a few studies showed that farmers who perceive a practice to be profitable were more likely to adopt than farmers who did not. Farmers who had received adoption payments in the past were not consistently more likely to continue to adopt new practices because once farmers participate in a government program they seemed to be increasingly dependent on government support for future adoption Corbett (2002). Many studies indicated that attitudes about the importance of environmental quality and perception of environmental quality always had positive impacts on adoption of EBPs. Studies also indicated that overall awareness of the environmental impacts of farming practices was more likely to have a positive impact on adoption of EBPs. However, Bewsell et al., 2007 found that farmers who chose to fence off streams did so to improve their management of stock, and not necessarily to protect the environment. The impact of farm characteristics has also been considered in the literature. However, as indicated by Prokopy et al. (2008) review, no single characteristic has been studied to a great extent.

3. Discrete choice model

In modelling people's discrete choice decisions, random utility is generally applied as the underlying framework. The main assumption in this framework is that people choose the alternative that provides the greatest utility to them. In addition, the random utility theory accommodates both heterogeneity in preferences and variations in personal choice, where some of the variation in the individual choice is expected to be random and some systematic. In the current study, the preference to fence streams and waterways on their dairy property or not to fence those streams or waterways can be modelled by describing the utility for fencing as $U_f = \beta_f X + \mu_f$ and utility for not fencing as $U_{nf} = \beta_{nf} X + \mu_{nf}$, where μ_f and μ_{nf} are random components of the individual's utility, X is a vector of attributes of the farmer that are measurable, and $\beta_{i = f, nf}$ is a vector that maps those attributes to the utility of that choice. If a farmer decided to fence his property, it indicates that $U_f > U_{nf}$ and therefore that $\beta'_f X - \beta'_{nf} X \succ \mu_{nf} - \mu_f$. Considering $\mu = \mu_{nf} - \mu_f$ and $\beta' X = \beta'_f X - \beta'_{nf} X$, we could set up a framework where a binary choice is treated as the probability that $\mu \leq \beta' X$. By employing latent variable approach, in this framework, y, the observed binary decision represented by 1 or 0, relates to the latent variable $y^* = \beta' X + \mu$. When $y^* > 0$, $y = 1$ and when $y^* \leq 0$, $y = 0$. Given a suitable functional form, the probability that the dependent variable equals one can be estimated as a function of X . For this purpose, a cumulative distribution function (CDF) is applicable. The most commonly used approach in binary choice analysis are those of the normal (probit) and logistic (logit) distribution.

In this analysis, it was observed from the survey data that fencing is being partially adopted in most of the cases and in some instances fully adopted or not adopted at all. This situation indicates the bounded nature of dependent variable and the possibility of observing values at the boundaries. Papke and Wooldridge (1996) were the first to discuss the functional forms and the application of quasi-likelihood estimation methods for regression models with a fractional dependent variable in the economics literature. Wagner (2003) employed a fixed effects fractional logit model to study the data with a fractional dependent variable where the export volumes of the firms were a fraction of total sales of a given firm. In a recent study, Durham (2007) employed a fractional probit model to explain the share of the consumer's purchases that are organic in relation to economic, environmental, health and demographic characteristics. In a similar way to these studies, the current analysis focused on the application of fractional dependent variable models to explain the adoption of fencing as an EBP in the dairy sector in New Zealand. The dependent variable was therefore measured as the portion of water stream length within and adjacent to the farm that has been fenced at the time of the survey. A number of software packages incorporate the fractional response in their non-linear estimates. LIMDEP 9.0 (Green, 2007) software allows for fractional dependent variables using a number of non-linear CDFs. Papke and Wooldridge (1996) discussed the maximizing the Bernoullli log-likelihood function (1) in the process of estimating fractional dependent variable models.

$$Max_{\beta} L = y_i \ln[G(\beta^{'}X)] - (1 - y_i)\ln[1 - G(\beta^{'}X)] - - - (1)$$

Where y_i the fractional dependent variable and $G(\cdot)$ is the cumulative distribution function utilized, which is well defined for $0 \prec G(\cdot) \prec 1$. This process produces consistent parameter estimates (Durham, 2007). However, standard error estimates will not be consistent due to possible misspecification of distributions, such as unspecified heteroskedasticity, incorrect choice of CDF, and omitted variables. The asymptotic variance of β is obtained by sandwich estimator (White, 2002).

4. Survey

A postal survey was undertaken in five regions in the North Island of New Zealand (Northland, Bay of Plenty, Manawatu-Wanganui, Taranaki, and Waikato) and three regions in the South Island (Canterbury, Southland, and West Coast). The selected regions are the main dairy farming regions in New Zealand. The survey in the Waikato region was carried out in a two-month period from March to April 2007 and the rest of the regions were surveyed from February to April in 2008. Sample sizes were decided based on the proportion of all dairy farmers in each region. A stratified random sampling procedure was employed to represent farmers from different land size groups in each region. Randomly selected addresses were obtained from AsureQuality Limited, a private company who maintained a database of farmers in New Zealand. The number of farmers selected according to their farm area and the number of farmers who responded in each region is given in Table 1. A questionnaire was developed to gather information on demographics, economic, attitudinal and other factors that may influence farmers' decision to fence, and the extent of fencing on individual farms. An indicator to capture the farmers' attitudes towards fencing was developed by employing the methodology by Ajzen (2006). The questionnaire was pre-tested with experts in the dairy farming and modified accordingly.

4.1 Eliciting attitudes towards fencing and farmers rating of influential factors

A Likert type 7-point scale was employed to measure farmer's agreement on three factors that could be affecting their decisions to fence streams on their farm. The factors considered were stock management *(STOMAGISS)*, animal health *(ANIHEALISS)*, and environment issues *(ENVIOISS)*. The scale for the question was "very strongly agree", "strongly agree," "agree", "neither agree nor disagree", "disagree", "strongly disagree", and "very strongly disagree." All three issues were assumed to have a positive impact on fencing. An attitude indicator was developed based on farmer's perception of different aspects of fencing. Six different perceptions were presented and farmers were asked to respond on a Likert type 7-point scale where the scale was the same as above. The six perceptions were: [waterway fencing is] very useful, beneficial to my farm, worthwhile investment, an essential practice, helpful in protecting animals from hazards, and helpful to stop stream water pollution. Each farmer's degrees of agreement for the statements were summed up to develop an attitude indicator *(ATTINDEX)* towards fencing. The highest score of 42 would indicate that a farmer's attitude towards fencing was extremely positive whereas the lowest score of 7 would indicate that a farmer's attitude towards fencing was extremely negative.

4.2 Other variables employed in the study

Definitions for all model variables are outlined in Table 2. Regional dummy variables were included to capture any significant differences in fencing among regions. The demographic factors included in the model were: respondent gender (male = 1, female = 0), age (years), number of years dairying, ownership type (owner-operator = 1, sharemilker or other ownership regime = 0), education level (any type of training apart from primary and secondary school education = l, otherwise 0), farm area (in hectares), and degree of involvement in farming (full time = 1 or part time = 0). The number of years of education was also examined as an explanatory variable. Economic variables in the model were kg of milk solids production per cow, and an equity level dummy indicator (equity 90% or more =1 and less than 90% =0). The model also included a variable to capture the impact of social capital (the strength of connections within and between social networks, Bourdieu, 1986) on fencing. An indicator for social capital was developed by considering (i) farmers' involvement with different societies (number of societies), (ii). whether a farmer is a committee member of any society, (iii) the usefulness of involvement with societies to gather information for their farming business (a Likert-type 7-point scale was used to indicate the usefulness of societies in gathering information). The dependent variable was the proportion of total stream and drain length on farm that had been fenced at the time of the survey.

5. Results and discussions

Initial model estimates, using dummy regional variables, indicated that fencing in Northland and West Coast region was significantly lower than in other regions (Table 3). Therefore, two separate models were developed: one for pooled data from Northland and West Coast regions, and the other one for the pooled data from rest of the regions. Summary statistics for the regions are given in Tables 4 and 5 respectively.

Goodness of Fit and Model Tests

Binary choice models are generally evaluated based on the log-likelihood function achieved, measured against the restricted log-likelihood function (all slopes equal to zero), using calculated statistics, and by the accuracy of their predictions. The estimated models perform well as indicated by log-likelihood measures. The log-likelihood gain in the models was significant. Prediction success for the fractional ranges would be examined in a similar fashion to binary models, by studying the percentage of predictions that fall into actual range reported rather than the number of correctly predicted zeros and ones. If the reported proportion was 21-30 percent and the fitted value was greater than or equal to 0.205 and less than 0.305, the prediction is considered in range. The number of predictions that fall into next adjacent range was also calculated. In the model for the Northland and West Coast regions 26.8 percent of predictions fell in the range indicated by the individual farmers surveyed and another 36.1 percent fell within the adjacent range. For the model of the rest of the regions, these percentages were 29.1 and 40.1 percent respectively. Hosmer and Lemeshow (H-L) (2000) as reported in Greene (2007) proposed a diagnostic test that assessed the match between actual and predicted values for logit and probit models. This measure is well-suited to examine share or fractional data (Durham, 2007). A low H-L score indicates a better fit (the measure has a limiting $\chi 2$ distribution with J-2 degrees of freedom). All goodness of fit measures are reported in Tables 6 and 7. These measures indicated that the estimated models were appropriate for explaining the intensity of fencing in dairy farms in the studied regions.

Tables 6 and 7 present the parameter estimates, the calculated marginal effects computed at the mean of the explanatory variables, and the goodness of fit measures. A marginal effect is a change in the fraction fenced for a unit change in each variable. For the dummy variables the reported marginal effect is for the change in probability when the dummy variable goes from 0 to 1, rather than from its mean. The marginal effect is calculated as the difference between the cumulative distribution function, $G(\beta'\mathrm{X})$, calculated with the dummy variable set equal to one, and cumulative distribution function calculated with the dummy variable set equal to zero, with all other variables set at their means.

As indicated in Tables 6 and 7, neither demographic factors nor any of the economic variables were significant explanatory variables for fencing. In both models attitude was a significantly positive variable. This finding mirrors others' work (Napier et al., 2000; Roberts et al., 2004). In the Northland and West Coast regions model, the dummy variable ownership is positive and significant. This indicated that farmers who were the owners of land were more likely to fence streams and waterways than farmers with other types of land ownership. Land ownership is expected to be positively associated with adoption because the owner will directly benefit from adopting practices and owners are assumed to be better stewards of land (Park and Lohr, 2005; Caswell et al., 2001).

Awareness of environmental issues had a significant and negative association with the proportion of waterway fencing in the all regions except for the Northland and West Coast regions. This indicated that although farmers were aware of the environmental impact of their farm activities, in practice farmers do not necessarily act to avoid problems. Blackett (2004) also indicated that the majority of farmers considered themselves environmentally aware. However, most of the farmers do not believe that they are part of environmental problems and do not take specific actions to stop polluting.

6. Conclusion

The results of this study indicate some important factors that should be included in policy agendas in order to enhance farmers' adoption of fencing. Particular attention should be given to sharemilkers, where landowners rent their dairy properties and share the milk harvest with the renters, as this is a common landownership pattern in New Zealand. In addition, the study indicates that the awareness of environmental issues alone will not encourage adoption of EBPs. Thus knowledge of how a behaviour can be carried out is often more important. Finally, a close analysis of different policy measures across different regions would be useful to understand the reason for the significantly lower level of fencing in the Northland and West Coast regions compared to other regions in New Zealand.

7. References

Ajzen I., 2006. Website: http://www-unix.oit.umass.edu/%7Eaizen/

Agritech, 2006. agritech.org.nz

Bewsell, D., Monaghan, R. M., and Kaine, G., 2007. Adoption of stream fencing among dairy farmers in four New Zealand catchments. *Environmental Management* 40(2), 201-209.

Blackett, P.E., 2004. Biophysical and institutional challenges to management of dairy shed effluent and stream management practices on New Zealand dairy farms. *PhD thesis*, University of Auckland, New Zealand.

Bourdieu, P., 1986. Forms of capital. In: John G. Richardson (Ed.). *Hand Book of Theory and Research for the Sociology of Education*, Greenwood, New York.

Corbett, J.B., 2002. Motivation to participate in riparian improvement programs: applying the theory of planned behaviour. *Science Communication* 23(3), 243-463.

Durham, C.A., 2007. The impact of environmental and health motivations on the organic share of produce purchases. *Agri. and Res.Eco.Rev.* 36(2), 304-320.

Dairying and Clean Streams Accord 2003. Fonterra Co-operative group, Local government New Zealand, Ministry for the Environment, Ministry of Agriculture and Forestry.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behaviour. In Zarembka, P. (ed) Frontiers in Econometrics. Academic Press, New York.

Greene, W.H., 2007. LIMDEP (version 9), Econometric modelling guide volume 1 &2.

Harris, R., 2004. *Handbook of Environmental Law*. Forest and Bird Society of New Zealand Inc. Wellington, New Zealand.

Knowler, D., Bradshaw, H., 2007. Farmer's adoption of conservation agriculture: a review and synthesis of recent research. *Food Policy* 32(1), 25-48.

Kabi, T., Horwitz, P., 2006. A review of landholder motivation and determinants for participation in conservation covenanting programmes. *Environmental Conservation* 33(1), 11-20.

Napier, T. I., M. Tucker, S. McCarter 2000. Adoption of conservation production systems in three Midwest watersheds. *Journal of Soil and Water Conservation* 55(2), 123-134.

Park, T.A., Lohr, L., 2005. Organic pest management decisions: A system approach to technology adoption. *Agricultural Economics* 33, 467-478.

Papke, L.E., Wooldridge, J.M., 1996. Econometrics methods for fractional response variables with an application to 401(k) plan participation rates. *J. of App. Econo.* 11(6):619-632.

Prokopy, L.S., Floess, K., Klotthor-Weinkauf D., Baumgart-Getz A., 2008. Determinants of agricultural best management practice adoption: evidence from. *Journal of Soil and Water Conservations* 63(5), 300-311.

Quinn, J., Wilcock, B., 2002. Clean dairying, clean waterways. *AgScience*, 4-5.

Wanger, J., 2003. Unobserved firm heterogeneity and the size exports nexus: evidence from German panel data. *Review of World Eco.*139 (1), 161-172.

White,H., 1982. Maximum likelihood estimation of miss-specified models. Econometrica 50(2), 1-16.

Table 1: Number of farmers selected according to land size groups and number responded in the survey.

Region	No. of Farms	no of farms selected for different land sizes (ha) <150	151-300	301-450	>450	farms responded (%)
Northland	1500	660	260	50	30	200 (20)
Bay of Plenty	900	396	156	30	18	187 (31.2)
Taranaki	2300	792	312	60	36	280 (23.3)
Manawatu-Wanganui	1100	462	182	35	21	152 (21.7)
Waikato	5100	993	389	77	41	488 (32.5)
West coast	350	231	91	18	10	65 (18.5)
Canterbury	820	396	156	30	18	148 (24.6)
Southland	610	330	130	25	15	98 (19.6)
Total						1618 (25.1)

Table 2: Variable Definitions

Name	Definitions
EDUDUM	Training other than primary and secondary school= 1
EDUNOYEA	number of years of education
AGE	Number of years
YRSDAIRY	Number of years at dairying
OWNDUMY	Full ownership=1 Others=0
SOCIALCAP	indicator score for networks
FULTIDUM	Full time farming =1 Part time=0
FARMAREA	Total area under dairying
MIPERCOW	milk production per cow / year
EQUDUMY	Greater than 90% equity=1
ATTINDEX	An indicator score for a attitude towards fencing
STOMAGIS	indicator score for importance of stock management issues
ANIHEALIS	Indicator score on importance of animal health issues
ENVIOISS	Indicator score on importance of environmental issues
REGUISS	Indicator score on importance of regulatory measures
FENCEDPR	Proportion of total stream and drain length that has been Fenced (dependent variable)

Table3-Model estimations with Dummy regional variables

Variable	Coeff	Sta Error
Constant	1.2020	.6223
AGE	-.0033	.0058
OWNDUMY	-.0295	.1618
SOCIALCA	-.0037	.0321
ATTSOCAP	.0060	.0122
EDUDUMY	.0020	.1386
EDUNOYEA	-.0113	.0286
FULTIDUM	-.3946	.2404
FARMAREA	-.0005	.0007
MILKPROD	-.000003	.000008
STOMAGIS	.0134	.0362
ANIHEALI	.0429	.0283
ENVIOISS	-.0881	.0354
REGUISUE	-.0160	.0310
EQUDUMY	.0710	.1468
ATTINDEX	.0268	.0078
DUMBOP	-.1047	.1882
DUMCANTE	.0048	.2286
DUMMANW	-.2938	.2035
DUMNORTL**	-.5035	.1874
DUMSOUTH	.2895	.2671
DUMTARAN	-.3045	.1761
DUMWESC**	-.7686	.2764

Log likelihood function	-394.7478
Restricted log likelihood	-418.9755
Hosmer-Lemeshow chi-squared	7.085
H-L probability value	0.52748

Table 4-Summary statistics West Coast and Northland

Variable	Mean	Std.Dev.	Minimum	Maximum
GENDER	.891386	.311739	.000000	1.00000
AGE	51.2462	10.8262	25.0000	95.0000
YRSDAIRY	28.0625	12.9346	3.00000	74.0000
RSATFAR	19.6241	12.7546	.750000	60.0000
OWNDUMY	.840304	.367022	.000000	1.00000
ETHNDUMY	.939163	.239486	.000000	1.00000
SOCIALCA	4.22467	1.83807	1.00000	19.0000
ATTSOCAP	12.1915	4.83476	3.00000	21.0000
EDUDUMY	.415730	.493773	.000000	1.00000
EDUNOYEA	12.8371	2.33505	6.00000	19.0000
FULTIDUM	.916981	.276433	.000000	1.00000
FARMAREA	162.128	113.539	13.0000	1050.00
NOMCOWS	309.131	177.609	68.0000	1000.00
MILKPROD	95542.0	57200.6	12375.0	352000.
MIPERCOW	308.432	58.8174	118.000	506.000
EQUDUMY	.295276	.457067	.000000	1.00000
FENCEDPR	.643029	.354182	.000000	1.00000
ATTINDEX	28.7581	8.85499	6.00000	42.0000
STOMAGIS	5.53360	1.78504	1.00000	7.00000
ANIHEALI	4.42353	1.97849	1.00000	7.00000
ENVIOISS	4.87200	1.86481	1.00000	7.00000
REGUISUE	4.67068	1.87835	1.00000	7.00000

Table 5: Summary statistics except West Coast and Northland

Variable	Mean	Std.Dev.	Min	Max	N
GENDER	.9	.29	0	1	1349
AGE	49.3	10.5	20	84	1333
YRSDAIRY	27	12.6	1	70	1340
YRSATFAR	16.7	12.1	.1	62	1342
OWNDUMY	.76	.421	0	1	1354
ETHNDUMY	.94	.22	0	1	1324
SOCIALCA	4.2	1.5	1	21	1135
ATTSOCAP	10.4	5.0	2	21	1050
EDUDUMY	.53	.499	0	1	1351
EDUNOYEA	13.1	2.4	6	19	1323
FULTIDUM	.93	.23	0	1	1347
FARMAREA	146.3	121.2	5	1550	1336
NOMCOWS	398.4	322.9	30	5200	1331
MILKPROD	135939	107870	69	1350000	1299
MIPERCOW	344.9	55.5	114	600	1283
EQUDUMY	.217	.412	0	1	1199
FENCEDPR	.79	.32	0	1	1128
ATTINDEX	31.1	8.7	7	42	1223
STOMAGIS	5.8	1.72	1	7	1275
ANIHEALI	4.3	2.1	1	7	1261
ENVIOISS	5.2	1.8	1	7	1279
REGUISUE	5.0	1.82	1	7	1269

Table 6: Model estimates for Northland and West Coast regions data.

Variable	Coeff.	Std. Error	Margin	Std. Err	Elasticity
Constant	-1.3202	1.4661			
AGE	-.0048	.0138	-.0016	.0047	-.1218
OWNDUMY	.7242*	.3801	.2720	.1465	.3255
SOCIALCA	-.0455	.0648	-.0157	.0224	-.1025
ATTSOCAP	-.0154	.0273	-.0053	.0094	-.0909
EDUDUMY	.0430	.3788	.0149	.1310	.0095
EDUNOYEA	.0648	.0790	.0224	.0274	.4151
FULTIDUM	-.3676	.5014	-.1160	.1411	-.1502
FARMAREA	-.0010	.0018	-.0003	.0006	-.0833
NOMCOWS	.0008	.0011	.0003	.0004	.1456
MIPERCOW	.0006	.0022	.0002	.0007	.0918
STOMAGISS	.0034	.0873	.0011	.0302	.0095
ANIHEALI	.0701	.0789	.0243	.0273	.1551
ENVIOISS	-.1231	.0866	-.0427	.0299	-.2936
REGUISUE	.0144	.0846	.0050	.0293	.0333
EQUDUMY	.4841	.3189	.1566	.0949	.0613
ATTINDEX	.0368*	.0208	.0127	.0071	.5449

Log likelihood function	-73.86287
Restricted log likelihood	-81.68997
Hosmer-Lemeshow chi-squared	2.62531
H-L probability value	0.95563
McFadden Pseudo R-squared	.0958147
% predicted in range	.268
% predicted in adjacent range	.361

Table 7: Model estimations for all regions except Northland and West Coast

Variable	Coeff.	Sta. Error	Margin	Std Error	Elasticity
Constant	1.1124	.7705	.2886	.1990	
AGE	-.0021	.0065	-.0005	.0017	-.0334
OWNDUMY	-.2462	.1895	-.0585	.0408	-.0616
ATTSOCAP	.0007	.0118	.0002	.0030	.0026
EDUDUMY	.0539	.1475	.0140	.0385	.0098
EDUNOYEA	-.0256	.0312	-.0066	.0081	-.1086
FULTIDUM	-.3939	.2834	-.0856	.0499	-.0983
FARMAREA	-.0004	.0005	-.0001	.0001	-.0192
MIPERCOW	.0008	.0010	.0002	.0003	.0931
STOMAGIS	.0183	.0400	.0047	.0103	.0335
ANIHEALI	.0325	.0306	.0084	.0079	.0445
ENVIOISS**	-.0864	.0393	-.0224	.0101	-.1433
REGUISUE	-.0163	.0334	-.0042	.0086	-.0258
EQUDUMY	-.0293	.1689	-.0076	.0446	-.0016
ATTINDEX**	.0279	.0084	.0072	.0021	.2747

Log likelihood function	-316.4531
Restricted log likelihood	-329.0020
Hosmer-Lemeshow chi-squared	8.2155
H-L probability value	0.4127
% predicted in range	.291
% predicted adjacent range	.401
McFadden Pseudo R-squared	.0381425