

Using an Ordered Probit Regression Model to Assess the Performance of Real Estate Brokers

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ABSTRACT

The ordered probit regression model is used to investigate domestic real estate brokers in Taiwan, in order to determine the factors affecting the listings of realtors and provide a reference for the domestic real estate brokerage market. Based on empirical analysis, this study found that the Wald Chi-Square of six independent variables reached a significance level of 5%, while the other two independent variables reached 10%. The empirical results indicate that the base pay plus commission system brings in more listings than a commission system and fixed pay. A regular chain type has more listings than a voluntary chain type or a non-chain type. The six variables which reach significant level are senior high (vocational) school, university, position, years of work, the square of the number of years of work, and hours of work per week.

Keywords: *Real Estate Brokerage Market, Ordered Probit Regression Model, Listings, Type of Management, Salary Structure*

INTRODUCTION

Taiwan's real estate brokerage market still has great growth space, and plays an important role in society. The preowned house market is very active. Thus, whether the efficiency of listings of real estate brokerage is rising must be explored. Compared with other countries, domestic real estate brokerage firms feature diversified salary structures and types of management. In Taiwan, forms of management include the regular chain, the voluntary chain, and the non-chain, which business mode, cost bearing, and HR management vary. Thus, whether salary structure affects the performance of real estate brokers should be clarified.

In the study of performance of real estate brokerage, Anderson, Fok, Zumpano, and Elder (1998) employed Data Envelopment Analysis to measure performance, and found that firm size could increase efficiency. Benjamin, Jud, and Sirmans (2000) argued that the salary of real estate brokers is higher than that of other industries. Anderson and James (2000) found that providing job training and education for real estate brokers can increase productive capacity, reduce action risk, and increase firm benefits. William (1995) indicated that large real estate brokerage firms often achieved better results, and that if firms provide new related services, the real estate brokers can increase transaction efficiency. Johnson, Dotson and Dunlap (1988) suggested that the service quality of a real estate brokerage is very important for increasing efficiency. Glower and Hendershott (1988) discussed determinants of real estate broker income, such as gender, educational background and location. Paarsch and Shearer (1999) examined the effects of commission split percentage of real estate brokers on their performance in the same salary system, and found that the commission ratio has significant impact on individual performance.

Li (1999) studied the effects of the type of management of real estate brokerage firms on performance. Findings showed that there is no significant difference between the average sales volume of a franchise system and a regular chain system. Moreover, the average sales volume of a national-brand franchise system and regional regular chains also show no significant difference. In addition, performance of regional brand firms was found to be inferior to national franchise chains and non-chain systems. Li (2001) studied the income of real estate brokers, and found that education, marital status, specialty, years of work, hours of work and location of branch offices have significant effects on their income. The income of brokers with base pay is lower than those without base pay, but the difference is not significant.

Li (2004) examined the effects of gender, age, years of schooling, educational background, years of work, the square of the number of years of work, licenses of brokers, and three types of management, on income of brokers. After applying the ordered probit regression model for evaluation, Li found that the three independent variables of age, educational background and license were not significant.

Based on the foregoing discussion, factors such as operating patterns, salary structure, work experience, and educational background appear to affect the performance of real estate brokerage firms and individual brokers. The degree of the effects and their causes are discussed in this paper. In previous studies, the performance of real estate brokers has been defined as performance-based salary, and listings have seldom been discussed. In practice, real estate brokerage firms make plans for employees to maintain business performance, such as defining the required number of listings and performance-based salary as incentives for employees. Data related to performance-based salary is difficult to collect, and those from questionnaires may be inaccurate. Thus, different from previous studies, this paper aims to explore listings empirically. This is the main contribution of this study.

RESEARCH DESIGN

Ordered Probit Regression Model

This study employed the ordered probit regression model for analysis of determinants affecting listings of real estate brokers. This approach is often applied to analysis of the dependent variable as an ordinal scale. The dependent variable in this paper is listings, expressed as an ordinal scale with three dimensions. The number of listings is expressed as Y^* (when $Y = 1$, it means the number of listings is 5 or less; when $Y = 2$, the number of listings is 6, 7, or 8; when $Y = 3$, the number of listings is 9 or more) and equals the independent variable x function (x is a vector, including gender, educational background, marital status, position, years of work, square number of years of work, hours of work per week, age of firm, number of salespersons, location of branch offices, salary structure, type of management) as shown below:

$$Y^* = B'x + u \tag{1}$$

where u is a error term, assumed to be a normally distributed, which cannot be explained by gender, educational background, marital status, position, years of work, the square of the number of years of work, hours of work per week, age of firm, number of salespersons, location of branch offices, salary structure and type of management. However the error term may be affected by factors other than these variables or by other external factors. Y^* cannot be determined directly, but its order type is known. Thus, the model can be further expressed by:

$$\begin{aligned} \text{Pr ob}(Y = 3) &= F(B'x) && \text{if } u < B'x \\ \text{Pr ob}(Y = 2) &= F(B'x + c) - F(B'x) && \text{if } B'x < u < B'x + c \\ \text{Pr ob}(Y = 1) &= 1 - F(B'x + c) && \text{if } u > B'x + c \end{aligned} \tag{2}$$

$c > 0$ is a parameter

where F denotes cumulative probability distribution function. This model uses the maximum likelihood method to estimate vector β' of independent variable x . This can further explain the deduction process. The listings model is as follows: ¹

$$Y_i = \beta'x_i + u_i, \quad i = 1, 2, \dots, n \tag{3}$$

where i is the observed value, n is the number of observed values. Y cannot be observed directly, and has m types, where m represents number of steps. If $\alpha_{j-1} < Y < \alpha_j, j = 1, 2, \dots, m$, Y is j type, and cannot be observed directly because Y only has an ordinal nature. Through the normalization rule, $Var(u) = 1, u_i \sim IN(0,1)$. Next, the ordinal variable is defined as:

$$\begin{aligned} Z_{ij} &= 1, \text{ if } Y_i \text{ is } j \text{ type} \\ Z_{ij} &= 0, \text{ others} \\ \text{Pr ob}(Z_{ij} = 1) &= \Phi(\alpha_j - \beta'x_i) - (\alpha_{j-1} - \beta'x_i) \end{aligned} \tag{4}$$

Φ is cumulative standard normal distribution. The likelihood function is as follows:

$$L = \prod_{i=1}^n \prod_{j=1}^m [\Phi(\alpha_j - \beta'x_i) - (\alpha_{j-1} - \beta'x_i)]^{Z_{ij}} \quad (5)$$

then the log likelihood function is presented by:

$$L^* = \log L = \sum_{i=1}^n \sum_{j=1}^m Z_{ij} \log[\Phi(\alpha_j - \beta'x_i) - (\alpha_{j-1} - \beta'x_i)] \quad (6)$$

From compactness, we can obtain:

$$Y_{i,j} = \alpha_j - \beta'x_i \quad (7)$$

$$\phi_{i,j} = \phi(\alpha_j - \beta'x_i)$$

$\frac{\partial \Phi(x)}{\partial x} = \phi(x)$, and $\frac{\partial \phi(x)}{\partial x} = -x\phi(x)$, Kronecker delta is defined as:

$$\begin{aligned} \delta_{j,k} &= 1 \text{ if } j=k \\ \delta_{j,k} &= 0 \text{ other} \end{aligned} \quad (8)$$

Thus

$$\frac{\partial L^*}{\partial \beta} = \sum_{i=1}^n \sum_{j=1}^m Z_{ij} \frac{\phi_{i,j-1} - \phi_{i,j}}{\Phi_{i,j} - \Phi_{i,j-1}} x_i = 0 \quad (9)$$

$$\frac{\partial L^*}{\partial \alpha_k} = \sum_{i=1}^n \sum_{j=1}^m Z_{ij} \frac{\delta_{j,k} \phi_{i,j} - \delta_{j-1,k} \phi_{i,j-1}}{\Phi_{i,j} - \Phi_{i,j-1}} = 0 \quad (10)$$

Since Eqs.(9) and (10) are the nonlinear functions of α and β , the asymptotic solution cannot be deduced by arithmetic, but may be deduced by computer technology and the Newton—Raphson method. The iteration method is used to deduce the numerical solution.

Questionnaire Design and Data Collection

The questionnaire contains three parts: (1) personal information, such as gender, marital status, and educational background; (2) variables related to position, years of work, hours of work and similar; and (3) variables related to real estate brokerage firms, such as location of branch offices, age of firms, type of management, salary structure, and number of employees. Their performance is expressed by the average number of listings in the most recent three months. This study investigated real estate brokerage under different types of management in northern, central, and southern Taiwan. To increase the recovery rate, the samples were mailed out four times, and 306 questionnaires were retrieved. After eliminating 15 invalid samples, there were 285 valid questionnaires for an effective response rate of 32%.

Statistical Description of Samples

For the demographic background, 72% are male, and 29% are female. The majority are 31~35 years old (30.6%), followed by 36~40 years old (24.6%). Two-thirds (67.7%) are married, while 30.9% are single. Most have a college education (47.4%), followed by senior high (vocational) school and university education (both are 25.3%). For the analysis, samples from non-chain firms and franchise chains are combined for comparison with samples of regular chains. The number of questionnaires collected from the branch offices of firms in northern, central, and southern Taiwan is 173, 56, and 56, respectively. The cross-over analysis for the type of management and salary structure indicates 65 (75.58%) regular chain offices have adopted base pay plus commission, 112 franchise chain offices (66.67%) have adopted commission systems, and 14 (56%) regular chain offices have adopted commission systems.

Empirical Results Analysis

This study explores the effects of gender, educational background, marital status, years of work, square of the number of years of work, hours of work per week, age of firms, number of employees, location of branch offices, salary

structure and type of management on real estate brokers. The data were analyzed with SPSS16.0 for regression evaluation. As shown in Table 1, the Chi-square value is 49.959, the p value is 0.000, and a significance level is 5%. The fitness of the regression model is superior. In addition, whether ordinal or categorical data meet the assumed percentage must be verified when using an ordered probit regression model for estimation. The test of parallel lines, conducted for verification, demonstrates that this ordered probit regression model is suitable (Chi-square = 12.422, d.f = 14, p-value = 0.572). Wald Chi-square values for the six independent variables reached a significance level of 5%, while the two independent variables reached a significance level of 10%.

The empirical results indicate that the coefficient of gender (male = 1, female = 0) is 0.006. This was not significant ($p < .05$), indicating that gender has no significant effect on the sum of listings. Li (2003) suggested that the income of male brokers is greater than that of female brokers because women have to spend extra time taking care of their families while working. However, the results of this study show that the gender difference is unrelated to the sum of listings. In recent years, women are paying increasing attention to work. With rising awareness of gender equality, women no longer play the main role in homemaking, and their work enthusiasm is equivalent to men.

As for educational background, college education is considered the base line in this analysis. Two dummy variables are set, with senior high (vocational) school the independent variable (senior high (vocational) school = 1, college, university = 0), the coefficient is -0.352, and a significance level is 10%. If university is considered an independent variable (university = 1, senior high (vocational) school = 0), the coefficient is -0.432, and a significance level is 5%. Brokers with a senior high (vocational) school education do not perform as well as brokers with a college education because the latter have better professional knowledge. However, the performance of the real estate brokers with a university education is lower than that of brokers with college education, which is not consistent with the empirical results of Glower and Hendershott (1988). This may be because the education offered by universities and colleges is very similar, and brokers with a college education begin working earlier (university-educated brokers tend to be younger), thus accumulating greater experience and connections, and achieving better performance than brokers with a university education.

For marital status, married is regarded as independent variable (married = 1, single = 0), the coefficient (0.209) is not significant. This demonstrates that the performance of married brokers is the same as that of single brokers. It is often thought that due to family responsibilities, married brokers work harder and make greater efforts to achieve higher salary or position. However, our findings are consistent with those of Follain, Lutes and Meier (1987), who found that performance and marital status have no significant relationship.

For position (manager = 1, broker = 0), the coefficient is 0.533, and the significance level is 5%. This reveals that position can affect listings. The higher the position is, the higher probability of increased listings is. The ability and experience of the employees in higher position are greater than those in lower positions, so that employees in higher positions can achieve better performance. Our results are consistent with theoretical expectations.

The coefficient of years of work is 0.118, and the significance level is 5%. The greater the number of years of work, the greater the probability of increased listings. This result is consistent with the findings of Follain, Lutes and Meier (1987), Glower and Hendershott (1988), and Crellin, Frew and Jud (1988). In theory, more years of work indicate richer work experience. With improved business foundation and abundant, stable connections, the performance of brokers with more years of work is better than brokers with fewer years of work. This result is consistent with expectations.

The coefficient of square of the number of years of work is -0.006, and a significance level is 5%. More years of work indicate a smaller rate of increase in expected listings. This is consistent with the view related to diminishing marginal return. These results are consistent with expectations.

The coefficient of hours of work per week is 0.01, and the significance level is 10%. This demonstrates that the greater the number of hours of work per week, the higher the probability of increasing listings. These findings are consistent with those of Follain, Lutes and Meier (1987), Glower and Hendershott (1988), and Crellin, Frew and Jud (1988). Real estate brokers with longer work weeks have more time to expand their customer base, and the probability of increasing their commitments increases. As expected, the number of their listings increases. These results are consistent the expectations.

The coefficient of age of firms is -0.001, and a significance level of 5% is not reached. This means that the age of firms has no significant impact on listings. This result is not consistent with that of Epley (2001). Generally, branch offices with greater age have better connections with surrounding businesses and local residents, thus possessing higher customer trust. Our results are not consistent with expectations, possibly because information access is now easily accessible, and many branch offices engage in online transaction. In addition, the real estate market in Taiwan has recovered. With all real estate firms doing well, age may not necessarily confer an advantage in performance.

The coefficient of number of salespersons is 0.007, and a significance level of 5% is not attained. This shows that the number of salespersons has no significant effect on the sum of listings. This is different from Crellin, Frew and Jud (1988), possibly because the real estate market in Taiwan has recovered and the number of branch offices is increasing rapidly. Relatively, estate brokers face more and more rivals, and regional listings are divided up easily. Accordingly, the number of salespersons has no significant effect on the number of listings.

Based on the analysis of the location of branch offices, southern Taiwan is considered the base line, two dummy variables are set, and northern Taiwan is the independent variable (northern Taiwan = 1, central and southern Taiwan = 0), and the coefficient is -0.01. When the north is the independent variable (central Taiwan = 1, northern and southern Taiwan = 0), the coefficient is 0.257. The two variables do not reach the significance level of 5%, indicating that the performance of brokers in branch offices in north is not significantly better than that of brokers in southern Taiwan. Similarly, the performance of brokers in central Taiwan is not significantly better than that of brokers in the south. These findings are different from those of Glower and Hendershott (1988) and Li (2000).

In the analysis of the salary structure, base pay plus commission system is treated as the independent variable (base pay plus commission system = 1, commission system and fixed salary = 0), the coefficient is 0.470, and a significance level of 5% is reached. This shows that base pay plus commission system has a greater probability of increasing listings than either a commission system or a fixed salary system. The base pay plus commission system ensures basic salary while providing a commission, enhancing the incentives for brokers. A commission system has no base pay, meaning that the employees have a reduced sense of belonging to a firm. A fixed salary system is applied to new employees from regular chains because new staff cannot achieve better performance due to their insufficient experience and immature business circle foundation. Consequently, the base pay plus commission system appears to result in better performance than the commission system and fixed salary system. These findings differ from those of Li (2001) who found no significant difference in income between brokers with base pay and those without. This may be because performance-based bonuses and group bonuses were taken into account.

In terms of management types, regular chain (regular chains = 1, franchise chain and non-chain firm = 0) is considered the independent variable, the coefficient is 0.442, and a significance level of 10% is reached. Empirical studies show that the probability of increasing listings for regular chains is greater than that of franchise chains and non-chain firms. For regular chains, employees of branch offices are appointed by headquarters, and all operating profits go to the headquarters; any losses are its responsibility as well. Regular chains focus on personnel training, as well as pre-job and post-job training, and offer a series of courses for brokers to deepen their professional knowledge. In addition, regular chains feature well-known brands and a rigorous organizational management system, and are trusted by customers. It is easy for such firms to expand listings. In franchise systems, organizational management is not as rigorous as in regular chains, and the individual franchise offices must assume sole responsibility for profits or losses. Brokers should thus achieve better performance cope with the expenses of branch offices. Employee training lacks comprehensive planning. Thus, the performance of a regular system is superior to that of a franchise system. The non-chain firms represent local original brands, and bear greater risk than regular chains and franchise chains. Personnel training is not as thorough and mature as regular chains and franchise chains. The non-chain firms are smaller and lack popularity. They must rely on stronger local business relationships to strengthen sales. The sum of listings of regular chains is significantly better than that of non-chain firms. However, Li (1999) found no significant difference in average sales volume between franchise chains and regular chains. The reason for this difference is that Li used different dependent variables and a smaller number of samples.

Table 1: Ordered regression analysis (Ordered Probit Model)

	Coefficient	Wald Chi-square value
Initial value (= 1)	1.228	6.941**
Initial value (= 2)	2.371	24.461**
Gender (male = 1, female = 0)	0.006	0.001
Senior high (vocational)school (senior high (vocational) school = 1, college, university = 0)	-0.352	3.201*
University (university = 1, senior high(vocational) school, college = 0)	-0.432	5.185**
Marital status (married = 1, single = 0)	0.209	1.303
Position (manager = 1, broker = 0)	0.533	8.907**
Years of work	0.118	5.442**
Square number of years of work	-0.006	6.100**
Weekly hours of work	0.010	3.054*
Age of firm	-0.001	0.005
Number of salespersons	0.007	0.337
Northern Taiwan (northern Taiwan = 1, central and southern Taiwan = 0)	-0.01	0.002
Central Taiwan (central Taiwan = 1, northern and southern Taiwan = 0)	0.257	1.086
Salary structure (base pay plus commission system = 1, commission system, fixed salary = 0)	0.470	6.791**
Type of management (regular chain = 1, franchise chain and non-chain = 0)	0.442	4.231**
Chi-squared	49.959	
Degree of freedom	14	
Number of observed samples	285	

Note: 1.independant variable is average listings of estate brokers in the past three months

2."**" represents significance level of 5%, "*" represents significance level of 10%.

3.Chi-squared represents Chi-squared value of fitness information of model reaches significance level of 5%.

Table 2 shows the marginal effect of listings. When the listings are fewer than 5, senior high (vocational) school, university and type of management have the greatest effects. The probability of increasing listings is 15.54% when the number of brokers with senior high (vocational) school education exceeds the number with a college or university education. The probability of increasing listings is 12.95% when the number of brokers with a university education exceeds the number with a senior high (vocational) school education. The probability of increasing listings is 15.34% when brokers of regular chains are fewer than those of non-chain firms.

When the number of listings is 6 to 8, senior high (vocational) school, university and type of management have the greatest impact. The probability of increased listings is 3.03% when the number of brokers with a senior high (vocational) school education is less than the number with a university education. The probability of increasing listings is 2.53% when the number of brokers with a university education is less than the number with a senior high (vocational) school education. The probability of increasing listings is 2.99% when the number of brokers of regular chains is greater than the number of franchise chains.

When the number of listings exceeds 9, senior high (vocational) school, university and type of management have the greatest impact. The probability of increasing listings is 12.51% when the number of brokers with a university education is less than the number with a senior high (vocational) school education. The probability of increasing listings is 10.43% when the number of brokers with a university education is less than the number with a senior high (vocational) school education. The probability of increasing listings is 12.35% when the number of brokers of regular chains is greater than the number brokers for franchise chains.

According to the analysis of marginal effects, senior high (vocational) school education, university education, and type of management have greater effects on listings. To increase listings, educational level, and type of management need to be further understood and selected.

Table 2: Marginal effect of listings number (listings number is considered as dependent variable)

Independent variable	Below 5	6~8	Above 9
Gender (male = 1, female = 0)	-0.0403	0.0079	0.0324
Senior high (vocational) school (Senior high (vocational) school = 1, college, university = 0)	0.1554	-0.0303	-0.1251
University (university = 1, senior high (vocational) school, college = 0)	0.1295	-0.0253	-0.1043
Marital status (married = 1, single = 0)	0.0002	0.0000	-0.0001
Position (manager = 1, broker = 0)	-0.0001	0.0000	0.0001
Years of work	-0.0613	0.0119	0.0493
Square number of years of work	0.0029	-0.0006	-0.0023
Weekly hours of work	0.0000	0.0000	0.0000
Age of firm	0.0002	0.0000	-0.0002
Number of salespersons	0.0025	-0.0005	-0.0020
Northern Taiwan (northern Taiwan = 1, central and southern Taiwan = 0)	-0.0424	0.0083	0.0341
Central Taiwan (central Taiwan = 1, northern and southern Taiwan = 0)	-0.1005	0.0196	0.0809
Salary structure (base pay plus commission system = 1, commission system and fixed salary system = 0)	-0.0004	0.0001	0.0003
Type of management (regular chain = 1, franchise chain and non-chain = 0)	-0.1534	0.0299	0.1235

Note: bold face represents the variable is significant in the model.

CONCLUSIONS

Conclusions

In this study, gender, educational background, marital status, position, years of work, square of the number of years of work, hours of work weekly, age of firms, number of salespersons, location of branch offices, salary structure and type of management are considered independent variables, and an ordered probit regression model is used to evaluate impact of these variables on listings of real estate brokers. Results indicate that Wald Chi-square value of eight independent variables reached the significance level.

Based on empirical results, brokers with a college education exhibit performance superior to brokers with a senior high (vocational) school education. Higher position leads to greater probability of increasing listings; more years of work leads to a greater probability of increasing listings. However, more years of work also leads to smaller rate of increase in listings.

Real estate brokers with base pay plus commission have a greater probability of increasing listings than the brokers with a commission and fixed salary. In addition, brokers of regular chains have a greater probability of increasing listings than brokers of franchise chains and non-chain firms. Based on the analysis of marginal effect, the effects of senior high (vocational) school education, university education, and type of management on listings are greatest. If managers of real estate firms intend to increase overall listings, the educational level of their brokers, along with the type of management, should be addressed.

Future Studies

This study discusses the effects of different variables on listings. This is different from past studies, and is the main contribution of this paper. Further study may explore increasing the sample of non-chain firms, and compare the differences between regular chains, franchise chains, and non-chain firms. The effects of individual commission percentage and group bonus of different types of management on business performance should also be analyzed. In addition, how performance may be related to gender, marital status and whether brokers have children would also be good topics for investigation.

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NOTES

¹ For the deduction of the likelihood function refer to Maddala (1999) and Li (2004).