Difference in the determinants of debt default by the business sector of the self-employed

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Abstract

This study explores the determinants of debt default by the self-employed with a focus on the difference in the determinants by the business sector. Estimation of Logit models using the data constructed by linking the Korea Credit Bureau data with the data from the Korea Credit Information Services reveals the following. First, in addition to the demographic characteristics and the financial characteristics of the debtor, the business sector of the self-employed also has a significant power in explaining the likelihood of debt default. Second, the effect of economic factors on the likelihood of debt default by the self-employed differs with the business sector. While the food & lodging sector is sensitive to interest rate shocks, the manufacturing sector and the wholesale & retail trade sector are sensitive to regional business cycle shocks. The real estate rental sector is sensitive to interest rate shocks and housing price shocks. Lastly, we find that information about the enterprise loans owed by the self-employed is useful in evaluating the default risk of the self-employed. The larger is the size of enterprise loans, the higher is the risk of default. The effect of the size of enterprise loans on the default risk of the self-employed also differs with the business sector.

Keywords: Self-employed, Business sector, Default, Enterprise loan

JEL Classification: D12, D14, E51, J23

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1 Introduction

Since the global financial crisis of 2008, the amount of household debt in Korea has grown rapidly, boosted by monetary easing and the property market boom. Although interest rates in Korea have fallen steadily, the amount of household debt has grown more rapidly, increasing the debt service burden for household debt and raising concern about the systemic financial market risk.

Within the household sector, the size of debt owed by the self-employed has grown more rapidly than the size of debt owed by salaried employees. While the average debt to income ratio of salaried employees grew by 55.9 percentage points from 110.5% at the end of September 2008 to 166.4% at the end of June 2018, the average debt to income ratio of the self-employed grew by 119.1 percentage points from 166.4% to 285.5% during the same period.

Compared to the household loans to salaried employees, loans to the self-employed are likely to be exposed to a higher risk for the following reasons. First, the household loans taken out by the self-employed are used to finance business operations as well as to finance housing purchase and living expenses. Second, the self-employed can take out enterprise loans in addition to household loans. Third, the self-employed tend to rely more on loans from nonbank financial institutions which charge higher interest rates.

While the amount of loans taken out by the self-employed has grown rapidly, their capacity to service debt has deteriorated by rising wages and rents and recently by the Covid-19 pandemic. Since 2018, the default rate on the loans of the self-employed has shown an increasing trend, raising concern about the systemic financial market risk posed by the rapidly growing debt of the self-employed.

Rising concern has motivated research on the debt failure by the self-employed. Earlier studies on this topic regarded the self-employed as a form of employment and focused on exploring the difference in the default risk between salaried employees and the self-employed. As household survey data and credit information data became available, later studies focused on exploring the determinants of debt default by the

self-employed. Still, these studies relied only on the household loan data of the self-employed. Since the debt of the self-employed has the characteristics of both household debt and enterprise debt, the business characteristics of the debtor should also be taken into consideration when the determinants of debt default are investigated, which in turn requires construction of a new data set that covers both the household characteristics and the business characteristics of the debtor.

Kwon and Yoon (2019) use the self-employed database newly constructed by linking the Statistical Business Register data and the data from the Korea Credit Bureau (hereafter the KCB) to explore the determinants of debt default by the self-employed. Using the database that captures both the household loans and the enterprise loans of the self-employed, they find that there is a wide difference in the likelihood of debt default among business sectors.

In this study, we use a different dataset of the self-employed constructed by linking the household credit information database of the KCB and the enterprise credit information database of the Korea Credit Information Services to explore the determinants of the likelihood of debt default by the self-employed. This sample consists of the self-employed in four business sectors, the manufacturing sector, the wholesale & retail trade sector, the food & lodging sector, and the real estate rental sector. These four sectors account for about 63% of the total self-employed in Korea.

While exploring the determinants of the likelihood of debt default, this study focuses on finding if the determinants differ with the business sector of the self-employed. We first estimate a Logit model that includes business sector dummies as explanatory variables to find if the likelihood of debt default differs with the business sector of the self-employed. Then, we explore if the effect of economic factors on the likelihood of default differs with the business sector of the self-employed by adding interaction terms constructed as the product between economic factors and business sector dummies to the Logit model. The study also explores if the effect of the size of enterprise loans on default probability differs with business sector.

This paper is comprised as follows: Section II presents a brief survey of the existing empirical literature on debt default by the self-employed. Section III describes the model and the data used in this study. Section IV presents and discusses the results of the empirical analysis. Section V

concludes and draws a few policy implications.

2 Literature Survey

Most of the research on household debt default adopts the life–cycle income theory of consumption and the permanent income theory of consumption as the theoretical foundation. According to these theories, utility maximizing rational consumers try to maintain a smooth consumption path although their income may fluctuate widely. Consumption smoothing requires that consumers borrow money when their income is low. According to these theories, debt default occurs when consumers are hit by temporary income and expenditure shocks but are unable to service their debt because of limited availability of liquidity. Zeldes (1989), Agarwal, Driscoll, Gabaix, and Laibson (2009), Agarwal and Mazumder (2013), Disney and Gathergood (2013), and Lusardi and Tufano (2015) point out that decrease in current income and expected future income, increase in living expenses, increase in life expectancy, early retirement, and health problems may work as the frictional factors that cause debt default. These studies also suggest that the degree of exposure to these frictional factors and the capacity of households to observe these shocks depend on household characteristics such as age, gender, and education.

Studies on the household debt in Korea have become active since the global crisis of 2008 as concern about the systemic risk posed by the rapidly accumulating household debt grew. Earlier studies on this topic relied on time series data because of limited availability of household survey data. (Shim, Chung, and Jung, 2009; Kim and Park, 2010; Kim and Moon, 2011; Kim, 2015) Later studies relied on micro data as household survey data and credit information data became available, (Kim and Yoo, 2013; Lee, Jun, Chung, and Byun, 2014; Choi and Park, 2015; Park and Hur, 2018).

The rapid accumulation of the debt owed by the self-employed since 2012 and the growing concern about the systemic risk posed by the debt of the self-employed motivated research on the debt default risk of the self-employed. Loans taken out by the self-employed have the

characteristics of both enterprise loans and household loans. Even the household loans taken out by the self-employed can be used to finance business operations. In consequence, it is natural to expect that the determinants of the likelihood of debt default differ between the self-employed and ordinary households.[1] As a result, some of the studies explored the difference in the determinants of debt default risk between the self-employed and salaried employees.

Hahm, Kim and Lee (2010), analyzing the effect of macroeconomic shocks on non-performing loans, identify low-income employees and high-income self-employed as risky groups. Kim and Byun (2012) conduct a stress test using the KCB data and find that as economic recession intensifies under a stress condition comparable to a financial crisis, debtors with debt from nonbank financial institutions, the self-employed, and debtors with debt from multiple financial institutions are most likely to default on their debt. Jung (2017) observes that the self-employed have a higher probability of default on household mortgages. Park and Hur (2018), using the data from the 2014 Survey of Household Finances and Living Conditions, explore the difference in the determinants of debt default between salaried employees and the self-employed. They find that the self-employed are faced with a larger debt service burden and as a result are more likely to default on their debt. Meanwhile, Kim and Jin (2018), using the administrative data from Statistics Korea, investigate the determinants of debt default for the group of salaried employees and the group of non-salaried workers separately. They find that in the low-income group salaried employees show higher default risk and that in the high-income group non-salaried workers show higher default risk.

Other studies use a more detailed classification of the form of employment occupation Kim (2004) classifies the form of employment as full-time employee, part-time employee, employer, self-employed, and unemployed and finds that the debt burden of employers and the self-employed is relatively high. Bae (2015) classifies the form of employment as full-time employee, temporary employee, self-employed with employees, one person self-employed, employee without compensation, and unemployed and investigates the determinants of debt

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[1] Skinner (1988), using the 1972~73 U.S. Consumer Expenditure Survey data, confirms that the savings behavior of the self-employed differs from that of the salaried employees.

default using the data from the Survey of Household Finances and Living Conditions. Bae finds that the form of employment has significant effects on default risk only in a part of the sample periods and concludes that household characteristics are the main determinants of the likelihood of debt default. Park (2018) also investigates if the form of employment has a significant effect on the likelihood of debt default.[2]

As explained in the introduction of this paper, analyzing the debt default risk of the self-employed requires information about the characteristics of business and the amount of enterprise loan in addition to information available from household survey data. Kwon and Yun (2019) use the self-employed database newly constructed by linking the Statistical Business Register data and the data from the KCB to explore the determinants of the likelihood of debt default by the self-employed. This database provides information about the business sector, the amount of enterprise loans, and other business characteristics of the self-employed. Kwon and Yun use this database to estimate Logit models and find that the business sector of the self-employed has additional power in explaining the likelihood of debt default even if the usual determinants, namely debtor characteristics and loan characteristics are controlled.

3 Model and Data

3.1 Model

This study investigates the determinants of debt default of the self-employed by estimating binary Logit models. The dependent variable in this model is a binary variable that takes one when a self-employed debtor defaults on the debt and zero otherwise. Since the self-employed have the characteristics of both households and business firms, the determinants of debt default by households as well as the determinants of

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[2] Research on the effect of the form of employment on the likelihood of debt default has also been conducted using the survey data of foreign countries. Disney, Bridges, and Gathergood (2008), for example, using the household panel data in the U.K., find that changes in the form of employment affect debt default risk by affecting household income. Keese (2012), using the socio-economic panel data in Germany, suggests household debt burden is higher when the debtor is unemployed.

debt default by business firms should be taken into consideration in specifying the Logit model. According to the literature on household debt, the personal characteristics of debtors such as age, gender, and education and the financial characteristics of debtors such as total amount of loans and composition of loans determine the likelihood of debt default. On the other hand, debt default by business firms are likely to be determined by economic factors such as business cycles and interest rates and business characteristics such as business sector and number of employees. These factors determine the business earnings profile of the self-employed and the likelihood of debt default. In consequence, we adopt the following four groups of variables as explanatory variables: debtor characteristics, loan characteristics, economic factors, and business sectors.

In this study, four business sectors are chosen, namely manufacturing, wholesale & retail trade, food & lodging, and real estate rental. These are the four largest business sectors of the self-employed. As of 2017, these four sectors altogether account for about 63% of all the self-employed in Korea.

3.2 Data

The sample is constructed by the following procedure. First, we randomly select 5% of the self-employed from the household credit information database of the KCB. Then, only the self-employed whose business sector belongs to the four business sectors, namely manufacturing, wholesale & retail trade, food & lodging, and real estate rental are kept as a sample. This process is repeated for each quarter from the first quarter of 2011 to the third quarter of 2017. Although the sample covers the self-employed in different time periods, it is not a panel data because we do not track the same self-employed through different time periods. The sample covers different time periods because we want to evaluate the effect of economic factors such as business cycles and interest rates, which change over time.

Since the KCB database provides information about household loans only, information about the enterprise loans owed by the self-employed is collected from the enterprise credit information database of the Korea Credit Information Services.

The dependent variable is constructed using the default criterion that repayment of either the household loan or the enterprise loan of the

self-employed is more than 90 days in arrears within a year from the quarter when the self-employed is selected as a sample. The 90-day criterion is commonly adopted by financial institutions to recognize non-performing loans. (Kim and Jin, 2018) Considering the fact that the repayment obligation of the debt owed by the self-employed falls upon each individual, delinquency in either of the enterprise loan or the household loan is regarded as debt default. In contrast, most of the previous studies using the survey data, except for Kwon and Yoon (2019), use delinquency of household loan alone as the criterion for debt default. Use of the household loan alone as the criterion of debt default may run the risk of underestimating the likelihood of debt default of the self-employed.

Meanwhile, as Jung (2017) points out, an endogeneity problem may occur if delinquency of repayment during the current sample period is used as the criterion for debt default. It is because debt default itself may have effects on the characteristics of the loans owed by the self-employed. To avoid such an endogeneity problem, we adopt the debt default criterion of 90-day in arrears within one year from the current sample period.

The explanatory variables can be grouped into four categories: debtor characteristics, financial characteristics, economic factors, and business sectors. We consider age, region, and gender as the debtor characteristics. The effect of age is estimated by including age dummies for each age group of under 20, 20-30, 30-40, 40-50, 50-60, 60-70, and over 70. Regional dummies are constructed for each of the five regions: Seoul, Incheon, Gyeonggi-do, five large cities, and non-metropolitan area. As for the financial characteristics of the debtor, the total amount of loans, the share of loans from nonbank financial institutions, and the number of credit institutions from which the debtor received loans are included as explanatory variables. The total amount of loans is further broken down to the amount of each of mortgage loans, non-mortgage loans and enterprise loans, respectively.

Three variables are included as economic factors: the interest rate on loans, the rate of change in regional service production, and the rate of change in regional housing prices. The monthly average interest rate on household loans, which is available from Bank of Korea, is used as the interest rate on loans. An increase in the interest rate on loans is expected to raise the possibility of debt default by raising the burden of debt service.

The index of service production, reported by Statistics Korea, measures the business activities of each region. The rate of change of housing prices is measured by using the index of housing transaction prices of the debtor's region, which is available from the Korea Real Estate Board. An increase in this rate is expected to lower the likelihood of debt default through positive wealth effects. Table 1 presents a brief description of each variable.

Table 1. Description of variables

Categories		Main variables
Dependent variable		Default (=1 if in arrears more than 3 months)
Characteristics of the self-employed	Age	20s (=1 if yes)
		30s (=1 if yes)
		40s (=1 if yes)
		50s (=1 if yes)
		60s (=1 if yes)
		Over 70 (=1 if yes)
	Region	Seoul (=1 if yes)
		Gyeonggi-do (=1 if yes)
		Incheon (=1 if yes)
		5 Large cities (=1 if yes)
		Non-metropolitan area (=1 if yes)
	Gender	Male (=1 if yes)
Financial characteristics		Mortgage balance
		Non-mortgage balance
		Enterprise loan balance
		Non-bank loan share
		Number of credit institutions
Economic factors		Loan interest rate
		Service production (rate of change)
		Housing price (rate of change)
Business sectors		Manufacturing (=1 if yes)
		Wholesale & retail (=1 if yes)
		Food & lodging (=1 if yes)
		Real estate rental (=1 if yes)

The sample consists of 529,074 self-employed debtors. About 3.1% of these self-employed experienced debt default on either household loans or enterprise loans. As for age distribution, the self-employed in the 40s and 50s explain about 67% of the entire sample. Regarding the region, Gyeonggi-do, five large cities, and non-metropolitan area explain 25.0%, 19.7%, 31.9% of the sample, respectively. The share of male self-employed is 56.7%.

The average balance of total household loan is 113,740 thousand won, which consists of the mortgage loan balance of 58,069 thousand won and

the non-mortgage loan balance of 55,680 thousand won. The average balance of enterprise loan is 94,190 thousand won, which amount to about 83% of the household loan. The share of loans from nonbank financial institutions is 56.7%. The average number of credit institutions from which the self-employed took out loans is about 1, which implies that most of the self-employed take out loans from only one financial institution.

Table 2. Summary of descriptive statistics

Categories	Main variables	Mean	S.D.	25% quantile	50% quantile	75% quantile
Dependent variable	Default	0.031	0.175	0	0	0
Age	20s	0.026	0.160	0	0	0
	30s	0.159	0.366	0	0	0
	40s	0.333	0.471	0	0	0
	50s	0.337	0.473	0	0	0
	60s	0.118	0.323	0	0	0
	More than 70	0.027	0.161	0	0	0
Region	Seoul	0.179	0.383	0	0	0
	Gyeonggi-do	0.250	0.433	0	0	0
	Incheon	0.055	0.228	0	0	0
	5 Large cities	0.197	0.398	0	0	0
	Non-metropolitan area	0.319	0.466	0	0	1
Gender	Male	0.567	0.495	0	1	1
Financial characteristics	Mortgage balance	58,069	145,995	0	0	70,000
	Non-mortgage balance	55,680	201,132	3,184	12,585	33,071
	Enterprise loan balance	94,197	497,188	0	0	26,000
	Non-bank loan share	0.567	0.458	0	0.834	1
	Number of credit institutions	1.059	1.164	0	1	2
Economic factors	Loan interest rate	0.042	0.009	0.033	0.040	0.048
	Service production (rate of change)	0.037	0.017	0.027	0.036	0.046
	Housing price (rate of change)	0.015	0.035	-0.003	0.012	0.028
Business sectors	Manufacturing	0.149	0.356	0	0	0
	Wholesale & retail	0.433	0.495	0	0	1
	Food & lodging	0.320	0.466	0	0	1
	Real estate rental	0.099	0.299	0	0	0

Note: Loan balance is in thousand won. Service production and Housing price are measured as the rate of change.

As for the business sector, the wholesale & retail trade sector and the food & lodging sector have the largest share of 43.3% and 32.0%, followed by 14.9% of the manufacturing sector and 9.9% of the real estate rental sector.

Table 3 presents the mean of each variable by business sector. We can notice that the proportion of the self-employed that defaulted on their debt is distinctively lower in the real estate rental sector than that in other sectors.

As for the age distribution by business sector, the wholesale & retail trade sector has a high share of the 20s and the 30s. This is because young people tend to enter a business sector that does not require a large amount of investment. On the contrary, the share of the 60s and over is high in the real estate rental sector. It is because a large amount of investment is required to enter this business sector. Besides, the demand is high for the retirees to generate income from real estate rental business, which does not require much labor input.

As for the regional distribution, the manufacturing sector and the real estate rental sector have higher shares of the self-employed whose business is located in Seoul, Incheon, or Gyeonggi-do. Among these regions, Gyeonggi-do where the rental cost is relatively low, has the highest share in the manufacturing sector. Meanwhile, the non-metropolitan area has the highest share in the food & lodging sector.

There is also a wide difference among business sectors in the gender distribution. The share of the male self-employed is high in the manufacturing sector and in the wholesale & retail trade sector. The share of the male self-employed in the manufacturing sector is about 80%. In contrast, the food & lodging sector has a low male share of 39%.

As for the financial characteristics of debtors, the real estate rental sector has the largest amount of loans among the four sectors. The average balance of household loan and enterprise loan in this sector amounts to 314,920 thousand won and 244,200 thousand won, respectively. The real estate rental sector not only has a high demand for loans to finance the purchase of residential and commercial properties but also can afford to take out a larger amount of loans by offering these properties as collaterals. The average balance of loans is also high in the manufacturing sector where investment in manufacturing facilities require a large amount of funding.

Meanwhile, the loan balance of the self-employed in the wholesale & retail trade sector and the food & lodging sector is relatively small in comparison to other sectors. These sectors demand a smaller amount of funding to start and operate business. These sectors also depend more heavily on nonbank loans as is demonstrated by the high share of nonbank loans displayed in Table 3. The self-employed in these sectors have limited ability to offer collaterals and as a result tend to rely more on nonbank financial institutions to take out loans although they have to pay higher interest rates. In particular, in the food & lodging sector where the share of small business operators is high, the share of nonbank loans amounts to 63%.

If we summarize the findings from Table 2 and Table 3, the self-employed have widely different characteristics and widely different likelihood of debt default depending on the business sector. In the wholesale & retail trade sector and in the food & lodging sector, the self-employed tend to take out loans from nonbank financial institutions which usually charge a higher interest rate. These sectors have a low entry barrier as a lower amount of investment is needed to start a business and as a result competition is high in these sectors. The fact that the probability of survival within five years of the start of the business is low explains why the likelihood of debt default is high in these sectors. On the other hand, the share of the self-employed in the 40s and 50s age group is high in the manufacturing sector because the entry barrier is high and a large amount of investment is needed, In the real estate rental sector, the share of the self-employed in the 60s and over group is high because of the high demand to generate income after retirement. Although the average balance of loans is high, this sector has the lowest rate of debt default because the properties can be used as collateral.

Table 3. Summary statistics by business sectors

Categories	Main variables	All	Manu-facturing	Wholesale & retail	Food & lodging	Real estate
Dependent variable	Default	0.031	0.030	0.033	0.036	0.012
Age	20s	0.026	0.017	0.028	0.034	0.007
	30s	0.159	0.130	0.188	0.160	0.072
	40s	0.333	0.350	0.361	0.314	0.242
	50s	0.337	0.377	0.305	0.355	0.364
	60s	0.118	0.108	0.099	0.117	0.220

	More than 70	0.027	0.018	0.019	0.020	0.096
Region	Seoul	0.179	0.163	0.181	0.144	0.307
	Gyeonggi-do	0.250	0.304	0.231	0.232	0.308
	Incheon	0.055	0.075	0.056	0.046	0.052
	5 Large cities	0.197	0.201	0.211	0.188	0.160
	Non-metropolitan area	0.319	0.257	0.321	0.390	0.173
Gender	Male	0.567	0.797	0.618	0.390	0.570
Financial characteristics	Mortgage balance	58,069	49,117	50,142	44,975	148,408
	Non-mortgage balance	55,680	46,850	41,740	44,313	166,521
	Enterprise loan balance	94,197	177,878	62,473	51,779	244,206
	Non-bank loan share	0.567	0.547	0.568	0.634	0.371
	Number of credit institutions	1.059	0.916	1.118	1.135	0.773
Economic factors	Loan interest rate	0.042	0.042	0.042	0.041	0.041
	Service production (rate of change)	0.037	0.037	0.037	0.037	0.037
	Housing price (rate of change)	0.015	0.015	0.015	0.015	0.015
No. of Observations		529,074	78,606	228,887	169,184	52,397

Note: Loan balance is in thousand won. Service production and Housing price are measured as the rate of change.

4 Empirical Analysis

This study investigates if there is difference in the determinants of the likelihood of debt default among different business sectors of the self-employed. In particular, this study investigates if the sensitivity of the likelihood of debt default to changes in economic conditions is different among business sectors. For this purpose, two different models are specified and estimated.

We first estimate a Logit model (Model 1) where, in addition to debtor characteristics, loan characteristics, and economic factors, business sector dummies are added as explanatory variables. Estimating this model can tell us if the business sector has an additional explanatory power for the likelihood of debt default even if the usual determinants are controlled. Then, we investigate if the sensitivity of the likelihood of debt default to economic conditions differs among different business sectors by estimating a Logit model (Model 2) where the interaction terms between business

sector dummies and economic factors are added as explanatory variables.

Table 4 presents the estimation result for model 1. The estimates for the coefficients of the business sector dummies reveal that after controlling for other factors, the likelihood of default in the food & lodging sector and the real estate rental sector is significantly higher than that in the manufacturing sector, while the likelihood of debt default in the wholesale & retail trade sector is not significantly different from that of the manufacturing sector. Such a result demonstrates that information about the business sector is useful in explaining the default risk of the self-employed. Meanwhile, the estimates for the marginal effect presented in the last column of Table 4 demonstrate that the real estate rental sector has the lowest default likelihood. This is because in the real estate rental sector the fund raised through loans is used to purchase properties which in turn can be offered as collaterals.

As for the debtor's age, debtors in their 20s and 30s have a higher default probability while those in their 50s and 60s have a lower default probability. One of reasons why the default probability of the 20s and the 30s is higher lies with the fact that the self-employed in these age groups are likely to have less business experience. Meanwhile, the estimate for the marginal effect of the debtors over 70 years old is also negative, implying that the super-aged have a higher likelihood of default although they have longer business experience.

The gender of debtors also has a significant effect on the likelihood of default. Table 4 demonstrates that male debtors are more likely to default on their debt than female debtors. This may be because male businessmen are more aggressive in taking risk and borrowing money.

Regarding the effect of the region where a business is located on the default likelihood, Gyeonggi-do and Incheon do not have an effect significantly different from that of Seoul, while business located in the non-metropolitan area has a lower likelihood of default than the business located in Seoul. In general, doing business in Seoul, Incheon, or Gyeonggi-do requires a larger amount of investment, which in turn calls for a larger amount of debt. Besides, competition is keen in these regions and as a result the likelihood of survival is lower for the business of the self-employed.

The estimation results show that the financial characteristics of debtors also have statistically significant effects on the likelihood of debt default.

The estimate for the coefficient of mortgage loans reveal that the default probability decreases as the size of mortgage loan grows. This is because mortgage loans are taken out to make investment in housing, which is less risky than investment in business. Meanwhile, non-mortgage loans and enterprise loans have adverse effects on the likelihood of default in the sense that the larger the balance of these loans, the higher is the probability of debt default. This is because while mortgage loans are taken out to purchase housing properties, non-mortgage household loans and enterprise loans are taken out mostly to cover the cost of household expenditure and business activities. Meanwhile, Table 4 demonstrates that the higher is the share of nonbank loans or the more credit institutions the debtor gets loans from, the higher is the probability of debt default.

Model 1 also evaluates the effects of economic factors such as the loan interest rate, the rate of change in the service production index, and the rate of change in the housing price index on the debt default probability. According to the estimation results presented in Table 4, higher loan interest rates raise the likelihood of debt default. This is because higher interest rates increase the debt service burden, which is likely to raise the probability of debt default especially for the self-employed with an excessive amount of loan balance. Table 4 also shows that decrease in the rate of change in the service production index raises the possibility of debt default. This particular variable serves as a proxy for business activities of the region where a business is located. A lower value for this variable implies slowdown of regional economic activities, which negatively affects business performance of the self-employed. Decrease in the rate of change of the housing price index also raises the likelihood of debt default. Property market depression is likely to raise the probability of debt default through negative wealth effects. Estimates for the marginal effect show that the loan interest rate has the largest effect on default probability, followed by change in the service production index and change in the housing price index. This is because loan interest rates have a direct effect on the debt service burden of debtors, whereas business fluctuations and property prices affect the default risk of debtors with a time lag.

Table 4. Estimation results with business sector dummies (Model 1)

Categories	Variable	Coefficient	Standard error	Marginal effect
Age	20s	0.645**	0.039	0.019
	30s	0.242**	0.022	0.007
	50s	−0.187**	0.021	−0.005
	60s	−0.209**	0.032	−0.006
	More than 70	0.214**	0.063	0.006
Region	Gyeonggi-do	−0.001	0.025	0.000
	Incheon	0.072	0.038	0.002
	5 Large cities	−0.241**	0.029	−0.007
	Non-Metropolitan area	−0.233**	0.025	−0.007
Gender	Male	0.254*	0.017	0.007
Financial characteristics	Mortgage balance	−0.056**	0.002	−0.002
	Non-mortgage balance	0.014**	0.004	0.000
	Enterprise loan balance	0.037**	0.002	0.001
	Non-bank loan share	0.732**	0.024	0.021
	Number of credit institutions	0.487**	0.005	0.014
Economic factors	Loan interest rate	18.781**	0.917	0.542
	Service production (rate of change)	−3.987**	0.541	−0.115
	Housing price (rate of change)	−0.753**	0.271	−0.022
Business sectors	Wholesale & retail	0.006	0.025	0.000
	Food & lodging	0.172**	0.026	0.005
	Real estate rental	−0.507**	0.047	−0.015
Constant		−5.499**	0.068	–
No. of observations		529,074		
LR chi2(22)		17433.02		
Log likelihood		−65,259.79		
Pseudo R2		0.1178		

Note: * and ** indicate the coefficient is different from zero with 5% and 1% significant level, respectively.

Model 2 investigates if the effect of economic factors on the default probability differs with business sectors by adding interaction terms between each determinant and each business sector dummy as explanatory variables. In addition, we also add interaction terms between the size of enterprise loans and business sector dummies. Table 5 presents the estimation result for the Logit model with interaction terms. Table 6 presents estimates of the marginal effect of the economic factors and the amount of enterprise loans on the default probability in each business sector.

Table 5 confirms that the effect of the size of enterprise loan on default

probability differs with business sectors and that the difference is statistically significant. As the estimates for the marginal effects in table 6 demonstrate, an increase in the amount of enterprise loan has the most significant effect on the default probability in the food & lodging sector, followed by the wholesale & retail trade sector. The self-employed debtors in these business sectors in general have a higher debt to income ratio. An increase in the amount of debt under the condition of high debt to income ratio has a more than proportionate effect on the debt service burden, raising the likelihood of debt default by a large margin. , In contrast, an increase in the amount of enterprise loan has the smallest effect on the likelihood of default in the real estate rental sector. In this sector, asset holdings and rental income tend to increase with the amount of enterprise loans as most of the fund raised by loans is invested in purchasing properties.

Regarding the effect of interest rates, they have larger effects on default probability in the real estate rental sector and the food & lodging sector than the default probability in other sectors. A hike in interest rates is likely to have a most significant effect on the debt service burden of the self-employed in the real estate rental sector because the self-employed in this sector usually have the largest amount of loan balance. Meanwhile, the food & lodging sector depends most heavily on nonbank loans with the share of nonbank loans exceeding 63%. Since the interest rate charged on nonbank loans is higher than the interest rate charged on bank loans, an increase in general interest rates is likely to result in a larger increase in the interest rate on nonbank loans. Consequently, a rise in interest rates has a larger effect on the debt service burden of the self-employed debtors in the food & lodging sector.

As for the effect of regional business fluctuations, Table 5 demonstrates that the likelihood of default decreases significantly during regional economic booms in all of the four business sectors. Estimates for the marginal effect presented in Table 6 reveals that the likelihood of default is more sensitive to regional business cycles in the manufacturing sector and in the wholesale & retail trade sector.

Table 5. Estimation results with interaction terms (Model II)

Categories	Main variables	Coefficients	Standard error	Marginal effect
Age	20s	0.646**	0.039	0.019
	30s	0.242**	0.022	0.007
	50s	−0.185**	0.021	−0.005
	60s	−0.206**	0.032	−0.006
	More than 70	0.219**	0.063	0.006
Region	Gyeonggi-do	0.005	0.025	0.000
	Incheon	0.075*	0.038	0.002
	5 Large cities	−0.240**	0.029	−0.007
	Non-Metropolitan area	−0.233**	0.025	−0.007
Gender	Male	0.253**	0.017	0.007
Financial characteristics	Mortgage balance	−0.056**	0.002	−0.002
	Non-mortgage balance	0.015**	0.004	0.000
	Enterprise loan balance	0.024**	0.004	0.001
	Non-bank loan share	0.737**	0.024	0.021
	Number of credit institutions	0.485**	0.005	0.014
Economic factors	Loan interest rate	14.149**	2.393	0.409
	Service production (rate of change)	−7.974**	1.384	−0.230
	Housing price(rate of change)	1.551**	0.600	0.045
Business sectors	Wholesale & retail(D1)	−0.290*	0.126	−0.008
	Food & lodging(D2)	−0.447**	0.130	−0.013
	Real estate rental(D3)	−1.842**	0.249	−0.053
Interaction terms	Enterprise loan balance·D1	0.014**	0.004	0.000
	Enterprise loan balance·D2	0.023**	0.005	0.001
	Enterprise loan balance·D3	−0.015	0.008	0.000
	Loan interest rate·D1	2.359	2.740	0.068
	Loan interest rate·D2	6.989*	2.826	0.202
	Loan interest rate·D3	26.437**	5.549	0.763
	Service production·D1	3.554*	1.572	0.103
	Service production·D2	5.820**	1.628	0.168
	Service production·D3	8.421**	2.839	0.243
	Housing price·D1	−2.425**	0.690	−0.070
	Housing price·D2	−2.701**	0.724	−0.078
	Housing price·D3	−6.798**	1.625	−0.196
Constant		−5.102**	0.120	−
No. of observations		529,074		
LR chi2(22)		17563.09		
Log likelihood		−65,194.76		
Pseudo R2		0.1187		

Note: * and ** indicate the coefficient is different from zero with 5% and 1% significant level, respectively.

Table 6. Marginal effects of explanatory variables

Independent variables	Marginal effect			
	Manu-facturing	Wholesale & retail	Food & lodging	Real estate rental
Enterprise loan balance	0.070	0.111	0.136	0.026
Loan interest rate	0.409	0.477	0.610	1.172
Service production (rate of change)	–0.230	–0.128	–0.062	0.013
Housing price (rate of change)	0.045	–0.025	–0.033	–0.152

Table 5 also demonstrates that the effect of regional property market conditions on the default probability differs significantly with business sectors. According to the marginal effect presented in Table 6, housing prices have the largest effect on the default probability in the real estate rental sector. One percentage point decrease in the rate of change of the housing price index raises the default probability in the real estate rental sector by 0.15 percentage point. In contrast, housing prices have negligible effects on the default probability in other business sectors. Housing prices have a large effect in the real estate rental sector because changes in property prices not only has a directly large effect on the wealth of the debtors in this business sector but also affects the rental rate of returns. One of the reasons why the real estate rental sector maintains a low level of default rate while the default rates in other business sectors recently have shown an upward trend is that housing prices in general have maintained an upward trend.

5 Conclusion

This study estimates Logit models to examine if information about the business sector of the self-employed is useful in predicting the default risk. In addition, this study explores if the effect of economic shocks on the likelihood of debt default differs with the business sector of the self-employed. While most of the previous studies investigate difference of the likelihood of default between salaried employees and the self-employed, this study examines difference in the determinants of debt default in four business sectors.

The findings from estimation of Logit models can be summarized as follows. First, the default risk of the self-employed is significantly affected by economic factors as well as by debtor characteristics. In particular, the self-employed are more likely to default on their debt if they are young, if they are males, or if their business is located in the Seoul metropolitan area. Regarding the financial characteristics, the self-employed are more likely to default on their debt if the amount of non-mortgage loans is larger, if the amount of enterprise loans is larger, and if they rely more heavily on loans from nonbank financial institutions. As for economic factors, higher interest rates, business recessions, and lower housing prices tend to raise the likelihood of debt default.

Second, not only the likelihood of debt default but the effect of economic shocks on the likelihood of debt default differ significantly with the business sector of the self-employed. Compared to the default risk of the self-employed in the manufacturing sector, the food & lodging sector displays a higher level of default risk while the real estate rental sector displays a lower level of default risk. While the likelihood of default in the food & lodging sector is sensitive to interest rates, the likelihood of default in the manufacturing sector and the likelihood of default in the wholesale & retail trade sector are sensitive to business fluctuations. Interest rates also have a large effect on the default risk in the real estate rental sector as the self-employed in this sector have a large loan balance.

The findings of this study have a few implications on the management of the default risk of the self-employed. First of all, in preparing the risk management measures, not only the difference in the default risk in different business sectors but also the difference in the sensitivity of the default risk to economic shocks should be taken into consideration. Risk management measures should focus on the business sectors where the likelihood of default is expected to be affected most by a particular economic shock. Second, financial institutions need to take into consideration the characteristics of business sectors when they construct the system to evaluate the likelihood of default of the self-employed. The existing models, however, focus only on the creditworthiness of the business owner and the financial information to evaluate the likelihood of default by the self-employed. Lastly, the enterprise loan balance as well as the household loan balance should be taken into consideration when the likelihood of default of the self-employed is evaluated. As the empirical

result of this study demonstrates, a substantial portion of the self-employed hold household loans and enterprise loans simultaneously and the amount of enterprise loans has a significant effect on the likelihood of debt default.

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