A Multivariate Probit Analysis on the Factors Influencing the Adoption of Water Saving Technologies by Rice Farmers in Sto. Domingo, Nueva Ecija

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We study the adoption of rice farmers of some water saving technologies (WST) such as controlled irrigation, direct seeding, land leveling and aerobic rice system. A multivariate probit model for the adoption of each WST is constructed since usage of different technologies exhibit correlation. The significant factors that influence the WST adoption are education, experience in rice farming, family income of the farmers, and size of manpower involved in farming. Higher education is needed to enhance the ability to successfully implement the WST. Experience in rice farming, i.e., the number of years a farmer is involved in rice management and production, increases the likelihood of adoption among farmers. Farmers with high income have lower likelihood of adoption since the production system in place is already efficient. Furthermore, a farmer is more likely to adopt the technology as more manpower is involved in the production system. The estimated model indicated that the probability of adoption of controlled irrigation is higher than the other three WST. In addition, the adopters of WST had greater output in terms of the harvested rice.

Keywords: Water Saving Technology, Multivariate Probit Model, Univariate Probit Model

1. Introduction

Rice is the predominant staple crop in Asia. However, it requires large amount of water and water problems are among the most complex scientific and technical challenges in the present times. In the Philippines, water shortage is perennially experienced due to low rainfall, water pollution and improper use of fresh water causing severe water stress to agricultural crops. The Philippine government, through the National Irrigation Authority (NIA) and the Philippine Rice Research

Institute (PhilRice), along with the International Rice Research Institute (IRRI) is dedicated in maintaining and enhancing irrigation water availability through infrastructure development and maintenance and the propagation of water saving technologies (WST). Some of these WST are controlled irrigation, direct seeding, land leveling and aerobic rice system.

WST are established to lead towards water conservation, water productivity and increase in yield. Studies conducted in the provinces of Tarlac, Nueva Ecija, Bohol and Bulacan reported that aerobic rice system can increase up to 6.4 tons of aerobic rice per hectare compared to standard practice of the farmers. Furthermore, Lampayan et al. (2003) noted that aerobic rice varieties in Tarlac and Nueva Ecija showed remarkable yield performance compared to conventional lowland varieties.

Direct seeding also yield 27% - 56% return on investment compared to transplanted rice. Furthermore, it reduces water requirement and increase water use efficiency and drought tolerance compared to transplanting.

Rickman (2002) noted a large increase in rice yield due to good field leveling. For the same rice varieties and fertilizer input, the average increase in crop yield due to properly leveled field was 24% or 530 kg/ha. It also significantly altered many linear relationships among soil chemical properties and microbial biomass, thus the benefit of improved water distribution must be weighed against the relatively severe and immediate alteration of soil properties and natural processes brought on by land leveling.

Lampayan et al. (2003) showed that the amount of water supplied in controlled irrigation is about 30% - 40% lower than that of the standard irrigation practice. Moreover, production under controlled irrigation had the highest average yield of about 7.5 tons per hectare. Despite of these advantages of WST, adoption rate of farmers was relatively low because of inadequate government extension support.

We used multivariate probit analysis to characterize the adoption of each WST. A multivariate probit analysis was deemed appropriate since it involves simultaneous modeling of several dichotomous dependent variables that are correlated, indeed, the four WST included in the study exhibit correlation. We further compare the characteristics of farmers who are adopters and non-adopters.

2. Methodology

A master list of the number and names of farmers per Irrigators Association (IA) in Sto. Domingo, Nueva Ecija from the compilation of Lateral B-Main of Irrigators Association, Inc. of 2007 of NIA District 1 – UPRIIS was obtained. There were a total of 2,194 farmers, of which 259 farmers were randomly selected and personally interviewed.

2.1 Methods of analysis

A descriptive analysis on the socio-demographic and farm characteristics and rice yield of the farmers was done and a multivariate probit model was then used to further analyze the data. A screening process of possible determinants was done through univariate probit analysis, all potential explanatory variables were included for each of the four water saving technologies. The significant explanatory variables in the univariate probit analysis were retained in the multivariate probit model of the water saving technologies. We then computed the probability of adoption and non-adoption for each of the water saving technologies. Finally, independent sample t-tests were conducted to determine if there are significant differences in the socio-demographic, farm characteristics, and rice yields between adopters and non-adopters of water saving technologies.

The multivariate probit analysis was postulated due to the presence of contemporaneous correlation existing between water saving technologies. Thus, it was used to take into account the correlation of the disturbances across equations. The general form of the model is given by

$$I^*_m = \beta'_m X_m + \epsilon_m, m = 1,2,...,M, \; I^*_m = \begin{cases} 1 \text{ if } I^*_m > 0 \\ 0 \text{ otherwise} \end{cases} \quad (1)$$

where ϵ_m, m = 1, 2, …, M are distributed as multivariate normal with mean vector 0 and covariance matrix R with diagonal elements equal to 1 (Greene, 2002).

3. Results and Discussions

The socio-demographic and farm characteristics of the farmers are presented in Tables 1 and 2. The average age of rice farmers in Sto. Domingo, Nueva Ecija is 51.08 years old. The youngest farmer is 28 years old and the eldest farmer is 89 years old. Most of the samples have other jobs aside from farming (e.g., driving, store keeping, etc). The average number of children of the farmers was about 3.69. There were farmers who have no children but one has thirteen children. The average annual family income is PhP 109,000. The farmers reported to have been into farming from 5 to 74 (average of 27.86) years. On average, farmers attended only 8.81 seminars. The average farm size used in rice farming is about 1.59 hectares. In addition, the survey revealed that the average total cost of the farm or the total farm asset was about PhP 1.77 million.

In Table 2, most of the farmers are male which is expected since farming is perceived as a man's job and historically, such in the case as well. In addition, 88.4% of the farmers are married, 2.7% and 8.9% are single and widowed groups, respectively. Moreover, most of the farmers (42.1%) only have elementary school level or have only reached high school level (40.2%)

Table 1. Descriptive statistics of socio-demographic characteristics of the farmers

Socio-Demographic Characteristics	Minimum	Maximum	Mean	Standard Deviation
Age (in years)	28.00	89.00	51.08	11.23
No. of Other Jobs	0.00	4.00	0.79	0.84
Number of Children	0.00	13.00	3.69	1.97
Annual Family Income (in 10,000 pesos)	3.00	35.00	10.90	3.50
Seminars Attended	0.00	23.00	8.80	4.08
Farmer's Experience (in years)	5.00	74.00	27.86	13.77
Farm Size (in ha.)	0.30	6.50	1.59	1.27
Farm Asset (in million pesos)	2.50	7.50	1.77	1.43

Table 2. Frequency distribution of socio-demographic characteristics of the farmers

Socio-Demographic Characteristics	Frequency (n=259)	Percentage
Gender		
Male	237	91.5
Female	22	8.5
Civil Status		
Single	7	2.7
Married	229	88.4
Widowed	23	8.9
Educational Attainment		
Elementary	109	42.1
High School	104	40.2
Vocational	11	4.2
College	35	13.5

Tables 3 and 4 describe the farm characteristics of the farmers. From Table 3, the number of persons involved in rice production averages 1.78. In a scale of 1 to 10 (highest), the average rating of the quality of work of the manpower involved in production is 7.28. Moreover, farmers are described as risk takers since the average risk rating is 6.28. Risk is measured to determine if the farmers can take risk of his/her production on technology not familiar to them.

Farmers usually have minimal or insufficient funds and they usually borrow some money to support production. In Table 4, 74.9% of the farmers are in debt related to rice production activities. Eighty-seven percent of them intend to pass

Table 3. Descriptive statistics of farm characteristics

Farm Characteristics	Minimum	Maximum	Mean	Standard Deviation
Labor Quality	2	10	7.28	1.94
Size of Manpower	1	8	1.78	1.19
Risk	1	10	6.28	2.49

Table 4. Frequency distribution of farm characteristics

Farm Characteristics	Frequency (n=259)	Percentage
Awareness		
Yes	213	82.2
No	46	17.8
Debt		
Yes	194	74.9
No	65	25.1
Pass		
Yes	226	87.3
No	33	12.7

the farm operation to his or her family member. In addition, 82.2% of them are aware that water saving technologies help in production of rice with minimal amount of water and result in generally good yield.

Table 5 noted that most of the farmers adopt controlled irrigation; adoption rate is at 53.7%. The second choice of the farmers is direct seeding with an adoption rate of 17.4%, followed by aerobic rice system (16.2%), and land leveling (14.7%).

Table 5. Frequency distribution of farmers using Water Saving Technologies

WST	Frequency	Percentage
Controlled Irrigation	139	53.7
Direct Seeding	45	17.4
Land Leveling	38	14.7
Aerobic Rice System	24	16.2

In Table 6, 26.3% of the farmers are non-adopters of any of the four water saving technologies. In addition, 55.6% of farmers in Sto. Domingo adopt only one WST, 8.1% of them adopt two, and 10% of them adopt three.

Table 6. Frequency distribution of farmers' adoption of Water Saving Technologies

Number of WST Adopted	Frequency	Percentage
No usage of WST	68	26.3
One WST Adopted	144	55.6
Two WST Adopted	21	8.1
Three WST Adopted	26	10.0

3.1 Construction of Multivariate Probit Models

The following variables were used in the construction of a multivariate probit model:

Age specify the age of the farmer in years.

Annual family income (AFINC) refers to the combined yearly earnings of the family.

Awareness (AWARE) refers to whether a farmer is aware on the existence of water saving technologies used in rice farming.

Civil status (CS) indicates whether the farmer is married, single, widowed or separated. (1=single, 2=married, 3=widowed, 4=separated)

Debt indicates whether a farmer has a debt on his or her last farm operation including the planting or seeding and harvesting.

Education (EDUC) indicates the highest educational attainment of the farmer

Experience (EXPR) indicates the numbers of years a farmer is involved in rice production.

Farm Asset (ASSET) indicates the amount of the farmer's total farm resources (in millions)

Farm Size (SIZE) indicates the size (in hectares) of the farm intended for rice farming.

Gender indicates the sexuality of the farmer. That is, zero (0) for female and one (1) for male.

Labor Quality (LQUAL) indicates the quality of labor available to the farmer. Thus this variable measures the farmer's perception of the quality of labor available. The range of values is from 1 (lowest) to 10 (highest).

Number of Children (NCHILD) refers to the number of children of the farmer

Number of Jobs (NJOB) other than farming refers to the number of other business or career of the farmer other than farming.*Risk* indicates the risk perception of the farmer toward his or her farm production.

Seminars attended (SATT) indicate the number of trainings and seminars on water saving technology attended by the farmers.

Size of Manpower (SMAN) refers to the numbers of persons employed by the farmer to manage the farm operation by helping in the planting, seeding and harvesting as well as selling of harvested products.

Pass indicates whether a farmer has an intention to pass on the operation of the farm to any of the member of the family

A univariate probit analysis was done first with the four WSTs as the dependent variables. Five potential explanatory variables are significant in the adoption of controlled irrigation (WST 1) — age of the farmers, highest educational attainment, experience of the farmers, risk, and debt. The number of seminars attended, the farmer's experience, and risk aversion are all significant variables in direct seeding (WST 2). Nine explanatory variables are significant in land leveling (WST 3), [farmer's age, number of other jobs, annual family income, seminars attended, farmer's experience, farm size, farm asset, debt, and the number of organizers managing the farm operations]. Annual income and the number of persons managing the farm operation are both significant in aerobic rice (WST 4). These significant variables are used in building multivariate probit model for the adoption of the four WSTs.

Table 7 showed the correlation matrix of the four water saving technologies showing that direct seeding, controlled irrigation, land leveling and aerobic rice have significant relationships. Existence of the correlation among the categories of the response variable justified the use of multivariate probit analysis in the data. According to Gillespie et al. (2004), the simultaneous equation system of the multivariate probit will provide efficient estimates when contemporaneous correlation is present.

Table 7. Correlation Matrix of the Four WST

Water Saving Technology	Controlled Seeding	Direct Seeding	Land Leveling	Aerobic Rice
Controlled Irrigation	1	-0.971*	0.035	0.194
Direct Seeding		1	-0.095	-0.250
Land Leveling			1	0.431*
Aerobic Rice				1

*. Significant at 5% level of significance

Controlled irrigation had a negative relationship with regards to direct seeding. This implies that if a farmer adopted controlled irrigation he or she is less likely to adopt direct seeding. Furthermore, land leveling and aerobic rice system had a positive relationship. A farmer using land leveling will have a greater chance of using aerobic rice. Thus, aerobic rice may be best planted on a land leveled farm.

The model for the adoption of controlled irrigation is given by

$$I_{CL}=-.2119\underset{(0.0113)}{-0.0298}(AGE)\underset{(0.0956)}{+0.2776}(EDUC)\underset{(0.0097)}{+0.0360}(EXPR)\underset{(0.0334)}{+0.1000}(RISK)\underset{(0.1543)}{-0.4623}(DEBT)$$

A farmer's age has a negative relationship with the adoption of controlled irrigation. That is, younger farmers are more likely to adopt this technology. Farmer's education is positively related with the adoption of controlled irrigation. Various studies have shown that better educated people are more likely to adopt new technology because they possess a longer planning horizon. In addition, a farmer's experience has a positive relationship with regards to the adoption of controlled irrigation. Thus, the longer years of experience they have in farming allowed them to experience different scenarios of water scarcity that made them more likely to adopt this technology. Moreover, as a farmer becomes a risk taker he would more likely adopt this water saving technology. Using the model, on the average, the computed probability of adopting controlled irrigation is 0.5239.

Risk was the only significant variable that relates to the adoption of direct seeding. The model is given by

$$I_{DS} = -0.74565\underset{(0.0344)}{-0.0765}(RISK)$$

Unlike the adoption of controlled irrigation, farmers who adopt direct seeding are said to be risk averse implying that they are afraid to take risk. Using this equation, the probability of adopting direct seeding is 0.1093.

The significant variables in the model of adoption of land leveling are the other jobs of farmers, number of seminars attended, total farm asset, and the number of organizers and is given by

$$I_{LL} = -2.3362\underset{(0.2508)}{-0.7035}(NJOBS)\underset{(0.0825)}{-0.1999}(SATT)\underset{(0.1348)}{+0.5197}(SMAN)$$

This showed that jobs and the number of seminars had negative coefficients, a farmer having more jobs will not likely to adopt land leveling as well as those with numerous seminars attended. In terms of organizers, if there are many persons involved in managing the farm operation then it will be more likely to adopt land leveling. Also, the computed probability of adopting land leveling is 0.0001.

Lastly, income and number of organizers are significantly related to the adoption of aerobic rice system. From the derived model below, the probability of adopting aerobic rice is, on the average, 0.0793.

$$I_{AR} = -3.3078\underset{(0.1974)}{+1.3288}(AFINC)\underset{(0.0825)}{+0.2490}(SMAN)$$

3.2 *Comparison of Adopters and Non-adopters of WST*

Using t-tests to compare the adopters and non-adopters, there are significant differences on their annual family income, number of seminars attended, farmers' experience, farm size and asset, manpower involved in farming and harvested rice as shown in Table 8. Adopters attended more seminars compared to non-adopters and are more experienced in farming. Moreover, adopters have wider farms intended for rice production compared to non-adopters as well as more assets. Also, more manpower is involved in the farm of adopters than non- adopters. There exists a large difference in terms of rice yield between adopters and non-adopters as well. Adopters had an average rice yield of 98.06 cavans per hectare while non-adopters have 86.19 cavans per hectare.

Table 8. Comparison of Adopters and Non-Adopters using T-test on Some Farmer

Variable	Adopters (n=191)		Non-Adopters (n=68)		P-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Age	51.43	11.36	50.10	10.88	0.402
Number of Other Jobs	0.77	0.816	0.84	0.92	0.565
Number of Children	3.84	1.963	3.26	1.94	0.390
Annual Family Income (in hundred thousand peso)	1.17	0.765	0.72	0.331	0.000*
Seminars Attended	9.35	4.02	7.25	3.84	0.000*
Farmer's Experience (in years)	29.31	13.74	23.78	13.10	0.004*
Risk	6.39	2.39	5.97	2.73	0.230
Farm Size (in hectares)	1.68	1.406	0.87	0.991	0.000*
Farm Asset (in million pesos)	1.94	1.558	1.21	0.802	0.000*
Labor Quality	7.38	2.01	7.00	1.68	0.134
Size of Manpower	1.93	1.29	1.38	0.71	0.000*
Harvested Rice (per hectare)	98.06	21.199	86.19	21.232	0.000*

*significant difference at $\alpha = .05$

4. Conclusions

We focused on the adoption of water saving technologies—namely controlled irrigation, direct seeding, land leveling, and aerobic rice system—in rice farming in Sto. Domingo, Nueva Ecija. The adoption rates of different water saving technologies in Sto. Domingo was low; 17.4%, 14.7% and 16.2% for direct seeding, land leveling, and aerobic rice system, respectively. Only controlled irrigation had a high adoption rate over 50%. In addition, 42.1% of the farmers are elementary level educated of which majority of them are non-adopters.

The average annual family income of adopters of WST is PhP 1.17 (in hundred thousand pesos) while non-adopters earn only PhP 0.72 (in hundred thousand peso) per year. Also, adopters have an average farm size of 1.68 hectares compared to non-adopters with an average of only 0.87 hectares.

Multivariate probit analysis is deemed appropriate in modeling the four WST since adoptions of each type are correlated. For controlled irrigation, the significant variables are age, education, experience, risk, and debt. However, age and debt are negatively correlated to the adoption of controlled irrigation. Thus, older farmers and those with debt are less likely to adopt controlled irrigation. However, education, experience and risk are positively correlated to the adoption of controlled irrigation. This implies that educated farmers are more likely to adopt this technology. In addition, farmers with longer experience in terms of rice farming and farmers that are risk takers are more likely to adopt this technology since they are not afraid to try new technologies that may seem to improve their production. For direct seeding, the only significant variable is risk. Risk taker farmers are less likely to adopt direct seeding since it is negatively correlated towards the adoption of direct seeding. Moreover, for land leveling, the variables that can be used to predict the probability of adoption are number of jobs, seminars attended, and size of man power. Both seminars attended and numbers of jobs are found to be negatively related with regards to the adoption of land leveling. That is, as the number of jobs of a farmer increases, his/her adoption to land leveling is less likely to occur. Finally, for the adoption of aerobic rice system, the significant variables are income and number of organizers. That is, farmers with larger income and with more manpower are more likely to adopt aerobic rice system. The multivariate probit analysis showed that the probability of adoption of controlled irrigation (0.5239) is higher than direct seeding, land leveling and aerobic rice with probability values of 0.1093, 0.0001, and 0.0793, respectively.

References

GILLESPIE, J., et. al., 2004, Factors Influencing the Adoption of Breeding Technologies in U.S. Hog Production. *Journal of Agricultural and Applied Economics. Southern Agricultural Economics Associations*. Volume 36: pp. 35 – 47.

GREEN, W. 2002. Econometric Analysis. 5th Edition. New Jersey: Prentice Hall.

LAMPAYAN R.M, et al., 2003. Transitions in Agriculture for Enhancing Water Productivity. Presented in International Workshop "Transitions in Agriculture for Enhancing Water Productivity" in Tamil Nadu, India, September 2003

RICKMAN, J.F. 2002. Manual for Laser Land Leveling. Rice-Wheat Consortium Technical Bulletin Series 5. Rice-Wheat Consortium for the Indo-Gangetic Plains. New Delhi, India.

APPENDIX A: UNIVARIATE PROBIT ANALYSIS

Probit regression

Number of obs=259

LR chi2 (17)=115.66

Prob > chi2=0.0000

Log likelihood=-120.99941

Pseudi R2=0.3234

Wst1	Coef.	Std. Er.	z	P>|z|	[95% conf. Interval]	
sex	.101005	.3808471	0.27	0.791	-.6454415	.8474515
age	-.0367803	.0153859	-2.39	0.017	-.0669361	-.0066246
status	.3846515	.305468	1.26	0.208	-.2140547	.9833577
jobs	-.1909673	.1294213	-1.48	0.140	-.4446283	.0626938
children	-.0672873	.0646414	-1.04	0.298	-.1939821	.0594076
income	.5410459	.2943319	1.84	0.066	-.0358341	1.117926
education	.3392945	.1185583	2.86	0.004	.1069246	.5716645
seminars	-.0718901	.0441916	-1.63	0.104	-.1585041	.0147238
experience	.0558043	.01588	3.51	0.000	.02468	.0869286
risk	.1425812	.0415005	3.44	0.001	.0612417	.2239208
size	-.1624499	.4987947	-0.33	0.745	-1.140069	.8151697
asset	.6438481	.4912612	1.31	0.190	-.3190062	1.606702
debt	-.7274798	.2521582	-2.89	0.004	-1.221701	-.2332588
work	.0073068	.0527609	0.14	0.890	-.0961026	.1107163
personnels	-.044649	.0947431	-0.47	0.637	-.2303422	.1410441
awareness	.1050905	.3665266	0.29	0.774	-.6132884	.8234694
pass	-.1115488	.2815047	-0.40	0.692	-.6632879	.4401903
_cons	-1.659603	1.011689	-1.64	0.101	-3.642478	.3232712

Probit regression

Number of obs = 259

LR chi2 (17) = 51.07

Prob > chi2 = 0.0000

Log likelihood = -94.067103

Pseudi R2 = 0.2135

Wst2	Coef.	Std. Er.	z	P>|z|	[95% conf. Interval]	
sex	-.3282726	.3703973	-0.89	0.375	-1.054238	.3976929
age	.0177332	.0176773	1.00	0.316	-.0169135	.05238
status	-.0134602	.3734586	-0.04	0.971	-.7454255	.7185051
jobs	-.0821722	.1405436	-0.58	0.559	-.3576326	.1932882
children	.0729089	.0685489	1.06	0.288	-.0614444	.2071622
income	.0450422	.360327	0.13	0.901	-.6611856	.7512701
education	-.122515	.1373917	-0.89	0.373	-.3917978	.1467678
seminars	.112866	.0519268	2.17	0.030	.0110913	.2146406
experience	-.0380609	.0186495	-2.04	0.041	-.0746132	-.0015086
risk	-.136025	.0456099	-2.98	0.003	-.2254188	-.0466312
size	-.5288049	.6988175	-0.76	0.449	-1.898462	.8408523
asset	-.2416773	.6823121	-0.35	0.723	-1.578984	1.09563
debt	.1482122	.2725137	0.54	0.587	-.3859048	.6823291
work	.0168786	.0574111	0.29	0.769	-.0956451	.1294023
personnels	.1391913	.1028372	1.35	0.176	-.062366	.3407485
awareness	.2522509	.4150158	0.61	0.543	-.5611652	1.065667
pass	-.237805	.2983072	-0.80	0.425	-.8224764	.3468664
_cons	-.2065323	1.134955	-0.18	0.856	-2.431003	2.017938

Probit regression

		Number of obs	=	259
		LR chi2 (17)	=	160.22
		Prob > chi2	=	0.0000
Log likelihood	= -27.887304	Pseudi R2	=	0.7418

Wst3	Coef.	Std. Er.	z	P>|z|	[95% conf. Interval]	
sex	-.8645893	.7674641	-1.13	0.260	-2.368791	.6396127
age	-.0923739	.0411039	-2.25	0.025	-.1729361	-.0118117
status	-1.344058	.8258652	-1.63	0.104	-2.962724	.2746079
jobs	-.9569725	.3860407	-2.48	0.013	-1.713598	-.2003467
children	.2873973	.1476776	1.95	0.052	-.0020454	.5768401
income	1.041447	.4944467	2.11	0.035	.0723494	2.010545
education	.440103	.2887164	1.52	0.127	-.1257707	1.005977
seminars	-.348089	.1388075	-2.51	0.012	-.6201468	-.0760313
experience	.1002369	.043496	2.30	0.021	.0149863	.1854876
risk	.2249388	.1289215	1.74	0.081	-.0277428	.4776204
size	-1.955998	.9499931	-2.06	0.039	-3.81795	-.0940457
asset	2.813356	.9970752	2.82	0.005	.8591248	4.767588
debt	1.331683	.6745137	1.97	0.048	.0096603	2.653705
work	-.0924366	.1129197	-0.82	0.413	-.3137551	.1288819
personnels	.4091452	.1555322	2.63	0.009	.1043078	.7139827
awareness	-.0080184	1.000776	-0.01	0.994	-1.969504	1.953467
pass	.0803696	.5096805	0.16	0.875	-.9185858	1.079325
_cons	-.5755904	2.05779	-0.28	0.780	-4.608786	3.457605

Probit regression

		Number of obs	=	259
		LR chi2 (17)	=	125.06
		Prob > chi2	=	0.0000
Log likelihood	= -52.266656	Pseudi R2	=	0.5447

Wst4	Coef.	Std. Er.	z	P>|z|	[95% conf. Interval]	
sex	.0939511	.560031	0.17	0.867	-1.00369	1.191592
age	-.0498752	.029735	-1.68	0.093	-.1081546	.0084043
status	-.3036479	.5160989	-0.59	0.556	-1.315183	.7078874
jobs	.0240136	.1633494	0.15	0.883	-.2961455	.3441726
children	.1651538	.1032408	1.60	0.110	-.0371944	.367502
income	1.673924	.3598279	4.65	0.000	.9686747	2.379174
education	.1949637	.170131	1.15	0.252	-.1384869	.5284143
seminars	.0306839	.0657001	0.47	0.640	-.0980859	.1594537
experience	.0362337	.0308593	1.17	0.240	-.0242494	.0967168
risk	-.0756861	.0663161	-1.14	0.254	-.2056634	.0542911
size	-.8345806	.5766558	-1.45	0.148	-1.964805	.2956439
asset	.6691765	.5227377	1.28	0.200	-.3553705	1.693723
debt	.4858694	.3875941	1.25	0.210	-.2738011	1.24554
work	.104653	.0793321	1.32	0.187	-.0508351	.2601411
personnels	.2739781	.122716	2.23	0.026	.0334591	.5144971
awareness	-.6811024	.6489534	-1.05	0.294	-1.953028	.5908229
pass	-.3227683	.3824124	-0.84	0.399	-1.072283	.4267463
_cons	-2.77472	1.556632	-1.78	0.075	-5.825662	.2762213

Appendix B: Multivariate Probit Analysis

Multivariate probit (SML, # draws=5)			Number of obs	=	259
			Wald chi2 (19)	=	140.64
Log likelihood	=	-314.40398	Prob > chi2	=	0.0000

	Coef.	Std. Er.	z	P>|z|	[95% conf. Interval]	
wst1						
age	-.297928	.011312	-2.63	0.008	-.0519639	-.0076217
education	.2775952	.0956083	2.90	0.004	.0902064	.464984
experience	.0360229	.0097152	3.71	0.000	.0169814	.0550643
risk	.1000181	.0333607	3.00	0.003	.0346324	.1654038
debt	-.4623273	.154322	-3.00	0.003	-.7647928	-.1598617
_cons	-.2118706	.5199313	-0.41	0.684	-1.230917	.807176
wst2						
seminars	.0240129	.0308647	0.78	0.437	-.0364809	.0845067
experience	.002356	.0083691	0.28	0.778	-.0140472	.0187592
risk	-.0765494	.0344387	-2.22	0.026	-.144048	-.0090508
_cons	-.7465427	.2799887	-2.67	0.008	-1.29531	-.197775
wst3						
age	-.0446541	.0290528	-1.54	0.124	-.10105965	.0122882
jobs	-.7035011	.2507582	-2.81	0.005	-1.194978	-.2120239
income	.6835806	.3747396	1.82	0.068	-.0508955	1.418057
seminars	-.1999005	.0825007	-2.42	0.015	-.3615988	-.0382022
experience	.0507697	.0321414	1.58	0.114	-.0122262	.1137657
size	-.803867	.7829614	-1.03	0.305	-2.338443	.7307091
asset	1.462911	.7593781	1.93	0.054	-.0254422	2.951265
debt	.8109523	.541133	1.50	0.134	-.2496489	1.871553
personnels	.5196991	.1348394	3.85	0.000	.2554187	.7839795
_cons	-2.336201	1.000644	-2.33	0.020	-4.297427	-.374975
wst4						
personnels	.2490307	.0888985	2.80	0.005	.0747929	.4232685
income	1.32884	.1974267	6.73	0.000	.9418906	1.715789
_cons	-3.307805	.3311936	-9.99	0.000	-3.956933	-2.658678
/atrho21	-2.110515	.6691607	-3.15	0.002	-3.422046	-.7989845
/atrho31	.0350363	.2220101	0.16	0.875	-.4000955	.4701682
/atrho41	.1963718	.1582368	1.24	0.215	-.1137665	.5065102
/atrho32	-.949929	.2378821	-0.40	0.690	-.5612332	.3712474
/atrho42	-.2549376	.1745677	-1.46	0.144	-.5970839	.0872087
/atrho43	.4612784	.2235231	2.06	0.039	-.0231812	.8993756
rho21	-.971058	.0381732	-25.44	0.000	-.9978708	-.6634687
rho31	.035022	.2217378	0.16	0.875	-.3800307	.4383352
rho41	.193886	.1522884	1.27	0.203	-.1132782	.4672216
rho32	-.0947082	.2357484	-0.40	0.688	-.5088919	.3550823
rho42	-.2495544	.163696	-1.52	0.127	-.5349713	.0869883
rho43	.4311256	.181977	2.37	0.018	.0231771	.7159937

Likelihood ration test of rho21 = rho31 = rho4.1636961 = rho32 = rho42 = rho43 =
0 : chi2(6) = 93.125 Prob > chi2 = 0.0000