Delinquency Behaviors of Households on the Residential Property Market

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Abstract: In this paper, we show the reason households default on the payment for whole debts with the Dynamic Random Effect Probit (DERP) model. We employ use 32 monthly data which includes financial statements of individual borrowers and macroeconomic situations. The dependent variable of this model is a dummy variable of delinquency. Explanatory variables include residential status, incomes, and loan amounts of credit and mortgage loans with delinquency status. Macroeconomic variables are comprised of the house price index the short term interest rate, the unemployment rate, and the industrial production index. We find that the delinquency probability is increasing when borrowers live their own house. Moreover, households have willing to delay the payment duty until the price of house encountering their satisfaction.
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1. Introduction

Even if households are rational, they calculate and compare the utility on the debt for loans. Choices of households' debts are divided into two categories. The one is paying all loans by the schedule and the other declares a status of delinquency. When households do not pay on schedule, the utility of delinquency is bigger than that of the scheduled payment. The accumulated delinquency on mortgage loans requires the ownership for a house which is the most valuable asset for a household. Lea, Webley, Levine (1993) show that economic, social, and mental factors influencing households' delinquency behaviors differ by amounts of loans. Another study focused on causes of households' debts illustrates that economic and population variables are significant. In addition, financial knowledge, managing asset skills, and consuming expenses induce how households delinquency behaviors (Lea, Webley, Walker, 1995). Thaler (1990) tries to explain households'delinquency behaviors by psychological facts. He uses intrinsic and extrinsic constrain concepts. Intrinsic constrains explain borrowers willingness to pay and extrinsic constrains are restrains which householdscannot control. Godwin (1994) studies households in financial problems. In his study, the result demonstrates that when households have positive opinions on debt, the probabilities for delinquency would ascend. Lin and DeVaney (1996) examine the relationship between household structures and delinquency. Incomes, formation and payment experience of households are significant. When heads of households are older and are educated highly, the probability lowers. Additionally, smaller households with professional jobs have the lowest delinquency probabilities on their mortgage loans. We use the overconfidence theory in order to capture behavioral economics explaining bankruptcy on mortgages of households. When people make choices, they legitimate reasons for preventing the rationality. In asset markets, Ahlers and Lakonishok (1983), Elton, Gruber, and Gultekin (1984), De Bondt and Thaler (1985) explain assets price and behaviors of households. This study, we improve prior studies by a specific statistical model with a balanced panel data. The empirical analysis validatesthe rationality on the mortgage loan delinquency behaviors of households.

2. Material and Methods

We implement the Dynamic Random Effect Probit (DREP) model for estimate macroeconomic and individual effects on mortgages. We set an econometric model by the assumption on the equilibrium of households, house and financial markets. Reasons of households' delinquency are various. However, we restrict macroeconomic variables in the model which include the house price, the interest rate, the unemployment rate and GDP. Those macroeconomic variables are linked with the delinquency behaviors directly. In addition, we focus on households' individual factors. Residential status, income of lenders who the head of families and loan amounts depend on collaterals and their credit is selected from individual variables. Therefore, we employ balanced panel data. Even if the previous status of delinquency is not concerned, the model does not reflect genuine state dependence[1] on the dependent

[1] Uhlendorff(2006) explains genuine state dependence that being in a state in one period itself increases ceteris paribus the probability of being in the same state in the next period. Genuine state

variable. In order to insist the dependence, we set previous delinquency status of households as an independent variable. When we set the model without the independent variable, the fixed factors cause a heteroscedasticity problem which makes other independent variables unreliable.

Estimated probability is denoted as $y^*_{i,t}$, the observed households status is $y_{i,t}$.

$$y_{i,t} = \begin{cases} 1 & if \quad y^*_{i,t} > 0 \\ 0 & else \end{cases} \quad (1)$$

We set restricted the econometric model as follow;

$$y^*_{i,t} = \gamma y_{i,t-1} + \beta x_{i,t} + a_i + u_{i,t} \quad (2)$$

In the equation (2), $x_{i,t}$ denotes individual and macroeconomic variables at time *t*. a_i denotes the unobserved probability effect on an individual sample. $u_{i,t}$ follows a normal distribution with σ_u^2 variance. $y_{i,t-1}$is a set for reflecting genuine state dependence ($DQ_{i,t-1}$). Thus, γ denotes the stability effect of last delinquency status and β is the coefficient of independent variable. In order to estimate β, we make a sampling 10,000 individual customers who contract mortgage loans with a bank in random. Individual variables are residential status(rent or ownership, $RS_{i,t}$), annual incomes($INCOME_{i,t}$), mortgage loans($LM_{i,t}$) and credit loans($LC_{i,t}$). Macroeconomic variables are the real house price index($RHPI_{t-3}$), the short term interest rate(IR_{t-3}), the unemployment rate(UR_{t-3}), and the industrial production index($INDEX_{t-3}$). The dependent variable means bankruptcy or equivalent events (3 month delinquency or others).If $v_{i,t} = a_{i,t} + u_{i,t}$ is relevant, $u_{i,t}$ is significantly correlated to time. Since the unobserved probability effect a_i is fixed to flow of time and random effects of individual observations are defined by time series variable $v_{i,t}$.

$$\lambda = Corr(v_{i,t}, u_{i,t}) = \frac{\sigma^2{}_a}{\sigma^2{}_a \sigma^2{}_u} \quad (3)$$

λ in the equation (3) denotes the correlation between $v_{i,t}$and $u_{i,t}$. The Standard random effect model supposes that $a_{i,t}$ is perfectly detached from independent variables$x_{i,t}$. If the estimation purpose variable $y_{i,t}$ is distributed as binary, standardization is required such as $\sigma^2{}_u = 1$. In addtion, with the Dynamic Random Effect Probit (DERP) model needs restricted dependent variable$y_{i,t}$ and random effectsa_i of the first observation. If an exogenous restriction of $y_{i,1}$ is not applied, the excessive estimation of transition probabilities in previous status $y_{i,t-1}$ appears. In order to solve this problem, Heckman (1981) introduced anlinearized approximation for estimating the first observation probability.

$$y^*_{i,t} = z_{i,1}\pi + \eta_i \quad (4)$$

In the equation (4), $z_{i,1}$ means vectors of exogenous instruments and includes independent variables $x_{i,1}$. $\eta_i$is orthogonally stable to the model residual $u_{i,t}$ and follows equation (5) below.

$$\eta_i = \theta a_i + u_{i,1} \quad (5)$$

If θ in the equation (5) is bigger than zero, a_i and $u_{i,1}$ are mutually independent. η_i is affected by two residual sequences, a_i and $u_{i,1}$. Therefore, we can induce a specific Dynamic Random Effect Probit (DERP) model equation (6) by combining the equation (4) and (5).

$$y^*_{i,t} = z_{i,1}\pi + \theta a_i + u_{i,1} \text{ for } i = [1, \dots, N] \quad (6)$$

In order to estimate the equation (6), information of random effects $a_i$to the individual$i$ has to be known. If we set a_i as a constant, the joint probability of $y^*_{i,t}$ is able to be calculated by the equation (7).

$$\Phi\left[\left(z_{i,1}\pi + \theta a_i\right)\left(2y_{i,1} - 1\right)\right] \prod_{t=2}^{T} \Phi\left[\left(\gamma y_{t-1} + \beta x'_{i,t} + a_i\right)\left(2y_{i,1} - 1\right)\right] \quad (7)$$

We use 32 monthly data for the minimum sufficient conditions(January, the year of 2011 ~ August, the year of 2013).Moreover, all of individual observations are in normal status in the start of time series ($DQ_{i,1}$=0). This follows a standard method to calculate probabilities of default on banks. Prior to the statistical estimation, we can expect that the direction of the estimation coefficient. For the previous status ($DQ_{i,t-1}$), the direction of the independent variable is positive. The negative coefficient sign of $DQ_{i,t-1}$ describes households behave oppositely to their last status. The primary purpose of testing the genuine state dependence is controlling last status bias. Threfore, the model is not valid when negative coefficient direction appears or is expected. When people reside in their own house, the probability would decrease because of residential stabilization. In South Korea, households are very defensive to the residential stability because the residential properties or owning houses values the wealth of households[2]. This assumption is implicated to mortgage loans estimation. When the house price is in upward trend, households in financial problems would like to delay their payments until the house price meets their satisfaction.

3. Empirical Results

In detailed advance of statistical estimations, we look over basic statistics of variables. The scale of

dependence is very sensitive and important in the field of labor economics especially.

[2]The non-financial assets of households in South Korea account for 75.1% of whole wealth of households. According to Korea Financial Investment Association, the bias to non-financial assets is skewed comparing to other advanced countries (U. S. A: 31.5%, Japan: 40.9%, England: 50.1%) at the end of 2012.

money amount variables (income, loan amount of mortgage and credit loan) is denoted by dollar and macroeconomic variables about rate are in the scale of percent.

Table 1. Basic Statistics of the Vvariables

Variables	Mean	Standard Deviation	Minimum / Maximum
$DQ_{i,t}$	0.05	0.22	0 / 1
$RS_{i,t}$	0.35	0.21	0 / 1
$INCOME_{i,t}$	3,122	139	1,587 / 24,832
$LM_{i,t}$	25,981	8,093	0 / 3,238,558
$LC_{i,t}$	23,025	5,421	0 / 629,003
$RHPI_t$	142.74	0.009	121 / 144
IR_t	3.04	0.012	2.91 / 3.19
UR_t	3.21	0.011	2.87 / 4.50
$INDEX_t$	105.32	0.002	94.2 /114.6

In the table 1, the transition probability to the event (bankruptcy or equivalent) is about 5%. This means that extracted samples experience relatively long-term(90 days and more) delinquency in 32 months sample periods. Therefore, we indirectly know that there exists the persistency of default if we consider the standard deviation of the variable 22% in a binary variable. Through the periods, 35% of samples live their own house and earn $3,122 in a month. Average amount of mortgage loan is $25,981 and credit loan is $23,025. Concerning households' income, credit loan amount is relatively higher than mortgage in average.

Table 2.The Results of DREP Estimation

Variables	Estimation	p-value	Expectation /Results
$DQ_{i,t-1}$	0.542	0.000	+ / +
$RS_{i,t}$	0.021	0.095	- / +
$INCOME_{i,t}$	-0.332	0.000	- / -
$LM_{i,t}$	-0.031	0.041	- / -
$LC_{i,t}$	0.048	0.000	+ / +
$RHPI_{t-3}$	0.015	0.000	+ / +
IR_{t-3}	0.071	0.000	+ / +
UR_{t-3}	0.009	0.000	+ / +
$INDEX_{t-3}$	-0.015	0.000	- / -
SSE: 1193.681 / MSE: 0.006 Root MSE: 0.079 / DFE: 320,000 Adj. R-Squre: 0.652 Wald Test: 1,352			

Prior to construe the consequences of the model, we need model fitness description. The sum of value of independent variables describing the dependent variable is calculated as 0.652. Wald(x^2) test value marks as 1,352. Thus, relative high adjusted R-square and Wald(x^2) test value prove that the model well fitted. By the estimation, we find out that the stability effect of delinquency status exists in significant at 1% level and the coefficient of it has the same direction as we expected. If households' incomes and mortgage loan amounts increase, probabilities of bankruptcy decrease significantly. When households make money more, they have more things to lose in the case of bankruptcy and mortgage loan amount is dependent to collaterals. However, credit loan amount makes an influence on the probability positively. Credit loans allocated to a lender is based on non-feasible households' assets such as the stability of income flow in the life cycle of lenders. Thus, physical collaterals lower delinquency otherwise promised collaterals increase. However, probabilities of delinquency increase when lenders live in their own houses. The result does not fulfill the expectation. Although assets status of people living in own house are robust more than others, payment probabilities on debt are not. Reasons of the result are divided into two phases. First, lenders are in overconfidence delusion which they have the ability to sell their residential properties when they want. This reason assumes that sellers drive market in the equilibrium of the market. Second, they live in residential properties excess to their economic capacity by leverage. Irrespective to reasons, choices of households on residence are not rational. Since we expect that the coefficient of the variable in positive direction by the rational behaviors of households, the assumption is violated to the statistical result. All of macroeconomic variables are estimated as the same direction comparing to model expectations. The interest rate and the unemployment rate incensement illustrate that the economic reduction on the residential property market and those affect to delinquency behaviors positively. The interest rate is financial burden for owning houses to households who have mortgage loans. The unemployment rate incurs income problems to entire economy. Cash flows of households are in wave by those two variables directly. The Industrial Production Index extension is lessening the probability of bankruptcy.The index replaces GDP in general. Economic production enlargement influences to delinquency behavior of households who have mortgage loans. The most notable thing in the empirical results is that people who have mortgage loans select choices on financial payment by house price fluctuation. As results, households postpone scheduled payment on mortgage loans when the real house price increases. Households calculate utilities of payment when they in the financial problems. Delinquency of mortgage loans in the trend of the house price escalating periods demonstrates that the utility of delaying payment dominates the utility of payment on time. Even if this hypothesis is relevant,

the market has to be efficient for clearance on transactions.

4. Conclusion

In this paper, we analyze delinquency behaviors of households who have mortgage loans with assumptions of the rationality of households. In the empirical analysis, Dynamic Random Effect Probit model is employed. In order to execute the adopted model, we gather 10,000 people balanced panel data. Individual observations are randomly selected from whole customers of a leading bank in South Korea. Individual variables include residential status, lenders income, mortgage loan amount and credit loan amount. In order to reflect macroeconomic influences to delinquency behaviors of households, we use four economic variables. The real house price, the interest rate, the unemployment rate and the industry production index are limited to only economic variables which have competences in illustrating mortgage loans delinquency. Before the implement of the model, we expect that coefficient directions on each variable in logical ways with rational behavior assumptions. Through the analysis, we find that there is a genuine state dependence of delinquency status of mortgage loans. A lender living in a house as a tenant behaves against bankruptcy defensively more. Income and mortgage loan amount have negative effects for delinquency of mortgage loans while credit loan amount is not. Results of macroeconomic variables are the same as we set. The house price, the interest rate, the unemployment rate increases probabilities of bankruptcy equivalent. The entire economy improvement sign such as the increase of Industrial Production Index decreases the probabilities. All of independent variables are significant at the 10% level[3].Changes of the house price affect household behaviors on bankruptcy positively. This result indicates that households delay their payment for loans by the house price. When they live their own house, the intention to delaying payment increases the probabilities. With this result, we can conclude that households live with rental contracts would be more defensive to bankruptcy. Therefore, we can conclude that ownership utility for the house is not much as we established.

[3]In the empirical results, most of coefficients are significant at the 5% level. Only p-value of residential status coefficient is under the 10%.

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